NIS-S208-6

DMS-100 Family

ISDN Basic Rate User Network Interface Specification

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NORTEL NETWORKS

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Chapter 1: Introduction

The publication of NIS S208-6, Issue 09.01 represents the Nortel Networks implementation of National ISDN on the Basic Rate Interface for the NA014 release. To achieve full NI compliance, terminal vendors are advised to build to Bellcore SR-4288. However, terminals built to SR-NWT-001953 are functional on DMS-100. Building to NIS S208-6, Issue 09.01 provides terminals with Bellcore NI compliance and additional functionality as offered by DMS-100.

This overview describes the technical changes made since the publication of NIS S208-6, Issue 08.01. Minor editorial changes are not discussed. Changes from Issue 08.01 are marked with change bars in the left-hand margin. All pages in this document are numbered sequentially.

The following chapters have been updated since Issue 08.01 to reflect features added in release NA014:

- Chapter 1 - Introduction - **NA014 updates**
- Chapter 2 - BRI Configurations - no changes
- Shared DN for CMD/VI call types
- Chapter 3 - Physical Layer Specification - no changes
- Chapter 4 - Data Link Layer Specification - no changes
- Chapter 5 - Functional Call Control Signaling - NI2 Uniform Display **NA014 updates**
- Chapter 6 - Supplementary Service no changes
- Chapter 7 - Data Service - no changes
- Chapter 8 - Subscription Parameters - no changes
- Chapter 9 - Parameter Downloading - no changes
- Appendix A - DPN Packet Mode Data Services - no changes
- Appendix B - ISDN Meridian Feature Transparency - no changes
- Appendix C- Flows for Chapter 5 - no changes
- Appendix D - Flows for Chapter 6 - no changes
- Appendix E - SPM (NI-1 Data) - no changes

1.1 Notice

This specification is provided as a guide for network planners and suppliers of systems and equipment designed to meet the requirements of the Nortel Networks BRI specifications. Nortel Networks reserves the right to revise the contents of this guide for any reason, including, but not limited to, conformity with standards promulgated by any public standards agency, advances in technology, or to reflect changes in requirements of communication networks, systems or applications. The provision of any capabilities described in this document is dependent on certain business decisions, resolution of which may also result in changes to, withdrawal of, or addition to, any or all of the capabilities herein.

Nortel Networks makes no representation in respect to and does not warrant any of the information in this Specification, but furnishes such in good faith and to the best of its knowledge and ability. Without restricting the generality of the foregoing, Nortel Networks makes no representations or warranties as to fitness for a particular purpose, or as to whether or not the use of the information in the Specification may infringe any patent or other rights of any other person. The recipient waives any claims it may have against Nortel Networks in respect of any use that the recipient makes of the information or products derived therefrom.

It is expected this Specification will be revised in the future to reflect domestic and international standards as they evolve and DMS-100 service and feature enhancements. Nortel Networks reserves the right to alter or modify this Specification or the equipment to which it relates at any time without notice and without liability.

It is the intent of Nortel Networks to make submissions to standards bodies and adopt domestic and international standards. The contributions currently being discussed at ECSA T1 committees, ITU study groups, and in respect of Bellcore Technical Requirements and Generic Requirements are monitored and incorporated into future programs whenever appropriate.

1.2 Standards Compliance Information

This document contains the specification for the Integrated Services Digital Network (ISDN) BRI user-network interfaces between the Nortel Networks ISDN DMS-100 switch and terminals designed for the BRI Digital Subscriber Line (DSL). The interfaces described in this document are based on the ITU ISDN I and Q Series Recommendations, ISDN Standards established by ANSI/ECSA-T1, and the *ISDN Basic Interface Call Control Switching and Signaling Requirements* (GR-268) and supplementary service Technical References and Generic Requirement documents published by Bellcore.

This release provides a comprehensive level of compliance to ITU recommendations Q.931 and Q.932, and describes the Nortel Networks offering of National ISDN-2. Other services are provided in addition.

Optional appendices to this specification provide descriptions of the packet mode services as provided by the DPN PH (Appendix A), and the NT specific Meridian Feature Transparency services (Appendix B). The main body of the NIS S208-6 specification (Chapters 1 to 9) describes the standard ISDN service offering using functional call control with TR and GR based supplementary services, and packet services provided from the DMS-100 Packet Handler (PH).

1.3 Scope and objective

This document is to define the characteristics of the ISDN BRIs between terminals and digital subscriber lines terminating on a DMS-100 ISDN switch, the signaling procedures across the interfaces, and the capabilities provided by the DMS-100 ISDN switch to support ISDN basic rate terminals.

It specifies how these terminals can gain access to the services and features provided by the DMS-100. It also describes the facilities available in the DMS-100 switch to support terminals, and suggests ways in which terminal manufacturers can exploit these facilities to complement the network-provided services.

The remainder of Chapter 1 lists conformance requirements, gives a brief description of ISDN BRI on DMS-100, lists the enhancements for NA012 release, the ISDN terminal support philosophy and how Nortel Networks supports this philosophy in the DMS-100 switch. For Meridian Feature Transparency, only the discussions regarding layers 1 and 2 in the remainder of this chapter apply. Appendix B contains further information on Meridian Feature Transparency.

1.4 Conformance

ISDN functional terminals claiming conformance to this specification are expected to conform to the following sections:

- Chapter 3, “T” interface or “U” interface physical layer requirements, as appropriate
- Chapter 4, static Terminal Endpoint Identifier (TEI) or dynamic TEI, as appropriate
- Chapter 5, for terminals using functional signaling for basic call control
- Chapter 6, for features that the terminal supports
- Chapter 7, for terminals supporting network based data services but only the features that the terminal supports
- Chapter 8, subscription parameters are provided for information only
- Chapter 9, for Service Profile Management (SPM)

ISDN Meridian Feature Transparency terminals claiming conformance to this specification are expected to conform to the following sections:

- Chapter 3, “T” interface or “U” interface physical layer requirements, as appropriate
- Chapter 4, static TEI or dynamic TEI, as appropriate
- Appendix B, for terminals supporting Meridian Feature Transparency

1.5 ISDN BRI Overview

ISDN BRI consists of two 64 kb/s B-channels for the carriage of voice, data and other end-user information, and a 16 kb/s D-channel for data and control, multiplexed together in a digital bidirectional 144 kb/s bit stream.

The ITU I and Q Series Recommendation and corresponding ANSI/ECSA-T1 standards define the characteristics of the ISDN basic rate interfaces using a ‘layered’ approach:

- the physical layer defines the electrical and physical characteristics of the S/T and U-Interfaces
- the data link layer defines the operation of the link access procedures on the D-channel
- the network layer defines the procedures for establishing, maintaining and clearing calls, and accessing supplementary services

1.6 NA014 Enhancements Overview

The NA014 release provides new capabilities to the Nortel Networks ISDN Basic Rate Interface (BRI). This section provides an overview of these capabilities:

- NI2 Uniform Call Display

1.6.1 NI-2 Uniform Call Display

ISDN Display interacts with call control and other services by sending information to a terminal that may be visible to the user by suitably equipped Customer Premises Equipment (CPE). This display information provides the user with information on call disposition or the status of subscribed features, and also provides a mechanism for the network to prompt the user for additional information.

Display information is sent only in the network-to-user direction in the codeset 5 Display Text information element (IE) on National ISDN (NI) Basic Rate Interface (BRI). The display text is required to conform to Telecordia requirements for ISDN Display Services defined in TR-NWT-000865 for those features which service uniformity is required in NI-2. Therefore, an NI-2 compliant switch will provide uniform display text for the uniform aspects of the following NI-2 services in the NA014 release:

- Basic Call
- Calling Number Identification Services
- ISDN Call Hold
- ACB
- Call Forwarding
- Additional Call Offering
- Flex Call
- EKTS

1.7 Overview of the ISDN Protocol Layers

1.7.1 The Physical Layer (Layer 1)

Two layer 1 specifications are defined:

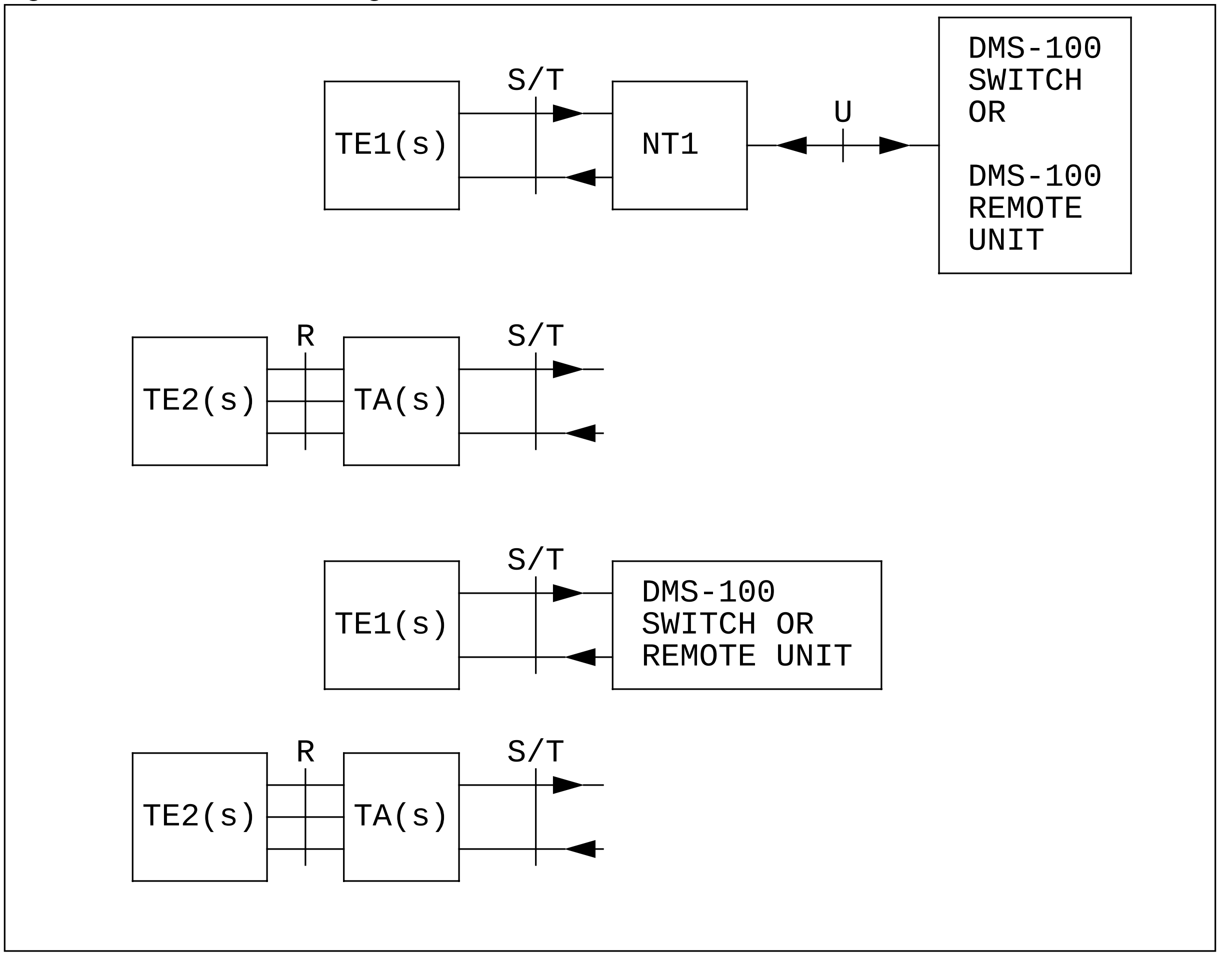
1 A two-wire loop interface defined at the network side of the Network Termination (NT-1) equipment. This interface is known as the ‘U-Interface’ and the point at which the interface physically exists is known as the ‘U-Reference Point’. The U-Interface specification allows for support of bi-directional transmissions between the DMS-100 switch and the NT-1 equipment over standard metallic loops in the outside plant.

2 A four-wire interface defined at the user side of the NT-1 equipment. This interface is known as the ‘S/T-Interface’, and the points at which this interface physically exists are known as the ‘S and T-Reference Points’. This S/T-Interface specification defines the means for connecting ISDN terminal equipment (TEs, NT-2s, and TAs) to NT-1s, or to a DMS-100 switch or DMS-100 Remote Units (RUs). This interface is intended for application over inside plant loops (customer premises wiring).

The location of the S/T and U-Interfaces in the access reference configurations describing the arrangements supported on the DMS-100 Switch and/or DMS-100 RUs are shown in Figure 1, “ISDN Interface configurations with S/T and U-Interfaces”.

The physical layer characteristics are defined in Chapter 3.

Figure 1 ISDN Interface configurations with S/T and U-Interfaces



1.7.2 The Data Link Layer (Layer 2)

The Data Link Layer specification defines the operation of the link access procedure on the D-channel. It includes functions such as frame delimiting, error detection and recovery, flow control, and assignment of terminal end-point identifiers (TEIs). The Data Link Layer specification is provided in Chapter 4.

1.7.3 The Network Layer (Layer 3)

The Network Layer specification defines the procedures for establishing, maintaining and clearing calls, and controlling access to supplementary services. The procedures are based on the process of exchanging messages over the D-channel.

This document specifies procedures for call establishment and supplementary services for terminals using functional signaling for basic call control (Chapter 5) together with signaling procedures for access to network-based supplementary services (Chapter 6). Access to data services and associated features is defined in Chapter 7.

For access to supplementary services associated with functional basic call control, two generic signaling mechanisms are used:

Functional Feature Management (FFM) - for control of services that affect the processing of calls in progress (for example, holding a functional call, offering additional functional calls), or are considered as optional parts of basic call processing (for example, calling line identification display), and feature activators and indicators

Feature Key Management (FKM) - generally for access to supplementary services that do not affect basic call processing (for example, Make Set Busy).

1.8 Abstract Terminal

To allow for the support of different physical implementations of terminals, the concept of an “Abstract Terminal” (AT) is introduced.

An AT is a collection of logical terminal components (for example, directory numbers, call references, bearer capabilities, feature activators, feature indicators, keypad, display, and so forth.) that a physical terminal may implement.

Physical terminals can have a wide variety of Human-Machine Interfaces (HMIs), however the network has only one virtual HMI, namely the AT.

Conceptually, the AT is part of the user-network interface. It is the primary vehicle through which a terminal and the DMS-100 interact, and represents the network view through a terminal endpoint of the terminal's resources and capabilities as defined by the service profile for the particular endpoint. This view by the network may also include the HMI. For more information on the AT, refer to Appendix B of this document.

1.8.1 ISDN Terminal numbering and addressing

This chapter describes the concept of Directory Number (DN) as used by the DMS-100 ISDN Switch.

1.8.1.1 DMS-100 ISDN terminals and Bearer Capabilities

ISDN terminals are connected to a Digital Subscriber Loop (DSL). Up to eight physical terminals may be connected to each DSL.

A bearer capability is, in part, defined in terms of the transmission characteristics of the channel provided between ISDN users upon successful connection of a call. Each terminal has access to the following ISDN bearer capabilities:

- B-channel, circuit mode - 64 kb/s unrestricted
- B-channel, circuit mode - 64 kb/s unrestricted, rate adapted from 56 kb/s
- B-channel, circuit mode - speech
- B-channel, circuit mode - 3.1 kHz audio
- B-channel, circuit mode - 7 kHz audio[1]
- B-channel, circuit mode - 64 kb/s restricted
- B-channel, packet mode (see note)
- D-channel, packet mode

Note: Access to the packet mode bearer capability in the B-channel is a provisioned service option, selected at subscription time. Access to packet mode bearer service through a switched B-channel is not currently available, but is planned.

1.8.2 ISDN terminal addressing

There are two modes of addressing ISDN terminals, determined by the Bearer Capability to be used:

- addressing terminals that access B-channel circuit mode Bearer Capability
- addressing terminals that access packet mode Bearer Capability on either B or D-channels

The DN scheme may differ for the circuit mode and packet mode terminals, in general for ITU X.31 case B service configuration, the DN scheme conforms to ITU ISDN numbering plan (E.164). ITU X.31 support is planned for a future release, however E.164 is currently supported.

1.8.3 Terminals using Circuit Mode Bearer Capabilities

Each terminal is represented by one or more ATs. Each AT uses its own logical link as identified by a TEI and a DSL number. The TEI associated with a particular terminal is unique across one DSL.

Externally, each terminal is associated with one or more DN's. The DN consists of a sequence of digits and may be associated with:

- a specific terminal
- a number of terminals arranged as a Hunt Group
- a group of terminals arranged in an EKTS shared-DN mode.

A given terminal can support multiple DN appearances. In addition, a number of calls can be supported by each DN, as defined at subscription time.

1.8.4 Terminals using the Packet Bearer capability

Internally, each D-channel Packet Mode Data (PMD) terminal is addressed by one TEI and a DSL number. The TEI is unique across one DSL. B-channel PMD terminals have a provisioned link between them and the ISDN Packet Handler.

Externally, each PMD terminal is identified by a single DN. This DN consists of a sequence of digits and may not be shared with any other PMD terminal. The DN is assigned according to the E.164 numbering plan.

Redirection from B to D-channel PMD terminals is supported, with the restriction that if the throughput class exceeds 9.6 kb/s, the calling terminal and network must support X.25 throughput class negotiation.

---

1. New procedures for this bearer capability may be developed in the future. Backward compatibility of this bearer capability using existing procedures is not assured, that is, can not be assigned to a 2B TEI. Bellcore has removed the 7 kHz audio bearer capability from the definition of National ISDN.

1.8.5 ISDN calls

The DN and the BC are used by a calling terminal or trunk to indicate to the ISDN switch the desired terminating user. Calls may be setup on any of the BCs between terminals of a compatible BC. The following call types are possible:

- VI Voice to B-channel VI
- CMD Data to B-channel CMD
- PMD Data to D-channel PMD
- PS Data to B-channel PS Data

Possible call origins are:

- VI Voice - Intra-ISDN (B-channel Voice Terminal) - Extra-ISDN (POTS)
- CMD Data - Intra-ISDN (B-channel Data Terminal) - Extra-ISDN (PSDS[1])
- PMD Data - Intra-ISDN (B or D-channel PS terminal) - Extra-ISDN (PPSN[2])

During call setup, the called DN and BC are used by the ISDN switch in order to determine the final destination of the call and the BC required. This determination is made in accordance with the principles described in the following sections.

1.8.5.1 Intraswitch Circuit Mode calls (ISDN and non-ISDN interworking)

The DN received is translated by the switch into the DSL numbers of the destination terminal(s). The switch then presents the call to those DSLs that have a compatible BC. When the appropriate service (subscription) options are set, the DN, the BC, or both, are checked by the network for compatibility with the associated terminal CA, as datafilled in the network.

1.8.5.2 Intra - ISDN Packet Mode calls

Since connections to the ISDN PH are dedicated at subscription time, intra ISDN PMD calls are performed using standard in-band X.25 call set-up procedures. The calling user specifies the called address. This address format requires prefixes to distinguish local, 10-digit and international calls.

The DMS ISDN switch also supports the alternative option of the user always dialing an international format number consisting of a country code plus national significance number. This option eliminates the need for dialing prefixes. The actual method chosen is at the option of the telephone operating company deploying this service.

1. Public Switched Digital-data Service

2. Public Packet Switched Network

1.8.5.3 Extra ISDN Packet Mode calls (PPSN)

The use of escape codes has been standardized by ITU as the mechanism for interworking between X.121 (PPSN) and E.164 (ISDN) numbering plans. The use of escape codes is fully supported on the Nortel Networks DMS-100 switch to allow full interworking of TEs on PPSNs and TEs on ISDN. Refer to Section 7.6, “X.25 subscription parameter values” for details of all CTs.

1.8.5.4 Packet devices on BRI interfaces supported

The DMS ISDN BRI supports up to eight terminals per interface, and 8 TEI addresses, one for each terminal. Only two of the terminals can have B-channel access, if they are both fully initializing terminals. If non-initializing terminals are deployed then up to eight terminals can have B-channel access. Additional D-channel packet terminals may also be connected to the interface, provided the total number of TEIs does not exceed eight. These additional terminals each have separate TEI addresses and DN.

The Nortel Networks packet service offering provides provisioned B-channel packet service (for example, nailed up B-channel packet or semi-permanent packet access). A 2 B-channel terminal can be provisioned on the same interface with a B-channel packet terminal, but that terminal will have access to only one B channel.

1.8.5.5 Extra-ISDN calls (POTS and PSDS)

Calls to the common DN from the POTS network are presumed to have a CT of VI and are processed accordingly.

Calls to the common DN from the PSDS are presumed to have a CT of CMD, and are processed accordingly.

1.8.6 ISDN terminal loudness objectives

Encoding and decoding between analog speech (or other) signals and B-channel 64 kb/s digital signals is carried out by the terminal. Rules for encoding and decoding of voice frequencies using Pulse Code Modulation (PCM) are specified in *CCITT Recommendation G.711* (ITU Recommendation, G.711, Volume III-1, Red Book, Geneva, 1984). Recommendation G.711 gives the encoding rules for both A-law and u-law encoding, but only u-law encoding is supported by this protocol specification.

Based on the coding scheme specified in G.711, the terminal should be designed to meet the following loudness objectives for ISDN terminals:

- Transmit Objective Loudness Rating = -46 dB
- Receive Objective Loudness Rating = 51 dB
- Sidetone Objective Loudness Rating = 9 dB

The Objective Loudness ratings are determined according to the methods described in I.E.E.E. Standard 661 (I.E.E.E. Standard 661-1979: *Method for Determining Objective Loudness Ratings of Telephone Connections*). The Objective Loudness Ratings are measured according to the methods described in I.E.E.E. Standard 269 (I.E.E.E. *Standard 269-1983: Standard Method for Measuring Transmission Performance of Telephone Sets*).

Chapter 2: ISDN BRI Configurations

2.1 Introduction

The DMS provides the National ISDN BRI capabilities to support access by initializing and non-initializing terminals to the 2B+1D channels of BRI. A single interface can accommodate up to eight terminals, each of which may access one or two B-channels and use the D-channel for packet data. Restrictions may be placed on terminals or groups of terminals to control their access to the B-channels.

Two-B-channel terminals are supported using a single Terminal Endpoint Identifier. These terminals are able to utilize a single TEI to provide Voiceband Information, Circuit Mode Data, and Packet Mode Data services using a single Directory Number. The single DN supports simultaneous access to two B-channels for circuit-mode calls, and access to packet services on the D-channel. The two simultaneous circuit calls may be any combination of Voiceband Information and Circuit Mode Data calls. The single DN and 2 B-channel access capabilities are supported for both initializing and non-initializing terminals.

A directory number may also be shared on a single interface across terminals handling different call types. Depending on the capabilities of the individual terminals, it is possible to offer voice, Circuit Mode Data, and Packet-Mode Data to different devices using the same DN.

2.1.1 Fully-Initializing Terminals

A Fully-Initializing Terminal is a terminal that, after establishing the Data Link layer, initializes at layer 3 by invoking the Service Profile IDentifier (SPID) initialization procedures, as described in Section 6.7.4, “Initializing Terminal Procedures”. It is the SPID which associates a terminal with a Terminal Service Profile, the set of services or feature parameters subscribed to by a terminal and associated with it after successful initialization. Support is also provided to FITs which require access to one B-channel (1B FITs) and two B-channels (2B FITs) from a single TEI/SPID.

2.1.2 Non-Initializing Terminals

In contrast to a Fully-Initializing Terminal, a Non-Initializing Terminal does not request the Service Profile IDentifier initialization. As a result, it is assigned to the default Terminal Service Profile. All NITs on the interface are associated with the same default TSP. NITs have access to features either through dial-access codes, or through fixed feature key values provisioned against the default terminal service profile.

Because a NIT does not initialize, it does not receive any type of downloaded profile through TR-1281 Parameter Downloading or Service Profile Management (SPM). A non-initializing circuit-mode terminal may be a terminal that requires access to one B-channel (1B NIT), or a terminal that requires access to two B-channels (2B NIT). The number of B-channels available to a terminal is controlled through provisioning. From a switch perspective, any restriction that applies to initializing two B-channel terminals also applies to non-initializing two B-channel terminals.

Up to eight non-initializing terminals may be provisioned on the interface. The number of non-initializing terminals allowed is controlled via provisioning. If the number of NITs on the interface exceeds this provisioned limit, the additional terminals will not receive service.

When there is more than one NIT on the interface, they share the same DN/CT pairs. This is called “DN contention.”

2.1.3 Packet-only Terminals

A packet-only terminal is a Non-Initializing Terminal which only subscribes to packet service, not voice (VI) or circuit mode data (CMD). Terminals that subscribe to PMD and VI and/or CMD are treated as “integrated” FITs or NITs, as described above.

A packet-only NIT may have either static or dynamic TEI. An interface may have up to eight packet-only terminals with static TEI; conversely, only one packet-only NIT with dynamic TEI is allowed on an interface. Static TEIs require manual provisioning; dynamic TEIs do not. Refer to Section 6.7.1, “Static or fixed terminals,” on page 365, for more information about static TEIs.

Packet-only terminals must operate as Non-Initializing Terminals. The network rejects initialization attempts by packet-only terminals, as described in Section 6.7.4, “Initializing Terminal Procedures,” on page 366.

2.1.4 Single TEI

A terminal that supports single Terminal Endpoint Identifier may have access to the VI, CMD and PMD (D-channel packet) Call Types (CTs) for both B-channels simultaneously by using single dynamic TEI. This is supported for initializing and non-initializing terminals.

2.1.5 Single DN

Single DN provides the capability to support a single DN across the VI, CMD and PMD Call Types on a single terminal. The single DN may be used for one or two simultaneous active circuit-mode calls. This is supported for initializing and non-initializing terminals.

Refer to Section 2.4.1, “Single DN, single TEI with different Call Types”, for more information.

2.1.6 DN Sharing for different Call Types

A Directory Number can be shared across up to three different terminals on an interface, with each terminal handling different call types.

Refer to Section 2.4.2, “Shared DN with different Call Types across multiple terminals”, for requirements and additional information.

2.2 Supported interface configurations

2.2.1 Terminal configurations

Figure 2, "BRI interface configurations prior to NA008," on page 50, Figure 3, "BRI interface configurations added in NA008", and Figure 4, "BRI interface configuration additions added in NA009", illustrate interface configurations available on ISDN BRI. The capabilities supported are:

- Prior to NA008:
  - — two fully initializing terminals, each with access to one B-channel
  - — one fully initializing terminal and one non-initializing terminal, each with access to one B-channel
  - — one terminal (either initializing or non-initializing) with access to both B-channels.
- NA008
  - — one fully initializing terminal and up to seven non-initializing terminals. The fully initializing terminal has access to one B-channel, and the non-initializing terminals share the other B-channel with the associated group restrictions. The non-initializing terminals support DN/CT sharing with contention
  - — up to eight non-initializing terminals, each may simultaneously access both B-channels, with DN/CT sharing with contention across the non-initializing terminals
  - — one fully initializing terminal and up to seven non-initializing terminals, all of which has simultaneous access to both B-channels; the non-initializing terminals support DN/CT sharing with contention
  - — two fully initializing terminals, both of which have the ability to simultaneously access both B-channels
  - — two provisioned B-channel packet terminals. Provisioned B-channel packet service is also known as Semi-permanent Packet Access. When a B-channel is provisioned for packet service, or any other use, it is not available to any of the other terminals on the interface
  - — up to eight D-channel packet terminals. A terminal may be D-channel packet only, or support the VI and CMD call types as well. D-channel packet terminals that support VI and CMD are limited to the configurations described above for B-channel terminals. The configuration of D-channel packet only terminals is limited only in that the total number of all terminals (of any type) on the interface may not exceed eight.

- NA009
  - — up to eight fully initializing terminals on the interface
  - — any combination of up to eight initializing or non-initializing terminals.

2.2.2 National ISDN compliance

The DMS-100 supports the following National ISDN interface configurations:

- NI-1
  - — configurations supported as of BCS-34.
- NI-2
  - — configurations supported in NA007 and following. Circuit-mode terminals used in configurations introduced in NA008 and NA009 must be NI-2 capable. NI-1 and NI-2 differences are described in Section 2.7.1, “Access Type background”

Figure 2 BRI interface configurations prior to NA008

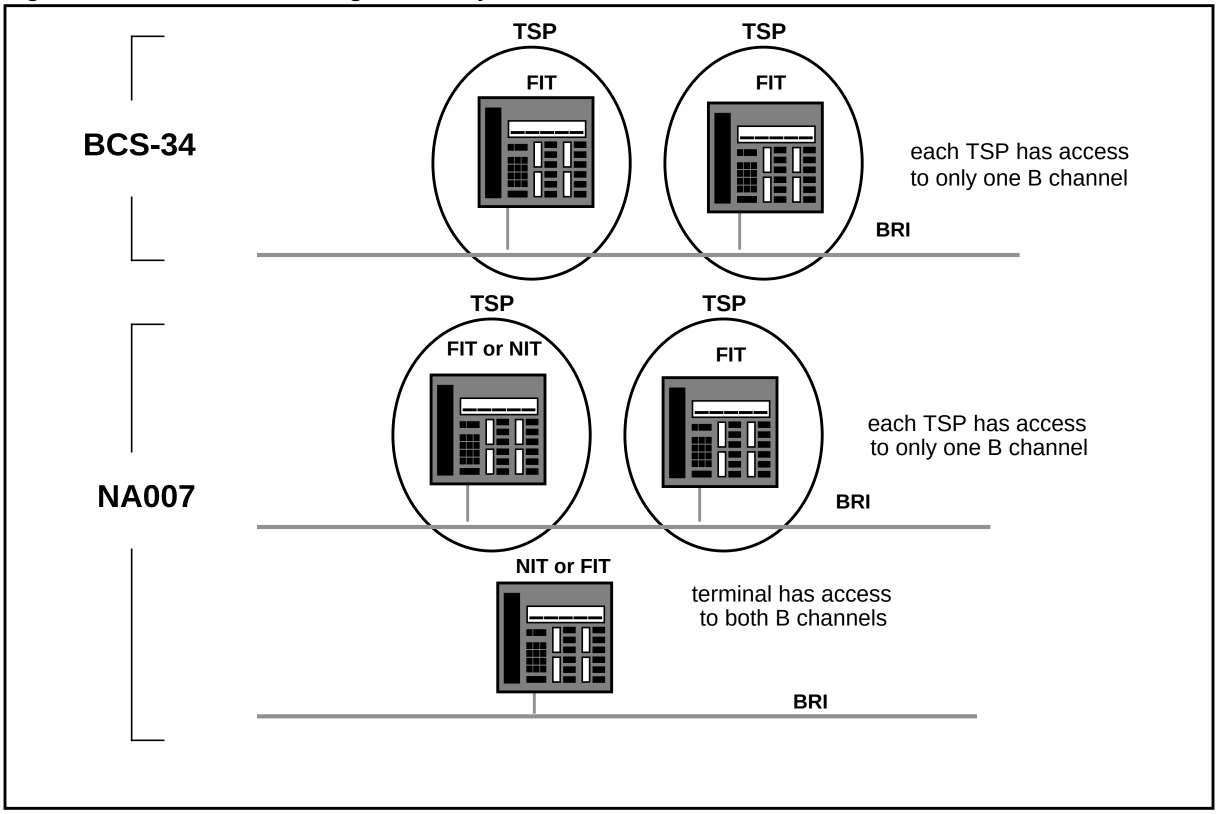


Figure 3 BRI interface configurations added in NA008

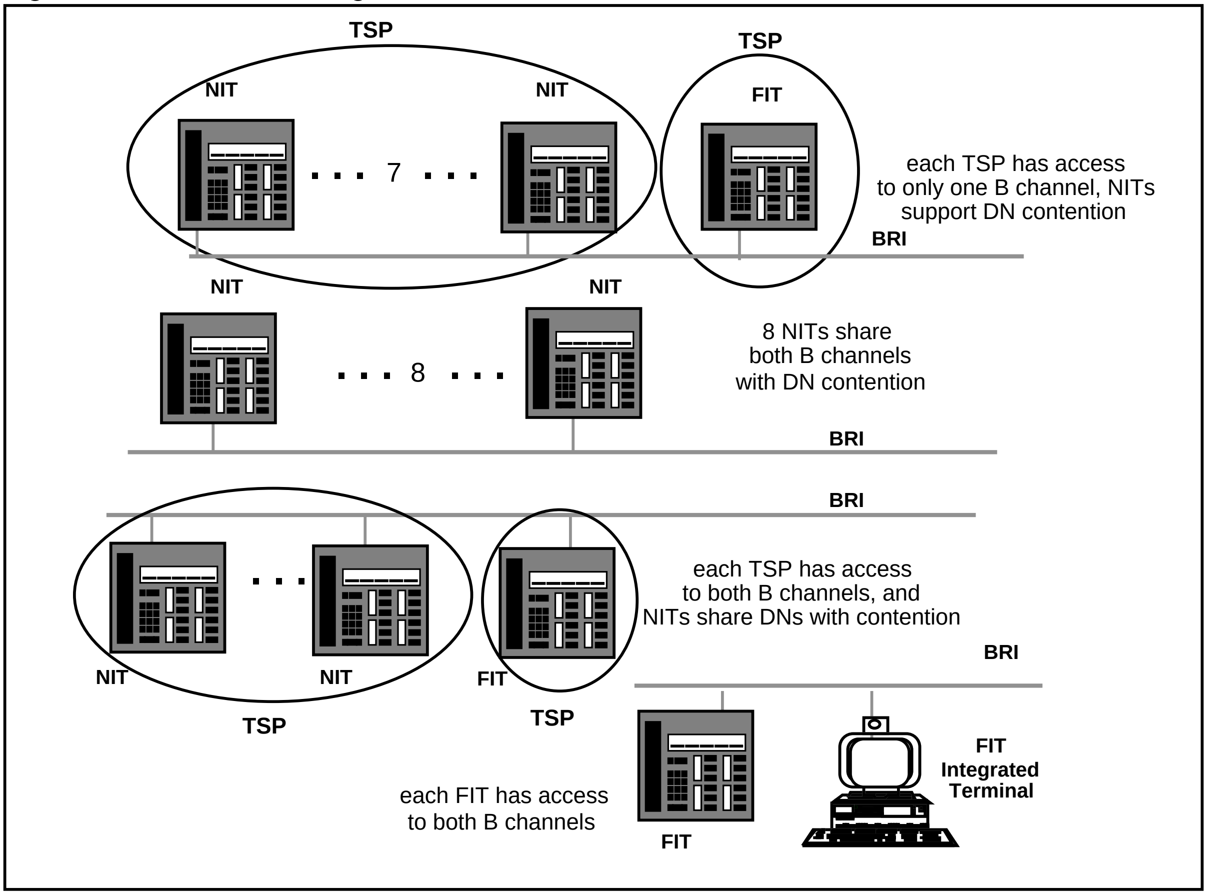
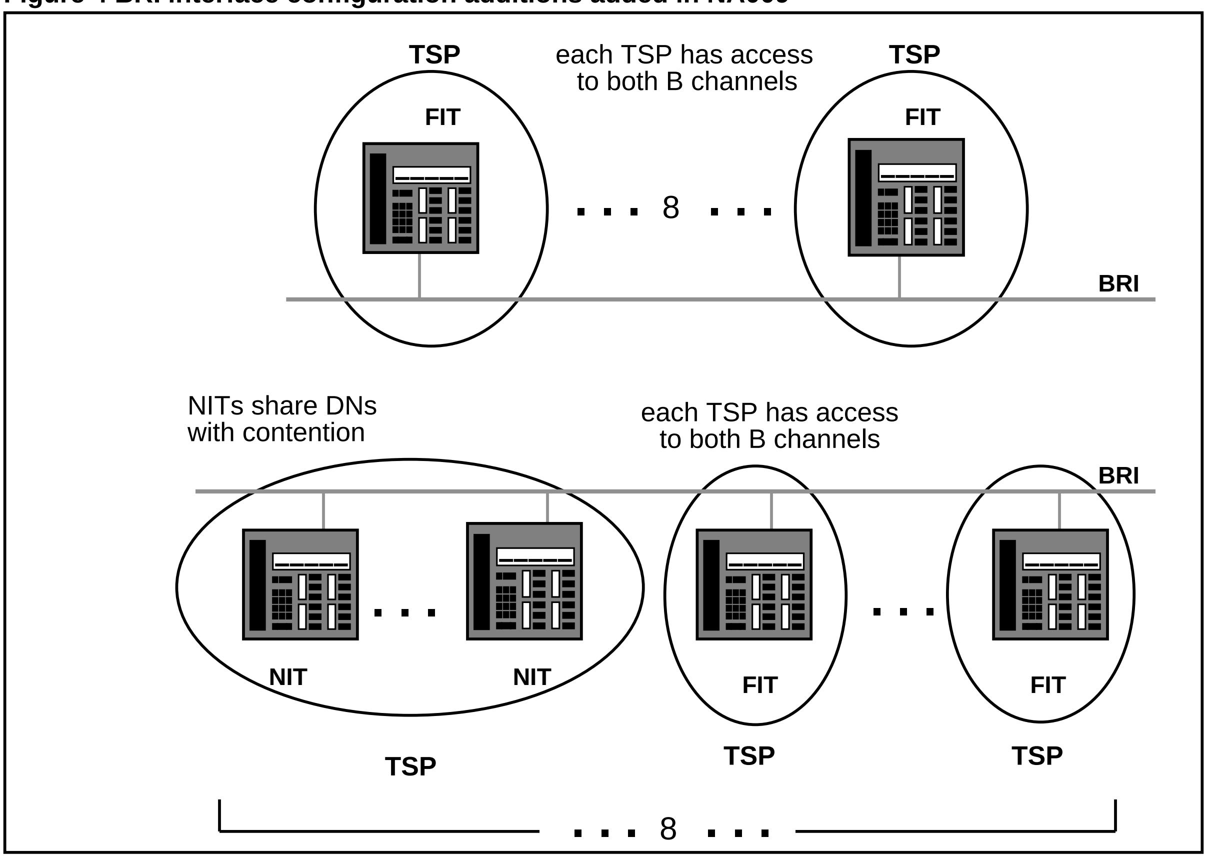


Figure 4 BRI interface configuration additions added in NA009



2.3 Summary of Terminal configurations supported

Table 1 Number of terminals allowed on interface

Terminal Type	FIT	NIT	Provisioned B-packet	D-packet
One B-channel FITS and NITS	0	0	0	8
	0	1	0	7
	1	0	0	7
	1	1	0	6
	0	1	1	6
	1	0	1	6
	0	0	2	6
	2	0	0	6
Two B-channel FITS and NITS	0 to 8	0 to 8	0	8 - (# NITs + # FITs)
	0 to 7	0 to 7	1	7 - (# NITs + # FITs)
	0	0	2	6

Each FIT, NIT, or D-packet terminal is visible to the DMS as a single device through its single TEI.

2.3.1 B-Channel Restrictions on a TSP Basis

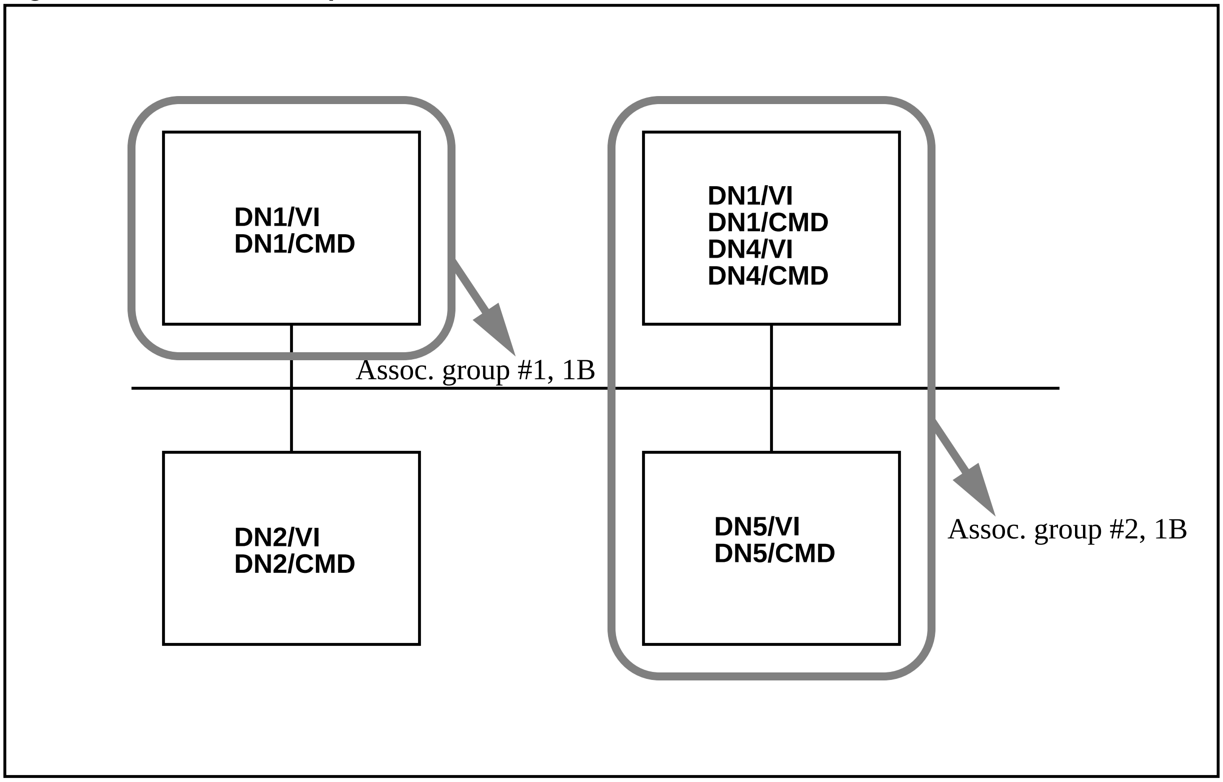
When more than one person is using the interface, it is sometimes useful to restrict each person to a single B-channel. If each person has more than one terminal, it is desirable to ensure that each person is still restricted to a single B-channel. Alternatively, for a single person, it may be useful to restrict one or more terminals to a use a single B-channel, to ensure that those devices do not obtain all the available channels and prohibit another device from gaining a B-channel.

To support these configurations, an associated group may be formed from one or more TSPs, as defined by National ISDN Enhancement #46. When an associated group is formed, all the terminals are restricted to accessing one B-channel simultaneously for the entire group. Thus, if one terminal in the associated group is using a B-channel, none of the other terminals in that associated group may access a B-channel. Once the terminal with the active B-channel has released it, other terminals in the associated group may gain access to a B-channel. Note that when a B-channel is put on hold, it is reserved against the terminal that placed it on hold, and thus the other terminals still cannot access a B-channel, since the associated group limit has still been reached. Just the DNs of all voice or all data Call Types can be put into an associated group.

This TSP-based B-channel access restriction also applies to a terminal when a shared DN (either basic EKTS or EKTS CACH) is provisioned on the terminal.

Figure 5, “Associated Groups on a TSP basis”, illustrates TSP-based associated groups. Associated Group #1 contains TSP1. Associated Group #2 contains TSP2 and TSP4. Note that TSP3 is not in an associated group. Also note that associated groups can span across TSPs and include all the DN/CTs provisioned against the particular TSP.

Figure 5 Associated Groups on a TSP basis



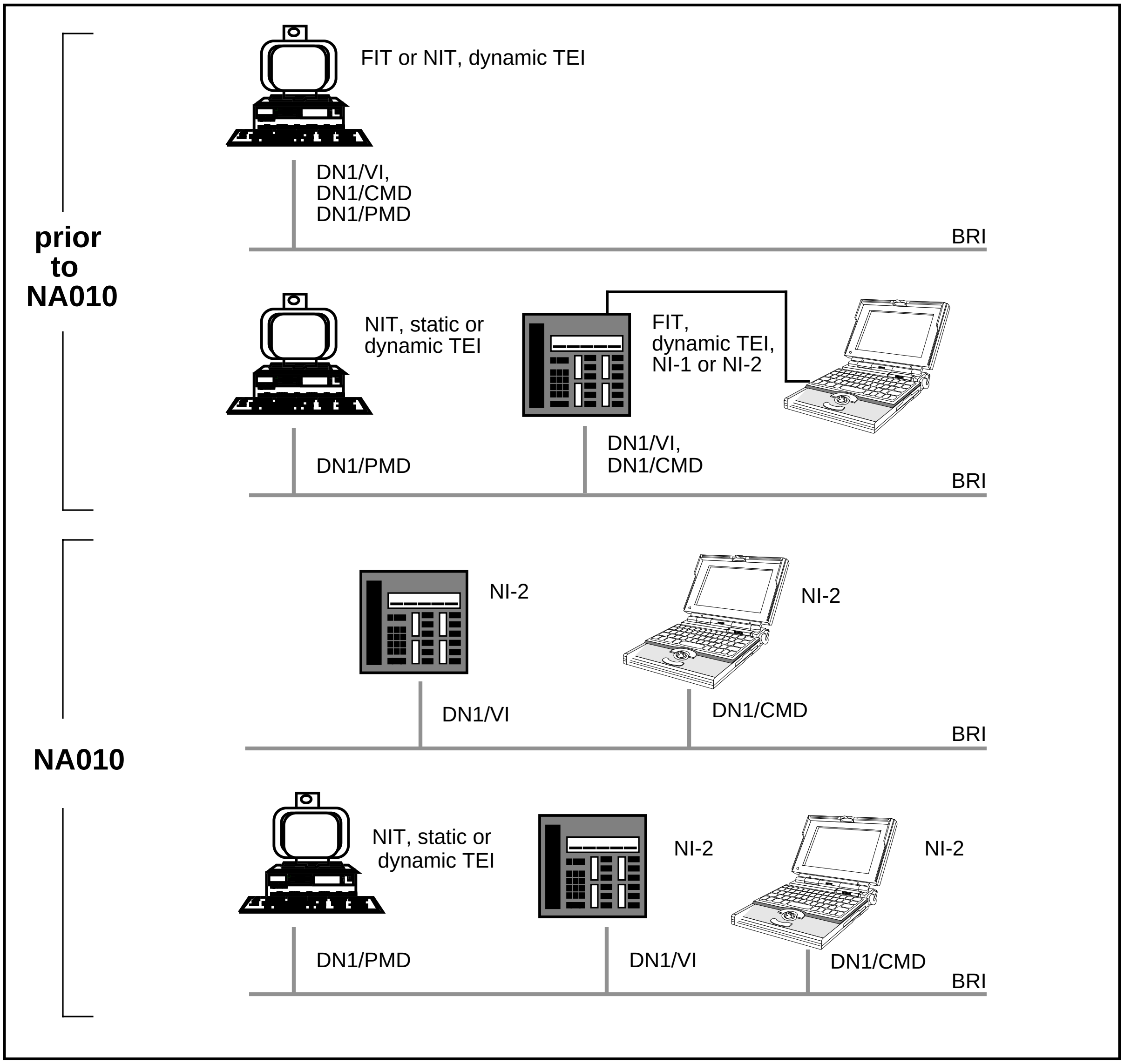
2.4 Directory Number / Call Type configurations

NA007 introduced the concept of DN sharing between circuit and packet terminals. Subsequent releases have extended this concept. For discussion purposes, “single DN” refers to a DN used on a single terminal across multiple call types. A “shared DN” refers to a Directory Number shared across multiple terminals on the same interface, with the terminals handling different call types. This section uses the term “DN sharing” to be short for Bellcore GR-268-based DN sharing. This is different than EKTS DN Sharing, a service discussed in Section 6.67, “Electronic Key Telephone Service”.

Figure 6, "NA010 Directory Number / Call Type configurations," on page 54, illustrates examples of DN sharing. They include:

- Prior to NA010:
  - — Single DN, single TEI with different CTs, on an integrated FIT or NIT
  - — Shared DN with different CTs, static TEI for packet service NIT
  - — Shared DN with different CTs, dynamic TEI for packet service NIT.
- NA010
  - — Shared DN for Voiceband Information and Circuit Mode Data between two NI-2 Terminals. This configuration, when combined with one of the preceding shared DN configurations, enables up to three terminals to share the same DN on an interface.

Figure 6 NA010 Directory Number / Call Type configurations



Note: Packet-mode only FITs are not supported.

The following rules apply to DN sharing:

- a given DN/CT pair can only be assigned to one terminal.
- call types cannot be shared across terminals using the same DN (non-MADN DNs).

Note that other terminals not sharing the same DN may be on the interface, as explained in Section 2.2.1, “Terminal configurations”.

2.4.1 Single DN, single TEI with different Call Types

This capability is available to both Fully-Initializing Terminals and Non-Initializing Terminals. A terminal that supports single DN can have access to Voiceband Information, Circuit-Mode Data, and D or B-channel Packet-Mode Data services using a single dynamic TEI. While the DMS-100 supports two active B-channel calls for VI and/or CMD calls using the same DN, a terminal may be provisioned to access either only one B-channel or both B-channels.

The number of circuit-mode calls is controlled by the Call Reference Busy Limit (CRBL) provisionable against a DN/CT.

2.4.2 Shared DN with different Call Types across multiple terminals

Terminals may share a Directory Number across two physically separate devices, one being a voice and/or Circuit-Mode Data terminal, the other being a packet-mode Non-Initializing Terminal. The packet-only NIT may have either a static or dynamic TEI. The single circuit-mode terminal in this arrangement may be either NI-1 or NI-2.

Terminals may also share a directory number with Voiceband Information (VI) and Circuit-Mode Data (CMD) Call Types across two different devices. Both terminals must be NI-2 terminals and reside on the same BRI loop. Each circuit-mode terminal uses its own single dynamic TEI.

The DN may also be shared by three terminals: two NI-2 circuit-mode terminals and a packet-only NIT (having either static or dynamic TEI), with all of them residing on the same interface.

2.5 SPID Initialization capabilities

SPID assignment is required when an Automatic TEI assignment is completed, and the TSP is provisioned as an initializing terminal. SPID assignment and initialization is not allowed for NITs. Refer to Section 6.7.4, “Initializing Terminal Procedures,” on page 366, for additional information.

2.6 Supported TEI assignment

The TEI assignment options are supported for the different terminal types as shown in Table 2, “Allowable Assignments of TEI to Terminal Types”.

Table 2 Allowable Assignments of TEI to Terminal Types

TEI Type	2 B-channel FIT	NIT	D-packet
Automatic Network-Assigned TEI - TSP subscription to this TEI assignment procedure enables terminals to request a TEI from the network. TEI assigned by this method are in the range 64-126	yes	no	no
Automatic User - Assigned TEI - TSP subscription to this TEI assignment procedure enables terminals to select their own TEI value in the range 0-63.	yes	no	no
User or Network Assigned TEI - This TSP subscription option enables terminals to establish a TEI through either the Network or User assigned procedures.	yes	yes	yes (D-packet NIT only)
Static Assigned TEI - This TSP subscription option provisions a TEI value in the range 0-63 against the TSP. Terminals must use the provisioned value to gain service access.	no	no	yes

2.7 Features vs. Access Types

2.7.1 Access Type background

BCS-34

With the BCS-34 NI-1 product, a Terminal Service Profile (TSP) was limited to single B-channel access. Up to two of these B-channel TSPs could be provisioned on the interface. For discussion purposes, this type of TSP is referred to as a NI-1 TSP. One NI-1 TSP may be associated with one FIT (Fully Initializing Terminal).

NA007
Support for 2 B-channel access from a single TSP was introduced. Because B-channel contention was not supported in NA007, a NI-1 BRI was limited to having only one of these TSPs on the interface. This type of TSP is referred to as a 2B TSP. The concept of a Default TSP also appeared in NA007: an NI-1 Default TSP and a 2B Default TSP which supported one single NIT.

NA008
A new 2B-channel access TSP that has several NI-2 capabilities such as CRBL on a DN/CT basis and parameter downloading was introduced. This type of TSP is referred to as a NI-2 TSP. The non-initializing version of this new NI-2 TSP is called a NI-2 Default TSP and supports up to eight NITs.

NA009
The NI-2 TSP introduced in NA008 was expanded to provide additional NI-2 and NI-3 features, as well as key National ISDN enhancements.

Table 3, " Basic Call Features vs. Access Types”, shows basic call features and supplementary features on three different platforms.

Table 3 Basic Call Features vs. Access Types

NI-1 TSP	2B TSP	NI-2 TSP
Two 1B FITs per BRI	One 2B FIT or One 2B NIT per BRI	m NITs + n FITs where (m, n >= 0) & (m + n <= 8)
Call Type assignment on a terminal basis using ABS (PMD,CMD, VI)	Call Type assignment on a DN basis (VI, CMD)	Call Type assignment on a DN basis (VI, CMD, PMD, for FITs and NITs)
Number of active calls controlled on a DN basis using AFC	Number of active calls controlled on a DN basis using AFC	Number of active calls controlled on a DN/CT basis using CRBL
ACOU on DN basis	ACOU on DN basis	ACOU on DN/CT basis
No support for Associated Groups	Support for Associated Groups	Support for Associated Groups
Service Profile Management	Service Profile Management	NI-2 Parameter Downloading
One TEI per TSP	One TEI per TSP	TERML (only applicable to NI-2 default TSP) to control number of TEIs per TSP; one TEI per TSP for initializing terminals
Default Service	Default Service	Default Service

Chapter 3: Physical layer specification

3.1 General

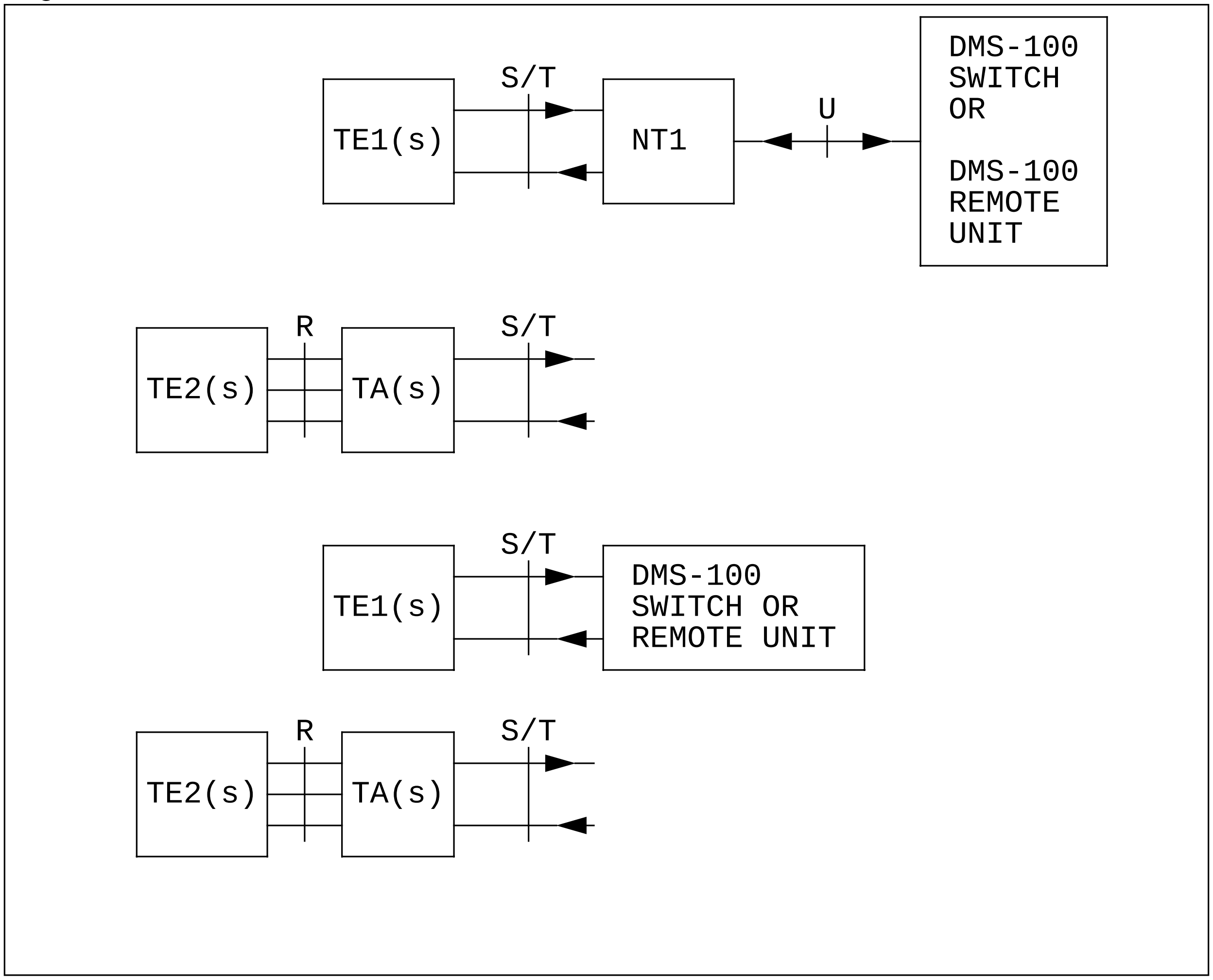
This specification defines the layer 1 characteristics of the ISDN BRI user-network interfaces supported on the DMS-100 switch and/or DMS-100 RUs. Two layer 1 specifications are defined:

1 A two-wire loop interface defined at the network side of the Network Termination (NT-1) equipment. This interface is known as the “U-Interface”, and the point at which the interface physically exists is known as the “U-Reference Point”. The U-interface specification allows for support of bi-directional transmissions between the DMS-100 switch and NT-1 equipment over standard metallic loops in the outside plant.

2 A four-wire interface is defined at the user side of the NT-1 equipment. This interface is known as the “S/T-Interface”, and the points at which this interface physically exists are known as the “S and T-Reference Points”. The S/T-Interface specification defines the means for connecting ISDN terminal equipment (TEs, NT-2s, and TAs) to NT-1s provided by Nortel Networkds and to DMS-100 switches and DMS-100 RUs. This interface is intended for application over inside plant loops (customer's premises wiring).

Reference configurations defining reference points U, T, and S supported on the DMS-100 switch or DMS-100 RUs are shown in Figure 7, “ISDN Basic Rate Interface Reference Points”.

Figure 7 ISDN Basic Rate Interface Reference Points



3.2 U-Interface Layer 1 specification

The U-Interface is located at the “U-Reference Point” as defined in Figure 7, “ISDN Basic Rate Interface Reference Points”.

The layer 1 specification for this interface supported by the DMS-100 switch at the U-Reference Point is fully compliant with the ANSI T1.601-1988 standard based on the 2B1Q line code and entitled, *Integrated Services Digital Network Basic Rate Interface for Use on Metallic Loops for Application on the Network Side of the NT layer 1 Specification*.

Improvements to this standard are expected with progress in implementation of its various aspects (for example activation/deactivation). Nortel Networks is actively and continuously involved in evaluating and improving the specifications in the ANSI U-Interface Standard and intends to remain fully compliant with it.

3.3 S/T-Interface Layer 1 specification

The S/T-Interface is located at the S/T-Reference Point, as shown in Figure 7, “ISDN Basic Rate Interface Reference Points”.

The layer 1 specification for this interface supported by the DMS-100 switch and NT-1s provided by Nortel Networks, at the S/T-Reference Point, is compliant with the ANSI TI.605-1991 standard entitled: *Integrated Services Digital Network Basic Rate Interface for S and T-Reference Points - Layer 1 Specification*.

Network Termination (NT) functionality is assumed at the S/T-Reference Point.

The S/T-Interface standards offer options. Among them are, powering across the interface, maintenance messaging across the S and Q channels, and activation/deactivation. The supported options include:

- the optional PS1 mode of powering across the S/T-Interface
- the optional S/Q channel messaging.

Chapter 4: Data Link Layer Specification

4.1 General

This section of the document specifies the frame structure, elements of procedure, format of fields and procedures for the proper operation of the Link Access Procedure on the D-channel (LAPD). This section is fully compliant with CCITT recommendation Q.921 (I.441) [7] and ANSI T1.602 [8].

The concepts, terminology, overview description of LAPD functions and procedures and their relationship with other CCITT recommendations are described in general terms in CCITT recommendation Q.920 (I.440) [1].

> ***Note: 1*** The term “data link layer” is used in the main text of this document. However, mainly in figures and tables, the term “layer 2” and “L2” are used as abbreviations. Furthermore, in accordance with Recommendations Q.930 (I.450) [2] and Q.931 (I.451) [3], the term “layer 3” indicates the layer above the data link layer.

> ***Note: 2*** All references to “layer management entity” and/or “connection management entity” refer to those entities at the data link layer.

4.2 Frame structure for Peer-to-Peer communication

4.2.1 General

All data link layer peer-to-peer exchanges are in frames conforming to one of the formats shown in Figure 8, "Frame formats," on page 62. Two format types are shown in the figure, Format A for frames where there is no information field, and Format B for frames containing an information field.

Figure 8 Frame formats

```
        Format A                            Format B

   8 7 6 5 4 3 2 1                      8 7 6 5 4 3 2 1
  +-----------------+                  +-----------------+
  |     FLAG        |                  |     FLAG        |  Octet 1
  | 0 1 1 1 1 1 1 0 |  Octet 1         | 0 1 1 1 1 1 1 0 |
  +-----------------+                  +-----------------+
  |  (High order    |                  | (High order     |
  |        byte)    |        2         |        byte)    |      2
  |---- address ----|                  |---- address ----|
  |   (Low order    |                  | (Low order      |
  |        byte)    |        3         |       byte)     |      3
  +-----------------+                  +-----------------+
  |                 |                  |                 |
  |-Control* -------|        4         |-Control*--------|      4
  |                 |                  |                 |
  +-----------------+                  +-----------------+
  |                 |                  | Information     |
  | FCS (1st octet) |      N-2         |                 |
  |-----------------|                  |-----------------|
  | FCS (2nd octet) |      N-1         | FCS (1st octet) |
  |-----------------|                  |                 |    N-2
  |     FLAG        |                  |-----------------|
  | 0 1 1 1 1 1 1 0 |        N         | FCS (2nd octet) |    N-1
  +-----------------+                  +-----------------+
                                       |     FLAG        |
                                       | 0 1 1 1 1 1 1 0 |      N
                                       +-----------------+

  * Unacknowledged operation   - 1 octet
  * Multiple Frame operation   - 2 octets for frames with
                                  sequence numbers;
                               - 1 octet for frames without
                                  sequence numbers.
```

4.2.2 Flag sequence

- All frames start and end with the flag sequence consisting of one 0 bit followed by 6 contiguous 1 bits and one 0 bit.
- The flag preceding the address field is defined as the opening flag.
- The flag following the Frame Check Sequence (FCS) field is the closing flag. It may also serve as the opening flag of the next frame in some applications. However, all receivers must be able to accommodate receipt of one or more consecutive flags. See *ISDN User-Network Interfaces: Layer 1 recommendations* (I.430 [4]) for applicability.

4.2.3 Address field

The address field consists of two octets as illustrated in Figure 8, “Frame formats”. The address field identifies the intended receiver of a command frame and the transmitter of a response frame. The format of the address field is defined in Table 5, "Address field format,” on page 66.

4.2.4 Control field

The control field consists of one or two octets. Table 10, "Control field formats," on page 70, illustrates the two frame formats (A and B), each with a control field of one or two octets, depending upon the type of operation being used.

The format of the control field is defined in Section 4.3.4, “Control field formats”.

4.2.5 Information field

The information field of a frame, when present, follows the control field, and precedes the frame check sequence (see Section 4.2.7, “Frame Checking Sequence (FCS) field”). The contents of the information field consists of an integral number of octets that hold a message from layer 3, or the management entity in general. The maximum number of octets in the information field is defined in Section 4.5.8.1, "Timer T200", on page 115.

4.2.6 Transparency

A transmitting data link layer entity examines the frame content between the opening and closing flag sequences, (address, control, information and FCS fields), and inserts a 0 bit after all sequences of five contiguous 1 bits (including the last five bits of the FCS) to ensure that a flag or an abort sequence is not simulated within the frame. A receiving data link layer entity examines the frame contents between the opening and closing flag sequences and discards any 0 bit that directly follows 5 contiguous 1 bits.

4.2.7 Frame Checking Sequence (FCS) field

The FCS field is a 16-bit sequence. It is the one’s-complement of the sum (modulo 2) of:

- The remainder of (x raised to k power) ($x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x^1 + 1$) divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency, and
- the remainder of the division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the product of x^{16} by the content of the frame existing between, but not including, the final bit of the opening flag and the first bit of the FCS, excluding bits inserted for transparency.
- As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all 1’s and is then modified by division by the generator polynomial (as described above) of the address, control and information fields; the 1’s complement of the resulting remainder is transmitted as the 16-bit FCS.
- As a typical implementation at the receiver, the initial content of the register of the device computing the remainder is preset to all 1’s. The final remainder after multiplication by x^{16} and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the serial incoming protected bits and the FCS, is “0001 1101 0000 1111” (x^{15} through x^0, respectively) in the absence of transmission errors.

4.2.8 Format convention

4.2.8.1 Numbering convention

The basic convention used is illustrated in Table 4, “Format convention”. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1-8. Multiple octets are shown vertically and are numbered from 1 - n.

Table 4 Format convention

8	7	6	5	4	3	2	1	OCTET
								1
								2
								•
								N

4.2.8.2 Order of bit transmission

The octets are transmitted in ascending numerical order; inside an octet bit 1 is the first bit to be transmitted.

4.2.8.3 Field mapping convention

- When a field is contained within a single octet, the lowest bit number of the field represents the lowest order value.
- When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases. The lowest bit number associated with the field represents the lower order value.
- For example, a bit number can be identified as a couple (o, b) where o is the octet number and b is the relative bit number within the octet. Field Mapping Convention (as pictured in Figure 9, “Field mapping convention”) illustrates a field that spans from bit (1, 3) to bit (2, 7). The high order bit of the field is mapped on bit (1, 3) and the low order bit is mapped on bit (2, 7).

Figure 9 Field mapping convention

8	7	6	5	4	3	2	1
					2^4	2^3	2^2
2^1	2^0						

An exception to the preceding field mapping convention is the data link layer FCS field, that spans two octets. In this case, bit 1 of the first octet is the high order bit, and bit 8 of the second octet is the low order bit as seen in Figure 10, “FCS mapping convention”.

Figure 10 FCS mapping convention

8	7	6	5	4	3	2	1	
2^8							2^{15}	1st octet of field
2^0							2^7	2nd octet of field

4.2.9 Invalid frames

An invalid frame is a frame that either:

- is not properly bounded by two flags
- has fewer than 6 octets between flags of frames that contain sequence numbers and fewer than 5 octets between flags of frames that do not
- does not consist of an integral number of octets prior to zero bit insertion or following zero bit extractions
- contains a frame check sequence error
- contains a single octet address field
- contains a service access point identifier (see Section 4.3.3.3, "Service Access Point Identifier (SAPI)", on page 66) not supported by the receiver.

Invalid frames are discarded without notification to the sender. No action is taken as the result of such frames.

4.2.10 Frame abort

Receipt of seven or more continuous 1 bits is interpreted as an abort, and the data link layer entity ignores the frame currently being received.

4.3 Elements of procedures and formats of fields

4.3.1 General

The elements of procedures define the commands and responses used on the data link connections carried on the D-channel.

Procedures are derived from these elements of procedures and are described in Section 4.5, "Definition of the Peer-to-Peer procedures", on page 86.

4.3.2 Address field format

The address field format shown in Table 5, “Address field format” contains the address field extension bits, a command/response indication bit, a data link layer SAPI subfield, and a TEI subfield.

Table 5 Address field format

<table>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>OCTET</th></tr>
<tr><td colspan="6" rowspan="2">Service access point identifier (SAPI)</td><td>Command/ Response field</td><td>Address field extension bit</td><td rowspan="2">2</td></tr>
<tr><td>C/R</td><td>EA = 0</td></tr>
<tr><td colspan="7">Terminal Endpoint Identifier (TEI)</td><td>EA = 1</td><td>3</td></tr>
</table>

4.3.3 Address field variables

4.3.3.1 Address field Extension bit (EA)

- Extend the address field range by reserving the first transmitted bit of the address field octets to indicate the final octet of the address field.
- The presence of a 1 in the first bit of an address field octet signals that it is the final octet of the address field.
- The double octet address field for LAPD operation has bit 1 of the first octet set to a 0 and bit 1 of the second address octet set to 1.

4.3.3.2 Command Response field bit (C/R)

- The C/R bit identifies a frame as either a command or a response.
- The user side sends commands with the C/R bit set to 0, and responses with the C/R bit set to 1.
- The network side does the opposite; that is, commands are sent with C/R set to 1, and responses are sent with C/R set to 0.
- The combinations for the network side and user side are shown in Table 6, “C/R Field Bit usage”.

Table 6 C/R Field Bit usage

Command/response	direction	C/R value
command	network to user	1
	user to network	0
response	network to user	0
	user to network	1

4.3.3.3 Service Access Point Identifier (SAPI)

- The SAPI identifies a point at which data link layer services are provided by a data link layer entity to a layer 3 or management entity.
- Consequently, the SAPI specifies a data link layer entity that should process a data link layer frame, and a layer 3 or management entity, that is, to receive information carried by the data link layer frame.
- The SAPI allows 64 service access points to be specified, where bit 3 of the address field octet containing the SAPI is the least significant binary digit,

and bit 8 is the most significant. The SAPI values are allocated as shown in Table 7, “SAPI values”.

Table 7 SAPI values

SAPI Value	Related Layer 3 or Management Entity
0	Call control procedures
1	reserved for packet mode communication protocols using Q930/931 call control procedures (*not applicable for this specification*)
16	Packet communication conforming to X.25 Level 3 procedures
17	Terminal loopback SAPI
63	Layer 2 management procedures
	All others Reserved for future standardization

4.3.3.3.1 Terminal Loopback SAPI

- A terminal loopback capability is provided using SAPI 17.
- This loopback is implemented in the network. The network recognizes the SAPI 17 frame, and sends it back to the same loop.
- Other than this specification, terminals implementing SAPI 17 do not require any additional layer 2 protocol elements.
- This capability could be used, for example, for testing terminals or for communicating between terminals (that is, intra-loop signaling).

4.3.3.4 Terminal End-point Identifier (TEI)

- The TEI for a point-to-point data link connection may be associated with a single Terminal Equipment (TE).
- A TE may contain one or more point-to-point TEIs.
- The TEI for a broadcast data link connection is associated with all user-side data link layer entities containing the same SAPI.
- The TEI subfield allows 128 values, where bit 2 of the address field octet containing the TEI is the least significant binary digit, and bit 8 is the most significant binary digit.

The following conventions apply in the assignment of these values:

- TEI for Broadcast Data Link connection - The TEI subfield bit pattern 111 1111 (=127) is defined as the group TEI. The group TEI is assigned to the broadcast data link connection associated with the addressed Service Access Point (SAP).
- TEI For Point-to-Point Data Link connection - The remaining TEI values are used for the point-to-point data link connections associated with the

addressed SAP. The range of TEI values are allocated as shown inTable 8, “TEIs and ranges”.

Table 8 TEIs and ranges

	Dynamic TEIs		Static TEIs
	User-Assigned	**Network-Assigned**	
Range	0-63	64-126	0-63
User Type	Non-automatic TEI assignment user equipment	Automatic TEI assignment user equipment	Non-automatic TEI assignment user equipment

- Dynamic TEIs are either network assigned with TEI values in the range 64-126, or user-assigned with TEI values in the range 0-63.
- Network assigned dynamic TEIs are selected by the Network, and their allocation is the responsibility of the network. For terminals to use network assigned dynamic TEIs, such terminals must support the automatic assignment procedure described in Section 4.5.3.2, "TEI assignment procedure", on page 89.
- User assigned dynamic TEIs are selected by the user, and their allocation is the responsibility of the user.
- Static TEIs are assigned by the network administration at service subscription time, with values in the range 0-63.
- Terminal equipment that uses either user-assigned dynamic TEIs or static TEIs do not use the automatic TEI assignment procedure.

4.3.3.4.1 Supported TEI Assignment

The currently-supported TEI assignment options is supported for the different terminal types as shown in Table 9, “Allowable assignments of TEI to terminal types”. This feature does not change TEI assignment to a D-channel packet terminal.

Table 9 Allowable assignments of TEI to terminal types

	2 B-channel FIT	**NIT**	**D-packet**
Automatic Network-Assigned TEI TSP subscription to this TEI assignment procedure enables terminals to request a TEI from the network. TEI assigned by this method are in the range 64-126	Yes	No	No
Automatic User -Assigned TEI TSP subscription to this TEI assignment procedure enables terminals to select their own TEI value in the range 0-63.	Yes	No	No
User or Network Assigned TEI This TSP subscription option enables terminals to establish a TEI through either the Network assigned or User assigned procedures.	Yes	Yes	No
Static Assigned TEI This TSP subscription option provisions a TEI value in the range 0-63 against the TSP. Terminals must use the provisioned value to gain service access.	No	No	Yes

4.3.4 Control field formats

The control field identifies the type of frame, either a command or response. It contains sequence numbers where applicable.

Three types of control field formats are specified:

1 numbered information transfer (I format)

2 supervisory function (S format)

3 unnumbered information transfers and control functions (U format).

The control field formats are shown in Table 10, " Control field formats”.

Table 10 Control field formats

<table>
<tr><th colspan="8">Bits</th><th rowspan="2">Control field bits (Modulo 128)</th><th rowspan="2">Octet
#</th></tr>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th></tr>
<tr><td colspan="7">N (S) Transmitter send sequence number</td><td>0</td><td rowspan="2">I Format</td><td>4</td></tr>
<tr><td colspan="7">N(R) Transmitter receive sequence number</td><td>P</td><td>5</td></tr>
<tr><td>X</td><td>X</td><td>X</td><td>X</td><td>S</td><td>S</td><td>0</td><td>1</td><td rowspan="3">S Format</td><td rowspan="2">4</td></tr>
<tr><td colspan="4">X = Reserved and set to 0</td><td colspan="2">Supervisory function bit</td><td></td><td></td></tr>
<tr><td colspan="7">N(R) Transmitter receive sequence number</td><td>P/F</td><td>5</td></tr>
<tr><td>M</td><td>M</td><td>M</td><td>P/F</td><td>M</td><td>M</td><td>1</td><td>1</td><td>U Format</td><td rowspan="2">4</td></tr>
<tr><td colspan="3">M = Modifier Function bit</td><td colspan="6">P/F = Poll bit when issued as a command, final bit when issued as a response.</td></tr>
</table>

4.3.4.1 Information Transfer (I) format

- Use the I format to perform an information transfer between layer 3 entities.
- The functions of N(S), N(R) and P (Section 4.3.5, “Control Field parameters and associated state variables”) are independent; that is, each I frame has:
  - — an N(S) sequence number
  - — N(R) sequence number that may or may not acknowledge additional I frames received by the data link layer entity
  - — a P bit that may be set to 0 or 1.
- The use of N(S), N(R) and P is defined in Table 4.5, "Definition of the Peer-to-Peer procedures,” on page 86.

4.3.4.2 Supervisory (S) format

Use the S format to perform data link supervisory control functions such as:

- acknowledge I frames
- request retransmission of I frames

- request a temporary suspension of transmission of I frames.

The functions of N(R) and P/F are independent, that is, each supervisory frame has an N(R) sequence number that may or may not acknowledge additional I frames received by the data link layer entity, and a P/F bit that may be set to 0 or 1.

4.3.4.3 Unnumbered (U) format

- Use the U format to provide additional data link control functions and unnumbered information transfers for unacknowledged information transfer.
- It does not contain sequence numbers.
- It includes a P/F bit that may be set to 0 or 1.
- The unnumbered frames have a control field length of 1 octet.

4.3.5 Control Field parameters and associated state variables

The various parameters associated with the control field formats are described in this section. The coding of the bits within these parameters is such that the lowest numbered bit within the parameter field is the least significant bit.

4.3.5.1 Poll/Final bit

- All frames contain the Poll/Final (P/F) bit. The P/F bit serves a function in both command frames and response frames.
- In command frames the P/F bit is referred to as the P bit.
- In response frames it is referred to as the F bit.
- A data link layer entity uses the P bit set to 1 to solicit (poll) a response frame from the peer data link layer entity.
- A data link layer entity uses the F bit set to 1 to indicate the response frame transmitted as a result of a soliciting (poll) command.

The use of the P/F bit is described in Section 4.2, "Frame structure for Peer-to-Peer communication", on page 61.

4.3.5.2 Multiple frame operation - variables and sequence numbers

- Modulus - Each I frame is sequentially numbered and may have a value 0 through (modulus-1). The modulus is 128, and the sequence numbers cycle through the entire range, 0-127.

  Note: All arithmetic operations on state variables and sequence numbers contained in this specification are affected by the modulus operation.

- Send State variable V(S) - Each point-to-point data link connection endpoint has an associated V(S) when using I frame commands.
  - The send state variable denotes the sequence number of the next in-sequence I frame to be transmitted.
  - The V(S) can take on the value 0 through (modulus-1).

- — The value of the V(S) is incremented by 1 with each successive I frame transmission, and shall not exceed V(A) by more than the maximum number of outstanding I frames, k.
- — The value k may be in the range of $1 \leq k \leq 127$.

- Acknowledge State Variables V(A) - Each point-to-point data link connection endpoint has an associated V(A) when using I frame commands and supervisory frame commands/responses.
  - — The V(A) identifies the last frame acknowledged by its peer, (V(A) - 1 equals the N(S) of last acknowledged I frame).
  - — The V(A) can take on the value 0 through (modulus-1).
  - — Update the value of V(A) by the valid N(R) values received from its peer, see Table 10, "Control field formats," on page 70.
  - — A valid N(R) value is in the range $V(A) \leq N(R) \leq V(S)$.
- Send Sequence Number N(S) - Only I frames contain N(S), the send sequence number of transmitted I frames. At the time that an in-sequence I frame is designated for transmission, the value of N(S) is set equal to V(S).
- Receive State Variable V(R) - Each point-to-point data link connection endpoint has an associated V(R) when using I frame commands and supervisory frame commands/responses.
  - — V(R) denotes the sequence number of the next in-sequence I frame expected to be received.
  - — The V(R) can take on the value 0 through (modulus-1).
  - — Upon receipt of an error-free, increment the value of V(R) by one, in-sequence I frame whose N(S) equals the V(R).
- Receive Sequence Number N(R) - All I and supervisory frames contain N(R), the expected send sequence number of the next received I frame.
  - — When a frame of the above types is designated for transmission, the value N(R) is set equal to V(R).
  - — N(R) indicates that the data link layer entity transmitting the N(R) has correctly received all I frames numbered up to and including N(R) - 1.
- Unacknowledged operation variables and parameters - No variables are defined. One parameter is defined in Section 4.5.8.1, "Timer T200", on page 115, its default value is 260 octets.).

4.3.6 Frame types commands and responses

The commands and responses explained below are used by either the user or the network data link layer entities, and are represented in Table 11, “Commands and responses, Connection Management application”, and Table 12, "Commands and responses-unacknowledged and multiple frame acknowledged information transfer applications,” on page 74. Each data link connection supports the full set of commands and responses for each application implemented.

Discard frame types associated with an application not implemented, and take no action as a result of that frame.

For purposes of the LAPD procedures in each application, those encodings not identified in Table 11, “Commands and responses, Connection Management application” or Table 12, "Commands and responses-unacknowledged and multiple frame acknowledged information transfer applications,” on page 74 are identified as undefined command and response control fields. The actions to be taken are specified in Section 4.5.7.5, "Frame rejection condition", on page 113.

The commands and responses in Table 11, “Commands and responses, Connection Management application”, are defined in the following sections:

4.3.6.1 Information (I) command

The Information (I) command transfers sequentially-numbered frames containing information fields provided by layer 3 across a data link connection. It is used in the multiple-frame operation on point-to-point data link connections.

Table 11 Commands and responses, Connection Management application

Encoding								Format	Commands	Responses	Octet
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**				
1	0	1	p/f	1	1	1	1	U = unnum bered	XID (Exchange ID)	XID (Exchange ID)	4
									Note The XID frame is not applicable for this specification		

Table 12 Commands and responses-unacknowledged and multiple frame acknowledged information transfer applications

Format	Commands	Responses	Bits (Encoding								Octet #
			8	7	6	5	4	3	2	1	
I (Information Transfer)	Information		N (S)							0	4
			N (R)							P	5
S (Supervisory)	RR (Receiver Ready)	RR (Receiver Ready)	0	0	0	0	0	0	0	1	4
			N (R)							P/F	5
	RNR (Receiver Not Ready)	RNR (Receiver Not Ready)	0	0	0	0	0	1	0	1	4
			N (R)							P/F	5
	REJ (Reject)	REJ (Reject)	0	0	0	0	1	0	0	1	4
			N (R)							P/F	5
U (Unnumbered)	SABME (set asynchronous balance mode extended)		0	1	1	P	1	1	1	1	4
	UI (unnumbered Information)		0	0	0	P	0	0	1	1	4
		DM (Disconnect Mode)	0	0	0	F	1	1	1	1	4
	DISC (Disconnect)		0	1	0	P	0	0	1	1	4
		UA (Unnumbered ACK)	0	1	1	F	0	0	1	1	4
		FRMR (frame reject)	1	0	0	F	0	1	1	1	4

4.3.6.2 Set Asynchronous Balanced Mode Extended (SABME) command

The SABME unnumbered command places the addressed user side or network side into modulo 128 multiple frame acknowledged operation.

- No information field is permitted with the SABME command.
  - — A data link layer entity confirms acceptance of a SABME command by the transmission at the first opportunity of a UA or DM response.
  - — Upon acceptance of this command, clear (set to zero) the data link layer entity's V(S), V(A), and V(R).
  - — The transmission of an SABME command indicates the clearance of all exception conditions.
- Previously-transmitted I frames unacknowledged when this command is processed remain unacknowledged, and are discarded.
- It is the responsibility of a higher level (for example, layer 3) or the management entity, to recover from the possible loss of the contents of such I frames.

4.3.6.3 Disconnect (DISC) command

The DISC unnumbered command terminates the multiple frame operation.

- No information field is permitted with the DISC command.
  - — The data link layer entity receiving the DISC confirms its the acceptance by the transmission of a UA response.
  - — The data link layer entity sending the DISC command terminates the multiple frame operation when it receives the acknowledging UA or DM response.
- Previously-transmitted I frames unacknowledged when this command is processed, remain unacknowledged.
- It is the responsibility of a higher level (for example, layer 3), or the management entity, to recover from the loss of the contents of such I frames.

4.3.6.4 Unnumbered Information (UI) command

When a layer 3 or management entity requests unacknowledged information transfer, the UI command sends a INFOrmation to its peer without affecting data link layer variables. UI command frames do not carry a sequence number, and therefore, the UI frame may be lost without notification.

4.3.6.5 Receive Ready (RR) command/response

The RR supervisory frame is used by a data link layer entity to:

- indicate it is ready to receive an I frame
- acknowledge previously received I frames numbered up to and including N(R) - 1, see Section 4.5, “Definition of the Peer-to-Peer procedures”
- clear a busy condition indicated by the earlier transmission of an RNR frame by that same data link layer entity

In addition to indicating the status of a data link layer entity, with the P bit set to 1, the data link layer entity may use this command to request the status of its peer data link layer entity.

4.3.6.6 Reject (REJ) command/response

The REJ supervisory frame is used by a data link layer entity to request retransmission of I frames starting with the frame numbered N(R).

- The value of N(R) in the REJ frame acknowledges I frames numbered up to and including N(R) - 1.
- Transmit new I frames pending initial transmission following the re-transmitted I frame(s).
- Only one REJ exception condition for a given direction of information transfer is established at a time.
- The REJ exception condition is cleared (reset) upon the receipt of an I frame with an N(S) equal to the N(R) of the REJ frame.
- An optional procedure for the re-transmission of a REJ response frame is described in Section 4.6, "Re-transmission of REJ response frames", on page 118; however, this optional procedure is not applicable for this specification.
- The transmission of a REJ frame also indicates the clearance of any busy condition within the sending data link layer entity reported by the earlier transmission of an RNR frame by that same data link layer entity.
- In addition to indicating the status of a data link layer entity, the REJ command, with the P bit set to 1, may be used by the data link layer entity to ask for the status of its peer data link layer entity.

4.3.6.7 Receive Not Ready (RNR) command/response

The RNR supervisory frame is used by a data link layer entity to indicate a busy condition, that is, a temporary inability to accept additional incoming I frames.

- The value of N(R) in the RNR frame acknowledges I frames numbered up to and including N(R) - 1.
- In addition to indicating the status of a data link layer entity, the RNR command, with the P bit set to 1, may be used by the data link layer entity to ask for the status of its peer data link layer entity.

4.3.6.8 Unnumbered Acknowledgment (UA) response

- The UA unnumbered response is used by a data link layer entity to acknowledge the receipt and acceptance of the mode-setting commands (SABME or DISC).
- Received mode-setting commands are not processed until the UA response is transmitted.
- The response can have no information field.
- Transmission of the response indicates the clearance of any busy condition reported by the earlier transmission of an RNR frame by that same data link layer entity.

4.3.6.9 Disconnected Mode (DM) response

The DM unnumbered response is used by a data link layer entity to report to its peer that the data link layer is in a state such that multiple frame operation can not be performed. No information field is permitted with the DM response.

4.3.6.10 Frame Reject (FRMR) response

- The FRMR unnumbered response may be received by a data link layer entity as a report of an error condition not recoverable by re-transmission of the identical frame, that is, at least one of the following error conditions, resulting from the receipt of a valid frame. The receipt of:
  - — a command or response control field that is undefined or not implemented
  - — a supervisory or unnumbered frame with incorrect length
  - — an invalid N(R)
  - — a frame with an information field exceeding the maximum established length.
- An undefined control field is any of the control field encodings not identified in Table 11, “Commands and responses, Connection Management application”, or Table 12, “Commands and responses-unacknowledged and multiple frame acknowledged information transfer applications”.
- A valid N(R) value is one that is in the range V(A) ≤ N(R) ≤ V(S).
- An information field that immediately follows the control field and consists of five octets, is returned with this response, and provides the reason for the FRMR response.

The information field format is shown in Table 13, “FRMR Information Field format extended (Modulo 128) operation”.

Table 13 FRMR Information Field format extended (Modulo 128) operation

8	7	6	5	4	3	2	1	Octet
Rejected frame								5
Control field								6
V (S)							0	7
V (R)							C/R	8
0	0	0	0	Z	Y	X	W	9

- Rejected frame control field - the control field of the received frame that caused the frame reject. When the rejected frame is an unnumbered frame, the control field of the rejected frame is positioned in octet 5, with octet 6 set to 0000 0000.

- V(S) - the current send state variable value on the user or network side reporting the rejection condition.
- C/R - set to 1 if the frame rejected was a response, or to 0 if the frame rejected was a command.
- V(R) - the current receive state variable value on the user or network side reporting the rejection condition.
- W set to 1 - indicates that the control field received and returned in octets 5 and 6 was either undefined or not implemented.
- X set to 1 - indicates that the control field received and returned in octets 5 and 6 was considered invalid because either:
  — the frame contained an information field not permitted with this frame or is a supervisory
  — unnumbered frame with incorrect length. Bit W must be set to 1 in conjunction with this bit.
- Y set to 1 - indicates that the information field received exceeded the maximum established information field length (N201) of the user or network side reporting the rejection condition.
- Z set to 1 - indicates that the control field received and returned in octets 5 and 6 contained an invalid N(R).
- Set octet 7 bit 1, and octet 9 bits 5 through 8, to 0.

4.3.6.11 Exchange Identification (XID) command/response

- The XID frame may contain an information field in which the identification information is conveyed.
- The exchange of XID frames is a compelled arrangement used in connection management (that is, when a peer entity receives an XID command, it responds with an XID response at the earliest time possible).
- The control file contains no sequence numbers.
- The information field is not mandatory.
  - — However, if a valid XID command contains an information field, and the receiver can interpret its contents, it should respond with an XID response also containing an information field
  - — If the information field can not be interpreted by the receiving entity, or a zero length information field was received, an XID response frame is issued containing a zero length information field.
  - — The information field’ s length must conform to the value N201.
- Sending or receiving an XID frame has no effect on the operational mode or state variables associated with the data link layer entities.

4.4 Elements for layer-to-layer communication

4.4.1 General

Communications between layers and between the data link layer and the management entity, are accomplished by means of primitives. They represent, in an abstract way, the logical exchange of information and control between the data link and adjacent layers. They do not specify or constrain implementations.

Primitives consist of commands and their respective responses associated with the services requested of a lower layer. The general syntax of a primitive is:

- XX - Generic name - Type: Parameters

  where XX designates the interface across that the primitive flows. For this document XX is either:

  — DL for communication between layer 3 and the data link layer

  — PH for communication between the data link layer and the physical layer

  — MDL for communication between the management entity and the data link layer

  — MPH for communication between the management entity and the physical layer

4.4.1.1 Generic names

The generic name specifies the activity to be performed. Figure 11, “Primitives associated with layer 2”, illustrates the primitives defined in this document. Note that not all primitives have associated parameters.

The primitive generic names, and their purpose, as defined in this document, are:

- DL-ESTABLISH - requests, indicates, and confirms the outcome of the procedures for establishing multiple frame operation.
- DL-RELEASE - requests, indicates, and confirms the outcome of the procedures for terminating a previously established multiple frame operation, or for reporting an unsuccessful establishment attempt.
- DL-DAT - requests and indicates layer 3 messages to be transmitted, or that have been received by the data link layer, using the acknowledged information transfer service.
- DL-UNIT DATA - requests and indicates layer 3 messages to be transmitted, or that have been received, by the data link layer using unacknowledged information transfer service.
- MDL-ASSIGN - used by the layer management entity to request that the data link layer associate the TEI value contained within the message portion of the primitive, with the specified Connection Endpoint Suffix (CES, as defined in Table 8, “TEIs and ranges”), across all SAPIs.

- MDL-ASSIGN - used by the data link layer to indicate to the layer management entity, the need to associate a TEI value with the CES specified in the primitive message unit.
- MDL-REMOVE - used by the layer management entity to request that the data link layer remove the association of the specified TEI value with the specified (CES), across all SAPIs. The TEI and CES are specified by the MDL-REMOVE primitive message unit.
- MDL-ERROR - indicates to the connection management entity that an error has occurred, that can not be corrected by the data link layer. The error is either associated with a previous management function request, or detected as a result of communication with the data link layer peer entity. The layer management entity may respond with an MDL-ERROR primitive, if the layer management entity can not obtain a TEI value.
- MDL-UNIT DATA - requests and indicates layer management messages to be transmitted, or have been received by the data link layer, using unacknowledged information transfer service.
- MDL-XID - used by the connection management entity to request, indicate, respond, and confirm the outcome of the actions for the use of the XID procedures.
- PH-DATA - requests and indicates message units containing frames used for data link layer peer-to-peer communications passed to and from the physical layer.
- PH-ACTIVATE -either requests activation of the physical layer connection, or indicates that it has been activated.
- PH-DEACTIVATE - indicates deactivation of the physical layer connection.
- MPH-ACTIVATE - indicates activation of the physical layer connection
- MPH-DEACTIVATE - requests deactivation of the physical layer connection, or indicates its deactivation. The REQUEST is for use by the network side system management.
- MPH-INFORMATION - used by the user side management entity, provides an indication as to whether the terminal is either:
  - connected
  - disconnected
  - unable to provide sufficient power to support the TEI management procedures.

4.4.1.2 Primitive types

The primitive types defined are:

- REQUEST - used when a higher layer or a management entity is requesting a service from the lower layer.
- INDICATION - used by a layer providing a service to inform the higher layer or layer management.

- RESPONSE - used by layer management as a consequence of the INDICATION primitive type.
- CONFIRM - used by the layer providing the requested service to confirm that the activity has been completed.

4.4.1.3 Parameter definition

- Priority indicator - Since several SAPs may exist on the network or user side, protocol message units sent by one SAP may contend with those of other service access points for the physical resources available for message transfer. The priority indicator determines which message unit has greater priority when contention exists. It is needed only at the user side to distinguish message units with a SAPI value of 0 sent by the SAP, from all other message units.
- Message unit - contains additional layer-to-layer information concerning actions and results associated with requests. In the case of the DATA primitives, it contains the requesting layer peer-to-peer messages. For example, the DL-DATA message unit contains layer 3 information. The PH-DATA message unit contains the data link frame.

Note: The operations across the data link layer/layer 3 boundary is such that the layer sending the DL-DATA or DL-UNIT DATA primitive can assume a temporal order of the bits within the message unit and that the layer receiving the primitive can reconstruct the message with its assumed temporal order.

Figure 11 Primitives associated with layer 2

Generic name	TYPE Req	Ind	Rsp	Cnf	PARAMETERS Pri	Msg	Message Unit Contents
L3 - L2							
DL-ESTABLISH	X	X	-	X	-	-	
DL-RELEASE	X	X	-	X	-	-	
DL-DATA	X	X	-	-	-	X	Layer 3 peer-to-peer message
DL-UNITDATA	X	X	-	-	-	X	Layer 3 peer-to-peer message
M - L2							
MDL-ASSIGN	X	X	-	-	-	X	TEI value, CES
MDL-REMOVE	X	-	-	-	-	X	TEI value, CES
MDL-ERROR	-	X	X	-	-	X	Reason for error
MDL-UNITDATA	X	X	-	-	-	X	Mgmt. function peer-to-peer message
MDL-XID	X	X	X	X	-	X	Connection mgmt. information
L2 - L1							
PH-DATA	X	X	-	-	X	X	Datalink layer peer-to-peer message
PH-ACTIVATE	X	X	-	-	-	-	
PH-DEACTIVATE	-	X	-	-	-	-	
M - L1							
MPH-ACTIVATE	-	X	-	X	-	-	
MPH-DEACTIVATE	X	X	-	-	-	-	
MPH-INFO.	-	X	-	-	-	X	Connected or Disconnected

L3 - L2: layer 3/data link layer boundary
L2 - L1: Data link layer/physical layer boundary
M - L2: Management entity/data link layer boundary
M - L1: Management entity/physical layer boundary
Req = Request Rsp = Response Pri = Priority Indicator
Ind = Indication Cnf = Confirm Msg = Message unit

4.4.2 Primitive procedures

4.4.2.1 General

Primitive procedures specify the interactions between adjacent layers to invoke and provide a service. The elements of the procedures are the service primitives.

The interactions between layer 3 and the data link layer are specified here.

4.4.2.2 Layer 3 - Data Link Layer interactions

Derive the states of a data link connection endpoint from the internal states of the data link layer entity supporting this type of a data link connection.

Data link connection endpoint states are defined as follows:

- Broadcast data link connection endpoint
  - — INFORMATION TRANSFER
- Point-to-point data link connection endpoint
  - — LINK CONNECTION RELEASED
  - — AWAITING ESTABLISH
  - — AWAITING RELEASE
  - — LINK CONNECTION ESTABLISHED

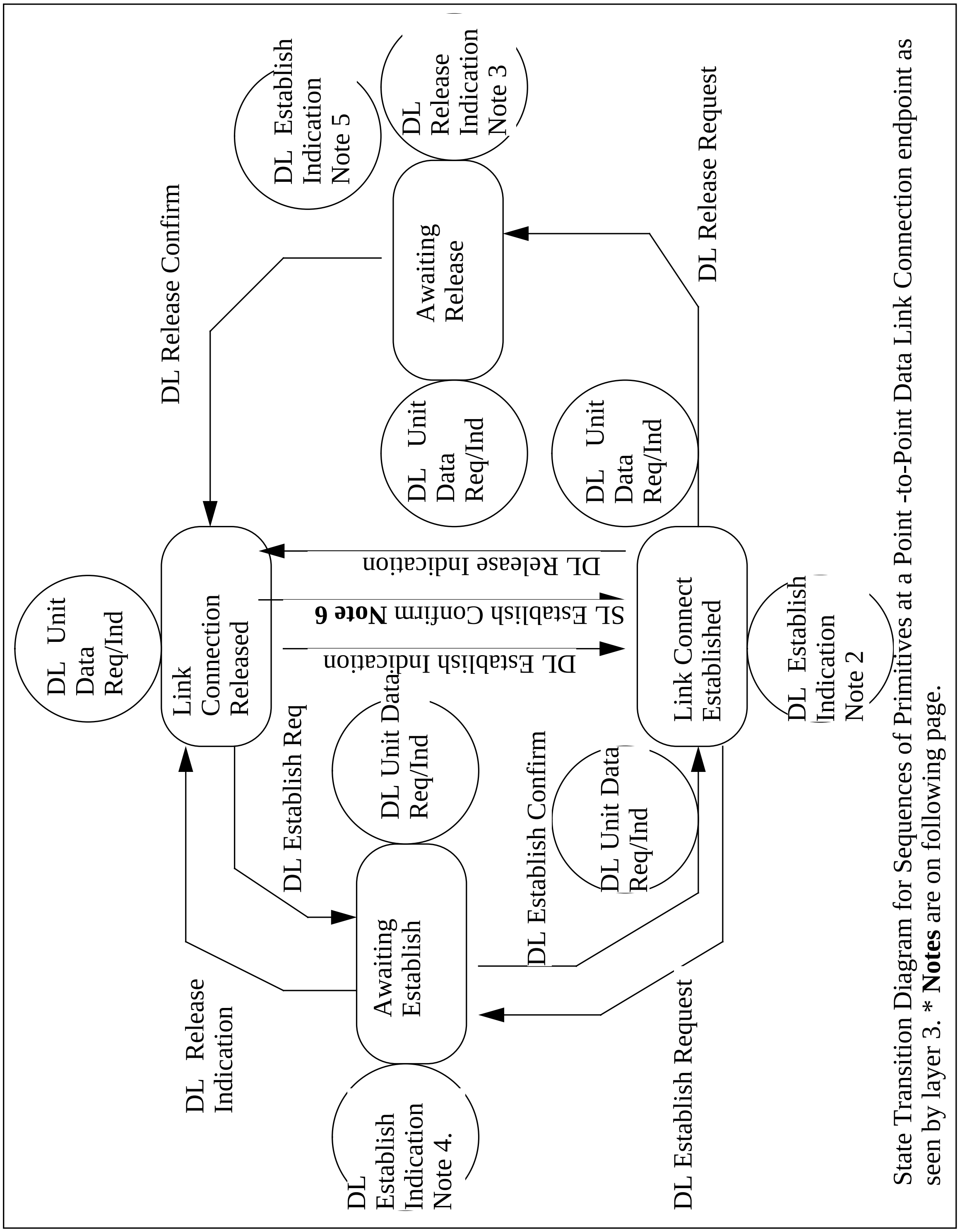
The primitives provide the procedural means to specify conceptually how a data link service user can invoke a service.

The constraints on the sequences in which the primitives may occur are defined here. The sequences are related to the states at one point-to-point data link connection endpoint. The possible overall sequences of primitives at a point-to-point data link connection endpoint are defined in the state transition model diagram, Figure 12, “State transition diagram for sequences of primitives”.

- The LINK CONNECTION RELEASED and LINK CONNECTION ESTABLISHED states are stable states.
- The AWAITING ESTABLISH and AWAITING RELEASE states are transition states.

The model illustrates the behavior of layer 2 as seen by layer 3. It assumes that the primitives passed between layers is implemented by a first-in first-out queue. In this model, “collisions” of REQUEST and INDICATION primitives can occur, illustrating actions that seem to be in conflict with the actual layer 2 protocol description. In some implementations these “collisions” could occur.

Figure 12 State transition diagram for sequences of primitives



Note: 1 If the data link layer entity issues a DL-ESTABLISH-INDICATION (this applies to the case of data link layer initiated or peer system initiated re-establishment), DL-RELEASE-CONFIRM or DL-RELEASE-INDICATION, it indicates the discard of all the data link service data units representing DL-DATA-REQUESTs.

Note: 2 Notifies layer 3 of link re-establishment.

Note: 3 Occurs if a DL-RELEASE-REQUEST collides with a DL-RELEASE-INDICATION.

Note: 4 Occurs if a DL-ESTABLISH-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note: 5 Occurs if a DL-RELEASE-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note: 6 Occurs if a DL-ESTABLISH-REQUEST (this applies to the case of layer 3 initiated re-establishment) collides with a DL-RELEASE-INDICATION. Since this DL-RELEASE-INDICATION is not related to the DL-ESTABLISH-REQUEST, the data link layer establishes the link and issues a DL-ESTABLISH-CONFIRM.

4.5 Definition of the Peer-to-Peer procedures

The procedures for use by the data link layer are specified in the following sections. The elements of procedure (frame types) that apply are:

- for unacknowledged information transfer Section 4.5.2, “Procedures for unacknowledged information transfer”
  - UI-command
- for multiple frame acknowledged information transfer (see Section 4.5.4, “Procedures for establishment and release of Multiple Frame operation” to Section 4.5.7, “Exception condition reporting and recovery”)
  - SABME-command
  - UA-response
  - DM-response
  - DISC-command
  - RR-command/response
  - RNR-command/response
  - REJ-command/response
  - I-command
  - FRMR-response
- for connection management entity information transfer (XID-command/response).

4.5.1 Procedure for the use of the P/F bit

4.5.1.1 Unacknowledged information transfer

For unacknowledged information transfer, the P/F bit is not used and is set to 0.

4.5.1.2 Acknowledged multiple frame information transfer

A data link layer entity receiving an SABME, DISC, RR, RNR, REJ or I frame with the P bit set to 1, sets the F bit to 1 in the next response frame it transmits as defined in Figure 13, “Immediate response operation of P/F bit”.

Figure 13 Immediate response operation of P/F bit

command received with P bit = 1	response transmitted with F bit = 1
SABME, DISC	UA, DM
I, RR, RNR, REJ	RR, RNR, REJ, (**See Note**)

Note: A LAPB data link layer entity may transmit an FRMR or DM response with the F bit set to 1 in response to an I frame or supervisory command with the P bit set to 1.

4.5.2 Procedures for unacknowledged information transfer

4.5.2.1 General

The procedures that apply to the transmission of information in unacknowledged operation are defined below. No data link layer error recovery procedures are defined for unacknowledged operation.

4.5.2.2 Transmission of unacknowledged information

Note: The term “transmission of a UI frame” refers to the delivery of a UI frame to the physical layer by the data link layer.

- Unacknowledged information is passed to the data link layer by layer 3 or layer management entities, using the primitive DL-UNIT-DATA-REQUEST or MDL-UNIT-DATA-REQUEST, respectively. Transmit the layer 3, or management, message unit in a UI command frame.
- For broadcast operation, set the TEI value in the UI command address field to 127 (binary 111 1111, the group value).
- For point-to-point operation, use the appropriate TEI value.
- Set the P bit to 0.
- In the case of persistent layer 1 deactivation, the data link layer is informed by an appropriate indication. Upon receipt of this indication, discard all UI transmission queues.

Note: The network side system management deactivation procedures should ensure that layer 1 is not deactivated before all UI data transfer is completed.

4.5.2.3 Receipt of unacknowledged information

On receipt of a UI command frame with a SAPI and TEI, supported by the receiver, pass the contents of the information field to the layer 3 or management entity using either the data link layer-to-layer 3 primitive DL-UNIT-DATA-INDICATION, or the data link layer-to-management primitive MDL-UNIT-DATA-INDICATION, respectively. Otherwise, discard the UI command frame.

4.5.3 Terminal Endpoint Identifier (TEI) management procedures

4.5.3.1 General

TEI management is based on the following procedural means:

- TEI Assignment procedures (see Section 4.5.3.2, “TEI assignment procedure”)
- TEI Check procedures (see Section 4.5.3.3, “TEI Check procedure”)
- TEI Removal procedures (see Section 4.5.3.4, “TEI Removal procedure”)
- optional user equipment initiated TEI Identity Verify procedures (see Section 4.5.3.5, “TEI Identity Verify procedure”).

Note: Regardless of the assignment procedures used, terminals must support the TEI check and TEI removal procedures.

A user equipment in the TEI-unassigned state uses the TEI assignment procedures to enter the TEI-assigned state. Conceptually, these procedures exist in the layer management entity. The layer management entity on the network side is referred to as the Assignment Source Point (ASP).

The purpose of these procedures is to:

- allow automatic TEI equipment to ask the network to assign a TEI value the data link entities within the requesting user equipment will use in their subsequent communications
- allow a network to remove a previously assigned TEI value from specific, or all user equipments
- allow a network to check, whether:
  - — or not a TEI value is in use
  - — multiple TEI assignment has occurred
- allow user equipment the option to request that the network invoke TEI check procedures.

When it is notified that the terminal is disconnected at the interface, the user side layer management entity instructs the user data link layer entities to remove all its associated TEI values (as defined in Recommendation I.430).

Additionally, it should instruct the user to remove a TEI value for its own internal reasons (for example, losing the ability to communicate with the network). The layer management entity uses the MDL-REMOVE-REQUEST for these purposes.

The information in Section 4.5.3.4.1, “Action taken by the data link layer entity receiving MDL-REMOVE-REQUEST”, includes the actions taken by a data link layer entity receiving a MDL-REMOVE-REQUEST.

- Typically, one TEI value would be used by the user equipment (for example, a data link layer entity that have been assigned a TEI value could use that value for all SAPs that it supports).

- If required, a number of TEI values may be requested by multiple use of the procedures defined in Section 4.5.3.2, “TEI assignment procedure”.
- The user must maintain the association between TEI and SAPI values.
- The initiation of TEI assignment procedures occurs on the receipt of a request for establishment or unacknowledged information transfer, while in the TEI-unassigned state.
- The data link layer entity uses the MDL-ASSIGN-INDICATION to inform the layer management entity. Alternatively, the user side layer management entity may initiate the TEI assignment procedures for its own reasons.

  Note: For initialization from a no power condition, the user equipment should postpone the start of the TEI assignment procedure until either an outgoing call or feature is requested, or an incoming call is received.
- For outgoing calls or feature requests, while the terminal is in the TEI unassigned state, the first time the user attempts to initiate an outgoing call or feature request, the terminal management entity should request that the terminal begin the TEI initialization process.
- For incoming calls, while the terminal is in the TEI unassigned state, the terminal should monitor the broadcast data link (TEI 127). Should the user detect any incoming message on the broadcast data link, it should begin the TEI initialization process.
- Dynamic TEIs are either network assigned, (that is, TEI values in the range 64-126), or user-assigned (that is, TEI values in the range 0-63).
- Terminals that use dynamic TEIs must support the terminal identification procedures described in Section 5.4.1.23, "SETUP", on page 162.
- Once the user equipment has successfully completed the TEI assignment procedures and has subsequently established layer 2 multiple frame operation, the terminal should begin the terminal identification process to associate a particular terminal with its service parameters.
- All layer management entity messages used for these TEI management procedures are transmitted to, or received from, the data link layer entity using the MDL-UNIT-DATA-REQUEST, or the MDL-UNIT-DATA-INDICATION, respectively.
- The data link layer entity transmits management entity messages in UI command frames. The SAPI value is 63. The TEI value is 127.

4.5.3.2 TEI assignment procedure

- If the user equipment is of the non-automatic TEI assignment category that is, either:

  — user assigned dynamic TEIs

  — “static” TEIs datafilled in the network at subscription time

  the user side layer management entity uses the MDL-ASSIGN-REQUEST primitive to deliver, to the data link layer, the TEI value-to-be-used entities.
- The remaining subsections on TEI assignment are not applicable for this specification. The user side layer management entity delivers non-

automatic TEI value(s) to its data link layer entity(s) without having to interact with the ASP. That is, the TEI assignment messaging between the user and the network is not required or supported.

Note: 1 The ASP is not assign non-automatic TEI values, that is, TEI values in the range 0-63, in the Identity Assign messages described below.

Note: 2 Whether a TEI value is automatic or non-automatic is known only to the management entity.

Note: 3 Terminals that support D-channel packet service (SAPI 16) must use Static TEIs.

- If the user equipment is of the automatic TEI assignment category, upon initiation of the automatic TEI assignment procedure, the user side layer management entity transmits to its peer, a message containing the following elements:
  - — message type = Identity request
  - — reference number (Ri)
  - — action indicator (Ai)
- Use the reference number Ri to differentiate between a number of user equipments that may simultaneously request assignment of a TEI value.
- The Ri is 2 octets long, and is randomly generated for each request message by the user equipments.
- All values in the range 0-65,535 is available from the random number generator.

Note: The design of the random number generator should minimize the possibility of identical reference numbers being generated by terminals that initiate their TEI assignment procedures simultaneously.

- Use the single octet Ai to indicate a request to the Assignment Source Point (ASP) for the assignment of any TEI value available.
- The coding of the Ai shall be:
  - — Ai = Group address TEI = 127. This Ai value requests the ASP to assign any TEI value.
- Start timer T202.
- Upon receipt of the Identity Request message, the ASP, shall either:
  - — select a TEI value
  - — deny Identity requests with Ai values in the range 64-26, and ignore Identity requests with the Ai value in the range 0-63
  - — ignore the Identity Request message if a previous Identity Request message that contains an identical Ri has been received and no response has been issued. In this case, the ASP shall not assign a TEI value to either request. (Note that this procedure can not guarantee that dual TEI assignments will not occur, due to Identity Request messages having the same Ri value.)

- After selecting the TEI value, the ASP uses the MDL-ASSIGN-REQUEST primitive to inform network data link layer entities, and to transmit to its peer, a message containing the following elements:
  - — message type = Identity assigned
  - — Reference number (Ri)
  - — the assigned TEI value in the Ai field.
- If the available TEI information/resources are exhausted, initiate a TEI check procedure.
- A user side layer management entity receiving this Identity assigned message compares the TEI value in the Ai field to its own TEI value(s) (if any) to see if it is already allocated. If there is a match, the user side layer management entity initiates either:
  - — TEI removal
  - — the TEI Identity verify procedures
- If there is no match, the user side layer management entity:
  - — compares the Ri value with any outstanding Identity request message, and if it matches:
    - – consider the TEI value assigned to the user equipment
    - – discard the value of Ri
    - – use the MDL-ASSIGN-REQUEST primitive to inform the user side data link layer entities
    - – stop timer T202
  - — compares the Ri value with any outstanding Identity request message, and if there is no match, does nothing
  - — If there is no outstanding identity request, does nothing

Note: The ASP may invoke the check procedure to verify that the TEI has been successfully assigned.

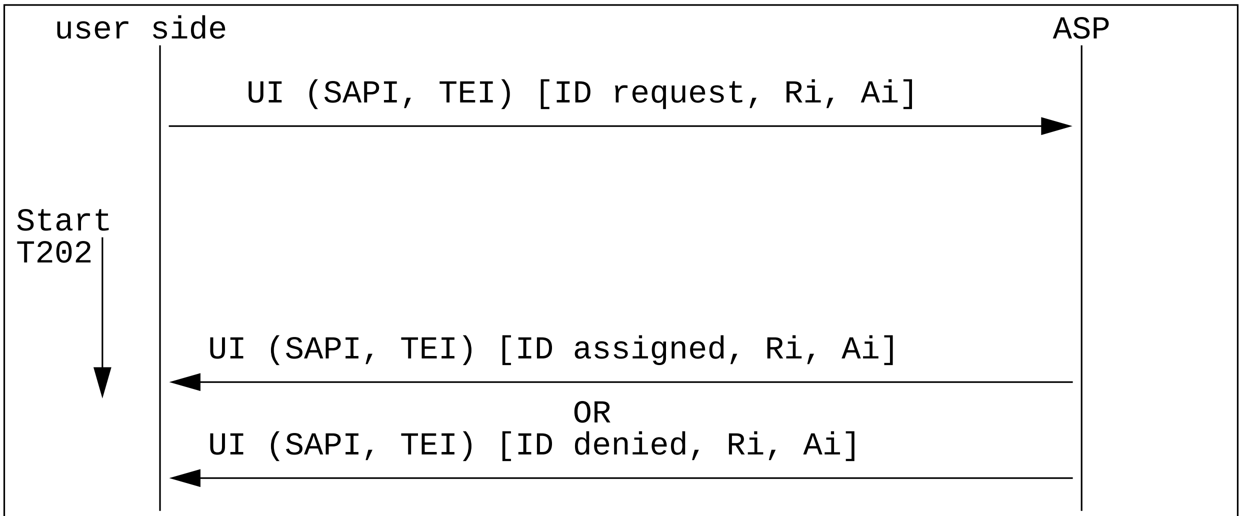
- When the data link layer receives the MDL-ASSIGN-REQUEST from the layer management entity, the data link layer entity:
  - — enters the TEI-assigned state
  - — proceeds with data link establishment procedures if a DL-ESTABLISH-REQUEST is outstanding, or the transmission of a UI command frame if a DL-UNIT-DATA-REQUEST is outstanding.
- To deny an identity request message, the ASP transmits to its peer a message containing the following elements:
  - — message type = Identity denied
  - — Reference number (Ri)
  - — the value of TEI, that is denied in the Ai field (a value of 127 indicates that no TEIs are available).

4.5.3.2.1 Expiry of Timer T202

- If the user receives either no response or an Identity denied message, to its Identity request message, upon expiry of T202, re-start it and re-transmit the Identity request message using a new Ri value.
- After N202 unsuccessful attempts to acquire a TEI value, the layer management entity informs the data link layer entity using the MDL-ERROR-RESPONSE.
- If a request for establishment had previously occurred, the data link layer entity upon receiving MDL-ERROR-RESPONSE:
  - — responds with the DL-RELEASE-INDICATION
  - — discards all un-serviced DL-UNIT DATA-REQUEST
- After N202 unsuccessful attempts, do not restart the TEI assignment procedures until a condition occurs as defined by Section 4.5.3.1, “General” (e.g., outgoing call request). The value of T202 and N202 are specified in Section 4.5.8, "List of system parameters", on page 115.

The TEI assignment procedure is illustrated in Figure 14, “TEI assignment procedure”.

Figure 14 TEI assignment procedure



SAPI : Service access point identifier = 63
TEI : group TEI = 127
ID request : Identity request
ID Assigned : Identity assigned
ID denied : Identity denied
Ai : Action indicator, see: figurer refid=codes..
Ri : Reference number
() : contents of the data link layer command address field
[] : contents of the data link layer command information field

4.5.3.3 TEI Check procedure

The TEI check procedure is not applicable for this specification.

4.5.3.3.1 Use of the TEI check procedure

Use the TEI check procedure in the TEI audit and recovery procedures. It allows the network side layer management entity to either:

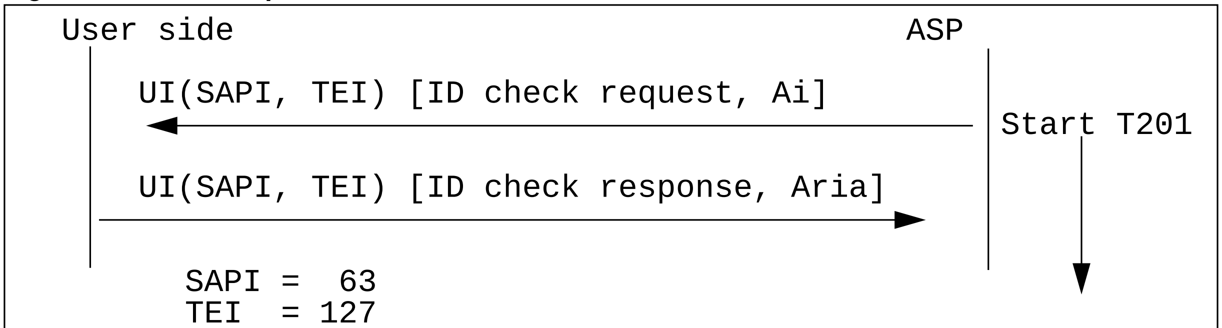
- establish that a TEI value is in use
- verify multiple TEI assignment

The check procedure for verifying multiple-TEI assignment may also optionally be invoked as a response to an Identity verify request message from the user equipment.

4.5.3.3.2 Operation of the TEI check procedure

The check routine procedure is shown in Figure 15, “TEI Check procedure”.

Figure 15 TEI Check procedure



Note: The randomly-generated Ri is present in the Identity check response to ensure that if more than one user equipment happen to commence transmission of the Identity check response at precisely the same time (that is, the first 0 bit of the opening flag coincides), due to different Ri values, a collision at layer 1 occurs (see ISDN user-network interfaces: layer 1 recommendations, 43X series, for clarification). The resolution of this collision results in multiple Identity check responses.

- The ASP transmits a message containing the following elements:
  - — message type = Identity check request
  - — an Ai field containing the TEI value to be checked, or the value 127, to check all TEI values.
- Start the Timer T201.
- If any user equipment is assigned the TEI value specified in the Identity check request message, it responds by transmitting a message containing the following elements:
  - — message type = Identity check response
  - — the TEI value in the Ai field
  - — Reference number (Ri).
- When using the TEI check procedure to verify multiple-TEI assignment:
  - — If more than one identity check response is received within T201, multiple-TEI assignment is considered present; otherwise, repeat the request once, and re-start T201.

- If more than one Identity check response is received within the second T201 period, multiple-TEI assignment is considered present.
- If no Identity check response is received after both T201 periods, the TEI value is assumed to be free, and available for (re)assignment.
- If one Identity check response is received in one or both T201 periods, the TEI value is assumed to be in use.

• When using the TEI check procedure to test whether a TEI value is in use:

- it is completed upon the receipt of the first TEI Identity check response message
- the TEI value is assumed to be in use

• Otherwise, if no Identity check response is received:

- within T201, repeat the Identity check request once and re-start T201
- after the second Identity check request, the TEI value is assumed to be free, and available for assignment.

• If the Ai value in the Identity check request is 127, the receiving user side layer management entity should respond with a single Identity check response message containing all of the TEI values in use within that user equipment

• If:

- an Identity check request with Ai equal to 127 is transmitted, and
- an Identity check response is received making use of the extension facility for parallel Identity check requests,

process each Ai variable in the Ai field as if it were received in separate responses.

4.5.3.4 TEI Removal procedure

Note that the Identity remove message is not applicable for this specification.

• The network or user side may, either, on its own initiative and without transmission, or reception of the Identity remove message, remove a TEI value.

• When the network side layer management entity determines that removal of a value (see Section 4.5.3.4, “TEI Removal procedure”) is necessary, the ASP transmits a message containing the following elements and issues an MDL-REMOVE-REQUEST primitive:

- message type = Identity remove
- value to be removed, as indicated in the Ai field (the value 127 indicates that all user equipments should remove their TEI values; otherwise, remove the specific TEI).

• To overcome possible message loss, send the Identity remove message twice in succession.

• When the user side layer management entity (of both automatic and non-automatic TEI categories) determines that the removal of a TEI value is necessary, it instructs the data link layer entity to enter the TEI-unassigned state, using MDL-REMOVE-REQUEST. This action would also be taken for all TEIs when the Ai field contains the group address (127).

- Further action to be taken is either upon:
  - — initiation of automatic TEI assignment for a new TEI value
  - — notification to the equipment user of the need for corrective action (that is, when equipment uses a non-automatic TEI value, and does not support the automatic TEI assignment procedure).
- Corrective action, in the case of non-automatic TEI values, may be as follows:
  - — the data link layer entity of a non-automatic TEI equipment, may after
    - – taking the action specified in Section 4.5.3.4.1, “Action taken by the data link layer entity receiving MDL-REMOVE-REQUEST”
    - – entering the TEI-unassigned state

  indicate to its layer management entity (through the MDL-ASSIGN-INDICATION) the need for a TEI value.

  - — The layer management entity may then use the MDL-ASSIGN-REQUEST to assign the same previously-removed TEI value.
  - — After removal, the re-assignment of a non-automatic value is equivalent to a release of the data link layer entity.
  - — Thus, in the case of accidental connection of more than 1 terminal with the same non-automatic TEI value, notify equipment users of the error by persistent TEI removals and layer 2 releases.
  - — The procedure depends on equipment users to then take corrective action that is, remove multiple assignment of non-automatic TEI values.
  - — The network may keep a count of such errors and disable the TEI value when an error threshold is reached, in that case, craftsperson intervention is required to restore the TEI value for use.

4.5.3.4.1 Action taken by the data link layer entity receiving MDL-REMOVE-REQUEST

A data link layer entity receiving an MDL-REMOVE-REQUEST shall, either:

- issue a DL-RELEASE-INDICATION primitive, if no DL-RELEASE-REQUEST is outstanding and the user equipment is not in the TEI-assigned state
- issue a DL-RELEASE-CONFIRM, if a DL-RELEASE-REQUEST primitive is outstanding.

The data link layer entity then enters the TEI-unassigned state after discarding the contents of both UI and I queues.

4.5.3.4.2 Conditions for TEI removal

At the user equipment, remove automatic TEI values, and in the case of non-automatic TEI values, make an appropriate indication to the user under either of the following conditions:

- on request from the network by an Identity remove message (not applicable for this specification)
- on receipt of an MPH-INFORMATION-INDICATION (disconnected) (not applicable for this specification)
- on receipt of MDL-ERROR-INDICATION primitive indicating that the data link layer entity has assumed possible multiple assignment of a TEI value, rather than requesting a TEI check routine by the transmission of an Identity verify request message
- optionally, on receipt of an Identity assigned message containing a TEI value in the Ai field already in use within the user equipment (see Figure 14, “TEI assignment procedure”) (not applicable for this specification).

At the network side, remove TEIs on receipt of an MDL-ERROR-INDICATION indicating a possible dual TEI assignment, either:

- following a TEI audit procedure showing that a TEI value is no longer in use or that multiple TEI assignment has occurred
- on receipt of an MDL-ERROR-INDICATION, indicating a possible multiple assignment, that may be confirmed by the invocation of the TEI check procedures.

4.5.3.5 TEI Identity Verify procedure

Not applicable for this specification.

4.5.3.5.1 General

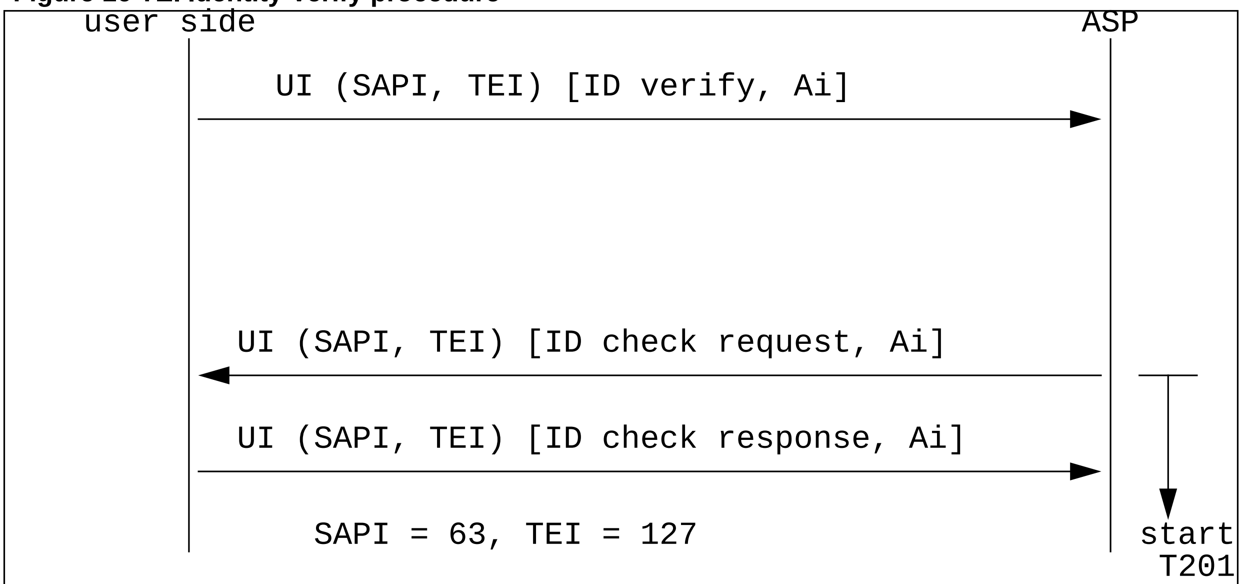
The Identity Verify procedure allows the user-side layer management entity to request that the network invoke the Identity check procedure for verification of multiple-TEI assignment.

This procedure is optional for user equipment. The network supports it for both automatic and non-automatic TEI values.

4.5.3.5.2 Operation of the TEI Identity Verify procedure

The identity verify procedure is illustrated in Figure 16, “TEI Identity Verify procedure”.

Figure 16 TEI Identity Verify procedure



Note: The Ai in the ID verify is in the range 0 to 126.

- The user equipment transmits an Identity verify message containing the following elements:
  — message type = Identity verify request
  — the TEI value to be checked in the Ai field; the Ri field is not processed by the network and is coded 0.
- If implemented, on receipt of the Identity verify message, the ASP invokes the TEI check procedure as defined in Section 4.5.3.3, “TEI Check procedure”.
- This results in the ASP sending an Identity check request message to the user equipment.

4.5.3.6 Formats and codes

Formats and codes are not applicable for this specification as these messages are not supported.

4.5.3.6.1 General

- All messages used for TEI management procedures are carried in the information field of UI command frames with:
  - — a SAPI value set to 63 (binary 11 1111)
  - — a TEI value set to 127 (binary 111 1111)

Table 14 Layer Management entity identifier

Bits								Octet
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**#**
Layer Management Entry Identifier								1
Reference Number								2
								3
Message Type								4
Action Indicator							E	5

- Code fields not used in a specific message to zeroes; they are not to be processed by either side.
- The coding of each field for the various messages is specified in Figure 17, “Codes for messages concerning TEI Management procedures”.
- E is the Action indication field extension bit (see Section 4.5.3.7, “Layer Management Entity identifier”).

Figure 17 Codes for messages concerning TEI Management procedures

Message name	Management entity Identifier	Reference number Ri	Message type	Action indicator Ai
Identity Request (u-n)	0000 1111	0 - 65535	0000 0001	Ai=127,i.e. any TEI value acceptable
Identity assigned (n-u)	0000 1111	0 - 65535	0000 0010	Ai= 64-126, assigned TEI value
Identity denied (n-u)	0000 1111	0 - 65535	0000 0011	Ai= 64-126, denied TEI value Ai= 127, no TEI value available
Identity Check Request (n-u)	0000 1111	not used (coded 0)	0000 0100	Ai= 127,check all TEI values Ai= 0 - 126,TEI value to be checked
Identity Check Response (u-n)	0000 1111	0 - 65535	0000 0101	Ai= 0-126,TEI value in use
Identity Remove (n-u)	0000 1111	not used (coded 0)	0000 0110	Ai= 127, Remove all TEI values Ai= 0-126, TEI value to be removed
Identity Verify (u-n)	0000 1111	not used (coded 0)	0000 0111	Ai= 0-126, TEI value to be checked

(n-u) Network to user

(u-n) User to network

Note: These messages are not applicable for this specification.

4.5.3.7 Layer Management Entity identifier

For TEI administration procedures, the layer management entity identifier octet is coded 0000 1111.

- Ri - octets 2 and 3 contain the Ri. When used, it can assume any value between 0-65,535.
- Message Type - octet 4 contains the message type, whose purpose is to identify the function of the message being sent.
- Ai - the Ai field is extended by reserving the first transmitted bit of the field octets to indicate its final octet.

  Code the Ai variables in the field as follows:

  — bit 1 is the extension bit, and is coded as

  – 0 to indicate an extension

  – 1 to indicate the final octet

  — bits 2-8 contain the action indicator, that identifies the concerned TEI values.
- Automatic negotiation of data link layer parameters - this procedure is defined in Section 4.8.4, "Automatic notification of data link layer parameter values", on page 124.

4.5.4 Procedures for establishment and release of Multiple Frame operation

4.5.4.1 Establishment of Multiple Frame operation

Only the extended multiple frame operation (modulo 128 sequencing) is supported.

4.5.4.1.1 General

Use these procedures to establish multiple frame operation between the network and the designated user entity.

Layer 3 uses the DL-ESTABLISH-REQUEST to request establishment of the multiple frame operation. Initiate re-establishment as a result of the data link layer procedures defined in Section 4.5.6, "Re-establishment of multiple frame operation", on page 111. Ignore all frames other than un-numbered frame formats received during the establishment procedures.

4.5.4.1.2 Establishment procedures

- A data link layer entity transmits the SABME to initiate a request to set multiple frame operation.
- Clear all existing exception conditions, reset the re-transmission counter, and re-start T200, defined in Section 4.5.8.1, "Timer T200", on page 115.
- The All Mode setting commands is transmitted with the P bit set to 1.
- Layer 3 initiated establishment procedures imply the discard of all outstanding DL-DATA-REQUESTS and all I-frames in queues.

- If it can enter the multiple frame established state, a data link layer entity receiving a SABME, shall:
  - — respond with a UA response with the F bit set to the same binary value, as the P bit in the received SABME
  - — set V(S), V(R) and V(A) to 0
  - — enter the multiple-frame-established state, and inform layer 3 using the DL-ESTABLISH-INDICATION
  - — clear all existing exception conditions
  - — clear any existing peer receiver busy condition
  - — start T203 (see Section 4.5.9.3.1, "Start Timer T203", on page 117), if implemented.
- If the data link layer entity can not enter the multiple-frame-established state, it responds to the SABME with a DM response, having the F bit set to the same binary value as the P bit in the received SABME command.
- Upon reception of the UA response with the F bit set to 1, the originator of the SABME shall:
  - — reset T200
  - — start T203, if implemented
  - — set V(S), V(R), and V(A) to 0
  - — enter the multiple-frame-established state, and inform layer 3 using the DL-ESTABLISH-CONFIRM
  - — upon reception of a DM response with the F bit set to 1, the originator of the SABME indicate this to layer 3 by means of the DL-RELEASE-INDICATION, and reset T200. It then enters the TEI-assigned state. DM responses with F bit set to 0 are ignored in this case.
  - — On completion of the establishment mode-setting operation, service a DL-RELEASE-REQUEST received during data link layer initiated re-establishment.

4.5.4.1.3 Procedure on expiry of T200

- If T200 expires before receipt of the UA or DM response with the F bit set to 1, the data link layer entity shall:
  - — re-transmit the SABME command as above
  - — re-start T200
  - — increment the retransmission counter.
- After re-transmission of the SABME command N200 times, the data link layer entity shall:
  - — indicate this to layer 3 and the connection management entity, using DL-RELEASE-INDICATION and MDL-ERROR-INDICATION, respectively

— enter the TEI-assigned state, after discarding all outstanding DL-DATA-REQUESTs and all I frames in the queue.

- The value of N200 is defined in Section 4.5.8.1, "Timer T200", on page 115.

4.5.4.2 Information transfer

Having either transmitted the UA response to a received SABME command, or received the UA response to a transmitted SABME command, transmit and receive I frames and supervisory frames according to the procedures described in Section 4.5.5, “Procedures for information transfer in Multiple Operation”.

If an SABME command is received while in the multiple-frame-established state, the data link layer entity conforms to the re-establishment procedure described in Section 4.5.6, "Re-establishment of multiple frame operation", on page 111.

On receipt of a UI command, follow the procedures defined in Section 4.5.2, “Procedures for unacknowledged information transfer”.

4.5.4.3 Termination of Multiple Frame operation

General use these procedures to terminate the multiple frame operation between the network and a designated user entity.

- Layer 3 entity requests for termination of the multiple frame operation by use of the DL-RELEASE-REQUEST.
- Ignore other than the un-numbered frames received during the release procedures.
- Discard all outstanding DL-DATA-REQUESTs and all I frames in the queue.
- In the case of persistent layer 1 deactivation, the data link layer entity discards all I queues and, if a DL-RELEASE-REQUEST is outstanding, delivers a DL-RELEASE-CONFIRM or a DL-RELEASE-INDICATION to layer 3.

4.5.4.3.1 Release procedure

- A data link layer entity initiates a request for release of the multiple frame operation by:
  - — transmitting the Disconnect (DISC) command with P bit set to 1
  - — starting T200
  - — resetting the re-transmission counter
- A data link layer entity receiving a DISC while in the multiple-frame-established or timer recovery state, transmits a UA response with the F bit set to the same binary value as the P bit in the received DISC.
- Pass A DL-RELEASE-INDICATION to layer 3 and enter TEI-assigned state.
- If the originator of the DISC receives either:
  - — a UA response with the F bit set to 1

— a DM response with the F bit set to 1, indicating that the peer data link layer entity is already in the TEI-assigned state

it enters the TEI-assigned state and resets T200.

- The data link layer entity that issued the DISC is now in the TEI-assigned state and notifies layer 3 using the DL-RELEASE-CONFIRM. The conditions relating to this state are defined in Section 4.5.4.4, “TEI-assigned state”.

4.5.4.3.2 Procedure of expiry of T200

- If T200 expires before receipt of a UA or DM response with the F bit set to 1, the originator of the DISC shall:

— re-transmit the DISC as defined in Section 4.5.4.3.1, “Release procedure”, and restart T200

— increment the re-transmission counter.

- If the data link layer entity has not received the correct response, as defined in Section 4.5.6, "Re-establishment of multiple frame operation", on page 111, after N200 attempts to recover, the data link layer entity shall:

— indicate this to the connection management entity using the MDL-ERROR-INDICATION

— enter the TEI-assigned state

— notify layer 3 using the DL-RELEASE-CONFIRM.

4.5.4.4 TEI-assigned state

While in the TEI-assigned state:

- the receipt of a DISC results in the transmission of a DM response with the F bit set to the value of the received P bit
- on receipt of an SABME, follow the procedures defined in Section 4.5.4.1, “Establishment of Multiple Frame operation”
- on receipt of an unsolicited DM response with the F bit set to 0, the data link layer entity, if it can, initiates the establishment procedures by the transmission of an SABME (Section 4.5.4.1.2, “Establishment procedures”); otherwise, ignore the DM
- on receipt of UI commands, follow the procedures defined in Section 4.5.2, “Procedures for unacknowledged information transfer”
- on receipt of any unsolicited UA response, issue an MDL-ERROR-INDICATION, indicating a possible multiple assignment of a TEI value
- discard all other frame types.

4.5.4.5 Collision of unnumbered commands and responses

4.5.4.5.1 Identical Transmitted and Received commands

If the transmitted and received un-numbered commands (SABME or DISC) are the same:

- the data link layer entities sends the UA response at the earliest possible opportunity
- enter the indicated state after receiving the UA response
- the data link layer entities notify layer 3, by means of the appropriate confirm primitive

4.5.4.5.2 Different Transmitted and Received commands

If the transmitted and received un-numbered commands (SABME or DISC) are different:

- the data link layer entities issues a DM response at the earliest possible opportunity
- upon receipt of a DM response with the F bit set to 1, the data link layer enters the TEI-Assigned state and notify layer 3 by means of the appropriate primitive.

The entity receiving the DISC issues a DL-RELEASE-INDICATION, while the other entity issues a DL-RELEASE-CONFIRM.

4.5.4.5.3 Unsolicited DM Response and SABME or DISC command

- When a data link layer entity receives a DM response with the F bit set to 0, a collision between a transmitted SABME or DISC, and the unsolicited DM response may have occurred.
- This is typically caused by a user equipment applying a protocol procedure according to X.25 LAPB [6], to ask for a mode-setting command.
- To avoid misinterpretation of the DM response received, a data link layer entity always sends its SABME or DISC with the P bit set to 1.
- Ignore a DM response with the F bit set to 0 colliding with an SABME or DISC.

4.5.5 Procedures for information transfer in Multiple Operation

The procedures that apply to the transmission of I frames are defined here.

Note: The term "transmission of an I frame" refers to the delivery of an I frame by the data link layer to the physical layer.

4.5.5.1 Transmitting I frames

- Transmit information received by the data link layer entity from layer 3 by means of DL-DATA-REQUEST an I frame.
- Assign to the control field parameters N(S) and N(R), the values of V(S) and V(R), respectively.
- Increment V(S) by 1 at the end of the I frame transmission.
- If T200 is not running at the time of I frame transmission, start it. If it expires, follow the procedures defined in Section 4.5.5.7, "Waiting acknowledgment".
- If V(S) is equal to V(A) plus k (where k is the maximum number of outstanding I frames - Section 4.3.5.2, "Multiple frame operation -

variables and sequence numbers", on page 71); the data link layer entity shall not transmit any new I frames, but may re-transmit an I frame, as a result of the error recovery procedures as described in Section 4.5.5.4, “Receiving REJ frames”, and Section 4.5.5.7, “Waiting acknowledgment”.

- When the network or user side is in the own receiver busy condition, it may still transmit I frames, if a peer receiver busy condition does not exist.

Note: DL-DATA-REQUEST primitives received while in the timer recovery condition shall be queued.

4.5.5.2 Receiving I frames

Independent of timer recovery condition, when a data link layer entity is not in an own receiver busy condition, and it receives a valid I frame whose N(S) is equal to the current V(R), it shall:

- pass the information field of this frame to layer 3 using the DL-DATA-INDICATION
- increment by 1 its V(R), and act as indicated below.

4.5.5.2.1 P Bit Set to 1

If the P bit of the received I frame was set to 1, the data link layer entity responds to its peer in one of the following ways:

- If the entity receiving the I frame is still not in an own receiver-busy condition, send an RR response with the F bit set to 1.
- If the entity receiving the I frame enters the own receiver busy condition, after receiving the I frame, send an RNR response with the F bit set to 1.

4.5.5.2.2 P Bit Set to 0

If the P bit of the received I frame was set to 0 and:

- If the data link layer entity is still not in an own receiver-busy condition, and:
  - — if no I frame is available for transmission, or if an I frame is available for transmission but a peer receiver busy condition exists, the data link layer entity transmits an RR response with the F bit set to 0
  - — if an I frame is available for transmission and no peer receiver busy condition exists, the data link layer entity transmits the I frame with the value of N(R) set to the current value of V(R) as defined in Section 4.5.5.1, “Transmitting I frames”, or
- if on receipt of this I frame the entity is now in an own receiver-busy condition, it transmits an RNR response with the F bit set to 0.
- When the entity is in an own receiver busy condition, it processes any received I frame according to Section 4.5.5.6, “Data link layer own receiver busy condition”.

4.5.5.3 Sending and receiving acknowledgments

4.5.5.3.1 Sending Acknowledgments

Whenever a data link layer entity transmits an I frame or a supervisory frame, set N(R) to V(R).

4.5.5.3.2 Receiving Acknowledgment

On receipt of a valid I or supervisory frame (RR, RNR or REJ), even in the own-receiver-busy or timer recovery condition:

- the data link layer entity treats the N(R) contained in this frame as an acknowledgment for all the I frames it has transmitted, with an N(S) up to and including the received N(R) - 1
- set V(A) to N(R)
- the data link layer entity resets T200 on receipt of either:
  - — a valid I frame or supervisory frame with the N(R) higher than V(A) (actually acknowledging some I frames)
  - — an REJ with an N(R) equal to V(A).

  Note: 1 If a supervisory frame with the P bit set to 1 was transmitted and not acknowledged, do not reset T200.

  Note: 2 Upon receipt of a valid I frame, do not reset T200 if the data link layer entity is in the peer-receiver-busy condition.

If T200 was reset by the receipt of an I, RR or RNR frame, and if there are outstanding I frames still unacknowledged, the data link layer entity restarts T200.

- If it then expires, the data link layer entity follows the recovery procedure as defined in Section 4.5.5.7, “Waiting acknowledgment”, with respect to the unacknowledged I frames.
- If it was reset by the receipt of an REJ frame, the entity follows the retransmission procedures in Section 4.5.5.4, “Receiving REJ frames”.

4.5.5.4 Receiving REJ frames

On receipt of a valid REJ frame, the data link layer entity, if:

- it is not in the timer recovery condition:
  - — clears an existing peer receiver busy condition
  - — sets its V(S) and its V(A) to the value of the N(R) contained in the REJ frame control field
  - — stops T200
  - — starts T203, if implemented
  - — if it was an REJ command frame with the p-bit set to 1, transmits an appropriate supervisory response frame (see note 2, Section 4.5.5.5, “Receiving RNR”), with the F-bit set to 1

- — transmits the corresponding I frame as soon as possible, as defined in Section 4.5.5.1, “Transmitting I frames”, taking into account the items 1- 3 below, and the paragraph following them.
- — if it was a REJ response frame with the F bit set to 1, notifies a protocol violation to the connection management entity using the MDL-ERROR-INDICATION.

- it is in the timer recovery condition, and it was a REJ response frame with the F bit set to 1:
  - — clear an existing peer receiver busy condition
  - — set its V(S) and its V(A) to the N(R) contained in the REJ frame control field
  - — stop T200
  - — start T203, if implemented
  - — enter the multiple-frame-established state
  - — transmit the corresponding I frame as soon as possible, as defined in Section 4.5.5.1, “Transmitting I frames”, taking into account the items 1-3, below and the paragraph following them.
- it is in the timer recovery condition, and it was an REJ frame other than a REJ response frame with the F bit set to 1:
  - — clear an existing peer receiver busy condition
  - — set its V(A) to the value of the N(R) contained in the REJ frame control field
  - — if it was a REJ command frame with the P bit set to 1, transmit an appropriate supervisory response frame with the F bit set to 1. (See note 2 in Section 4.5.5.5, “Receiving RNR”)

The transmission of I frames takes account of the following:

- if the data link layer entity is transmitting a supervisory frame when it receives the REJ frame, complete that transmission before commencing transmission of the requested I frame
- if the data link layer entity is transmitting an SABME or DISC, a UA, or DM response, when it receives the REJ, ignore the request for re-transmission
- if the data link layer is not transmitting a frame when the REJ is received, immediately commence transmission of the requested I frame.

Transmit all outstanding unacknowledged I frames, commencing with the I frame identified in the received REJ frame. Other I frames not yet transmitted may be transmitted after the re-transmitted I frames.

4.5.5.5 Receiving RNR

After receiving a valid RNR command or response, if the data link layer entity is not engaged in a mode setting operation, it sets a peer receiver busy condition, and:

- if it was an RNR command with the P bit set to 1
  - — if the data link layer entity is not in an own receiver busy condition, respond with an RR response setting the F bit to 1
  - — if the entity is in a own receiver busy condition, respond with an RNR setting the F bit to 1.
- if it was an RNR response with the F bit set to 1, clear an existing timer recovery condition, and use the N(R) contained in the response to update V(S).

  The data link layer entity takes note of the peer receiver busy condition and does not transmit any I frames to the peer that indicated the busy condition.

  Note: The N(R) in any RR or RNR command frame irrespective of the setting of the P bit, does not update the V(S).

The data link layer entity then:

- treats the N(R) contained in the received RNR frame as an acknowledgment for all the I frames (re)transmitted with an N(S), up to and including N(R) minus 1, and set its V(A) to the value of the N(R) contained in the RNR
- re-starts T200, unless a supervisory response frame with the F bit set to 1 is still expected.

If T200 expires, the data link layer entity:

- if it is not yet in a timer recovery condition, enters the timer recovery condition, and resets the re-transmission count variable
- if it is already in a timer recovery condition, adds one to its re-transmission count variable.

The data link layer entity then:

- if the value of the re-transmission count variable is less than N200:
  - — transmits an appropriate supervisory command (see note 2) with a P bit set to 1
  - — restarts T200.
- if the value of the re-transmission count variable is equal to N200, initiate a re-establishment procedure as described in Section 4.5.6, “Re-establishment of multiple frame operation”, and indicate this to the connection management entity using the MDL-ERROR-INDICATION.
- The data link layer entity receiving the supervisory frame with the P bit set to 1 responds, at the earliest opportunity, with a supervisory response frame (see note 2) with the F bit set to 1, to indicate whether or not its own receiver-busy condition still exists.
- Upon receipt of the supervisory response with the F bit set to 1, the data link layer entity resets T200, and:
  - — if there is an RR or REJ response, clear the peer receiver busy condition, and either transmit a the data link entity new I frames or re-

transmittal frames, as defined in Section 4.5.5.1, “Transmitting I frames”, or Section 4.5.5.4, “Receiving REJ frames”

— if there is an RNR response, the data link layer entity receiving the response proceeds according to Section 4.5.5.5, “Receiving RNR”, first paragraph.

- If either a:

— a supervisory command (RR, RNR, or REJ) with the P bit set to 0 or 1,

— a supervisory response frame (RR, RNR, or REJ) with the F bit set to 0, is received during the enquiry process, the entity shall:

  – if the supervisory frame is an RR or REJ command frame or an RR or REJ response frame with the F bit set to 0, clear the peer receiver busy condition and, if the supervisory frame is a command with the P bit set to 1, transmit the appropriate supervisory response frame (see Note 2) with the F bit set to 1. However, do not undertake the transmission or re-transmission of I frames until either receipt of the appropriate supervisory response frame with the F bit set to 1, or the expiry of T200

  – if the supervisory frame is an RNR command frame or an RNR response frame with the F bit set to 0, retain the peer receiver busy condition, and if the supervisory frame received was an command with the P bit set to 1, transmit the appropriate supervisory response frame (see note), with the F bit set to 1.

- Upon receipt of an SABME, the entity clears the peer receiver busy condition.

Note: If the data link layer entity is not in an own receiver busy condition, and is in a Reject exception condition (that is, N(S), a sequence error was received, and a REJ frame transmitted, but the requested I frame was not received), the appropriate supervisory frame is the RR frame.

- If the data link layer entity is not in an own receiver busy condition, but is in an N(S) sequence error exception condition, (that is, an N(S) sequence error has been received but a REJ frame has not been transmitted), the appropriate supervisory frame is the REJ frame.
- If the data link layer entity is in its own receiver busy condition, the appropriate supervisory frame is the RNR frame.
- Otherwise the appropriate supervisory frame is the RR frame.

4.5.5.6 Data link layer own receiver busy condition

- When the data link layer entity enters an own receiver busy condition, transmit an RNR frame at the earliest opportunity. It may be sent as either an:

— RNR response with the F bit set to 0

— RNR response with the F bit set to 1, if this condition is entered on receiving a command frame with the P bit set to 1

— RNR command with the P bit set to 1, if this condition is entered on expiry of T200.

- After updating the V(A), discard all received I frames with the P bit set to 0.
- Process all received supervisory frames with the P/F bit set to 0, including updating the V(A).
- After updating the V(A), discard all received I frames with the P bit set to 1, but transmit an RNR response frame with the F bit set to 1.
- Process all received supervisory frames with the P bit set to 1, including updating the V(A).
- Transmit An RNR response with the F bit set to 1.
- To indicate the clearance of the own receiver busy condition to the peer data link layer, the data link layer entity transmits either:
  - — an RR frame
  - — if a previously-detected N(S) sequence error has not yet been reported, an REJ frame with the N(R) set to the current value of the V(R)
- Transmission of an SABME command, or a UA response (in reply to an SABME) also indicates to the peer data link layer entity the clearance of the own receiver busy condition.

4.5.5.7 Waiting acknowledgment

The data link layer entity maintains an internal re-transmission count variable. If T200 expires the entity shall:

- if it is not yet in the timer recovery condition, enter the timer recovery condition and reset the retransmission count variable
- if it is already in the timer recovery condition, add one to its re-transmission count variable.

- If the value of the re-transmission count variable is less than N200, re-start T200, and either:
  - — transmit an appropriate supervisory command (see Note 2, Section 4.5.5.5, “Receiving RNR”) with the P bit set to 1
  - — re-transmit the last transmitted I frame (V(S)-1) with the P bit set to 1,

  or
- If the value of the re-transmission count variable is equal to N200:
  - — initiate a re-establishment procedure as defined in Section 4.5.6, “Re-establishment of multiple frame operation”
  - — indicate this by means of the MDL-ERROR-INDICATION to the connection management entity.
- The timer recovery condition is cleared when the data link layer entity receives a valid supervisory frame response with the F bit set to 1.
- If the received supervisory frame N(R) is within the range from its current V(A) to its current V(S) inclusive, set its V(S) to the value of the received N(R).

- If the received supervisory frame response is an RR or REJ response, reset T200 and, the data link layer entity resumes with I frame transmission or re-transmission, as appropriate.
- Re-set and re-start T200, if the received supervisory response is an RNR response, to proceed with the enquiry process according to Section 4.5.5.5, “Receiving RNR”.

4.5.6 Re-establishment of multiple frame operation

4.5.6.1 Criteria for re-establishment

The criteria for re-establishing the multiple frame mode of operation are defined by the following conditions:

- while in the multiple-frame mode of operation, the receipt of an SABME
- the receipt of a DL-ESTABLISH-REQUEST from layer 3 (see Section 4.5.4.1.1, “General”)
- while in the timer recovery condition, the occurrence of N200 re-transmission failures (see Section 4.5.7.5, “Frame rejection condition”)
- the occurrence of a frame rejection condition as identified in Section 4.5.7.3, “Timer recovery condition”
- while in the multiple-frame mode of operation, the receipt of an FRMR response frame (see Section 4.5.7.6, “Receipt of an FRMR response frame”)
- while in the multiple-frame mode of operation, the receipt of an unsolicited DM response with the F bit set to 0 (see Section 4.5.7.7, “Unsolicited response frames”)
- while in the timer-recovery condition, the receipt of an unsolicited DM response with the F bit set to 1.

4.5.6.2 Procedures

In all re-establishment situations, the data link layer entity follows the procedures defined in Section 4.5.4.1, “Establishment of Multiple Frame operation”. All locally generated conditions for re-establishment causes the transmission of the SABME.

In the case of data link layer and peer initiated re-establishment, the entity also:

- issues an MDL-ERROR-INDICATION primitive to the connection management entity
- issues a DL-ESTABLISH-INDICATION primitive to layer 3, and discard all I queues, if V(S) > V(A) prior to re-establishment.

In case of layer 3 initiated re-establishment, or if a DL-ESTABLISH-REQUEST occurs pending re-establishment, use the DL-ESTABLISH-CONFIRM.

4.5.7 Exception condition reporting and recovery

Exception conditions may occur as the result of physical layer errors or data link layer procedural errors.

- The error recovery procedures available to effect recovery following the detection of an exception condition at the data link layer are defined below.
- The actions to be taken by the connection management entity on receipt of an MDL-ERROR-INDICATION are defined in Section 4.7, "Occurrence of MDL-Error-Indication within the basic states and actions to be taken by the management entity", on page 120.

4.5.7.1 N(S) sequence error

- An N(S) sequence error exception condition occurs in the receiver, when a valid I frame is received that contains an N(S) value not equal to the V(R) at the receiver. Discard the information field of an I frame whose N(S) does not equal the V(R).
- The receiver shall not acknowledge (nor increment its V(R)) the I frame causing the sequence error, nor any I frames that may follow, until an I-frame with the correct N(S) is received.
- A data link layer entity, otherwise error-free, that receives one or more I frames having sequence errors, or subsequent supervisory frames (RR, RNR and REJ), uses the control field information contained in the N(R) field and the P or F bit to perform data link control functions.
  - — For example, to receive acknowledgment of previously-transmitted I frames, and to cause the data link layer entity to respond if the P bit is set to 1.
  - — Therefore, the re-transmitted I frame may contain an N(R) field value and P bit that are updated from, and therefore different from, the ones contained in the originally transmitted I frame.
- The REJ frame is used by a receiving data link layer entity to initiate an exception condition recovery (re-transmission), following the detection of the first N(S) sequence error.
- Establish only one REJ exception condition for a given direction of information transfer at a time.
- A data link layer entity receiving REJ command or response initiates sequential transmission (re-transmission) of I frames starting with the I frame indicated by the N(R) contained in the REJ frame.
- A REJ exception condition is cleared when the requested I frame, or when an SABME or DISC is received.
- An optional procedure for the re-transmission of a REJ response frame is described in Section 4.6, “Re-transmission of REJ response frames”; however, this procedure is not applicable for this specification.

4.5.7.2 N(R) Sequence error

- An N(R) sequence error exception condition occurs in the transmitter when a valid supervisory frame or I frame is received that contains an invalid N(R) value.
- A valid N(R) is one that is in the range V(A) ≤ N(R) ≤ V(S).
- Deliver the information field contained in an I frame, that is correct in sequence and format, to layer 3 using the DL-DATA-INDICATION.

- The data link layer entity shall:
  - — inform the connection management entity of this exception condition using the MDL-ERROR-INDICATION
  - — initiate re-establishment according to Section 4.5.6, “Re-establishment of multiple frame operation”.

4.5.7.3 Timer recovery condition

- If, due to a transmission error, a data link layer entity does not receive either:
  - — a single I frame
  - — the last I frame(s) in a sequence of I frames

  it will not detect an out-of-sequence exception condition and therefore, will not transmit a REJ frame.

- On the expiry of T200, the entity that transmitted the unacknowledged I frame(s) takes appropriate recovery action as defined in Section 4.5.5.7, “Waiting acknowledgment”, to determine at which I frame re-transmission must begin.

4.5.7.4 Invalid frame condition

Discard any invalid frame received (as defined in Section 4.2.9, "Invalid frames", on page 65 and Section 4.3.6, "Frame types commands and responses", on page 73), and take no action as a result of that frame.

4.5.7.5 Frame rejection condition

A frame rejection condition results from one of the conditions described in Section 4.3.6, “Frame types commands and responses”, (third paragraph) and Section 4.3.6.10, “Frame Reject (FRMR) response”, items b, c and d.

Upon occurrence of a frame rejection condition, the data link layer entity shall:

- issue an MDL-ERROR-INDICATION
- initiate re-establishment (see Section 4.5.6, “Re-establishment of multiple frame operation”).

Note: For satisfactory operation, a receiver must be able to discriminate between invalid frames, as defined in Section 4.2.9, “Invalid frames” and I frames with an information field exceeding the maximum established length (see Section 4.3.6.10, “Frame Reject (FRMR) response”, item d). An unbounded frame may be assumed, and thus discarded, if two times the longest permissible frame plus two octets are received without a flag detection.

4.5.7.6 Receipt of an FRMR response frame

Upon receipt of an FRMR response frame in the multiple-frame mode of operation, the data link layer entity shall:

- issue an MDL-ERROR-INDICATION
- initiate re-establishment (see Section 4.5.6, “Re-establishment of multiple frame operation”).

4.5.7.7 Unsolicited response frames

The action to be taken on the receipt of an unsolicited response frame is defined in Figure 18, “Action on receipt of unsolicited response frames”.

The data link layer entity shall:

- assume possible multiple-TEI assignment upon receipt of an unsolicited UA response
- inform the layer management.

Figure 18 Action on receipt of unsolicited response frames

Unsol. Rsp	TEI Assigned	Awaiting Establishment	Awaiting Release	Multiple frame modes of operation: Estab-lished Mode	Multiple frame modes of operation: Timer Recovery Condition
UA Rsp F=1	MEI	solicited	soli-cited	MEI	MEI
UA Rsp F=0	MEI	MEI	MEI	MEI	MEI
DM Rsp F=1	ignore	solicited	soli-cited	MEI	solicited
DM Rsp F=0	EST	ignore	ignore	RE-EST MEI	RE-EST MEI
Super. Rsp F=1	ignore	ignore	ignore	MEI	solicited
Super. Rsp F=0	ignore	ignore	ignore	soli-cited	solicited

Key MEI = MDL-ERROR-INDICATION
EST = Establish
RE-EST = Re-establish
Rsp = Response
Super. = Supervisory
Unsol. = Unsolicited

4.5.7.8 Multiple assignment of a TEI value

A data link layer entity assumes multiple assignment of a TEI value, and initiates recovery as specified below by the receipt of a UA response frame while in:

- the multiple-frame-established state
- the timer recovery state
- the TEI-assigned state.

After assuming multiple assignment of a TEI value, a data link layer entity informs the management entity using the MDL-ERROR-INDICATION.

4.5.8 List of system parameters

- The system parameters listed below are associated with each individual SAP.
- The parameter values are assigned when the data link is configured.
- The term default implies to use the value defined in the absence of any assignment, or negotiation of alternative values. Alternative values may be agreed upon, between the network and the terminal, at subscription time.

4.5.8.1 Timer T200

Set a default value of one second for T200, at the end of which, initiate re-transmission of a frame according to the procedures described in Section 4.5.5, “Procedures for information transfer in Multiple Operation”.

> ***Note: 1*** Timer T200’s value must be greater than the maximum time between transmission of command frames and the reception of their corresponding response or acknowledgment frames.

> ***Note: 2*** More than one second may be necessary when an implementation includes multiple terminals on the user side together with a satellite connection in the transmission path.

- Maximum number re-transmissions (N200) - a system parameter; its default value is 3.
- Maximum number of octets in an information field (N201) - a system parameter; (Section 4.2.5, “Information field”), its default value is 260 octets.
- Maximum number of transmissions of an Identity Request message (202), when the user requests a TEI - a system parameter. The default value of N202 is 3. The default value is 260 octets.
- The maximum number (k) of sequentially-numbered I frames that may be outstanding (that is, unacknowledged) at any given time - a system parameter that shall not exceed 127. The default value is 7.
  - — For an SAP supporting basic access (16 kb/s) signalling, the default value is 1.
  - — For an SAP supporting basic rate (16 kb/s) packet information, the default value is 3.

— For all SAPs in the primary rate interface (64 kb/s), the default value is 7.

- The minimum time between re-transmission of the TEI Identity check messages (T201) is a system parameter; set it to T200 s.
- The minimum time between the transmission of TEI Identity request messages is a system parameter (T202); set it to 2 s.
- Timer T203 represents the maximum time allowed without frames being exchanged. Its default value is 10 s.

4.5.9 Data link layer monitor function

4.5.9.1 Introduction

The procedural elements defined in Section 4.5, “Definition of the Peer-to-Peer procedures”, allow for the supervision of the data link layer resource. This subsection describes procedures that may be used to provide this supervision function.

4.5.9.2 Data link layer supervision in the multiple- frame-established state

These procedure propose a solution that is already identified in the HDLC classes of procedures. The connection verification is a service provided by the data link layer to layer 3. This implies that layer 3 is informed only in case of a failure. Furthermore, the procedure may be incorporated in the ‘normal’ exchange based on the involvement of layer 3.

The procedure is based on supervisory command frames (RR command, RNR command) and T203, and operates in the multiple-frame-established state as follows:

- If no frames are being exchanged on the data link connection (neither new nor outstanding I frames, nor supervisory frames with a P bit set to 1), there is no means to detect either a faulty data link connection condition, or user equipment having been unplugged.
- Timer T203 represents the maximum time allowed without frames being exchanged, if it expires, transmit a supervisory command with a P bit set to 1. Such a procedure is protected against transmission errors by making use of the normal T200 procedure, including re-transmission count and N200 attempts.

4.5.9.3 Connection verification procedures

4.5.9.3.1 Start Timer T203

- timer T203 is started when:
- the multiple-frame-established state is entered, and
- in the multiple-frame-established state when T200 is stopped.

Upon receiving an I or supervisory frame, T203 is re-started if T200 is not to be started.

4.5.9.3.2 Stop of Timer T203

- timer T203 is stopped when:
- in the multiple-frame-established state T200 is started (see note), and
- upon leaving the multiple-frame-established state.

Note: These two conditions mean that T203 is only started when T200 is stopped and not re-started.

4.5.9.3.3 Expiry of Timer T203

if T203 expires, the data link layer entity acts as follows (note that T200 is neither running nor expired):

- sets the transmission count variable to 0
- enters timer recovery state
- transmits a supervisory command with the P bit set to 1 as follows:
  - — if there is not a receiver busy condition (own receiver not busy), transmit an RR command
  - — if there is a receiver busy condition (own receiver busy), transmit an RNR command
- start T200
- send a MDL-ERROR-INDICATION to connection management after N200 re-transmissions.

Note: T203 may not be needed at the user side.

4.6 Re-transmission of REJ response frames

4.6.1 Introduction

Note: This option is not applicable in this specification.

This section describes an optional procedure that may be used to provide a reject re-transmission procedure.

4.6.2 Procedure

This optional reject re-transmission procedure can supplement the Q.921 LAPD protocol by defining a new variable for multiple frame operation (see Section 4.3.5.2, “Multiple frame operation - variables and sequence numbers” and by modifying the N(S) sequence error exception condition reporting and recovery, Section 4.5.7.1, “N(S) sequence error”).

4.6.2.1 Recovery state variable V(M)

- When using I frame commands and supervisory frame commands/responses, each point-to-point data link entity may have an associated V(M).
- The V(M) denotes the sequence number of the last frame received that caused an N(S) sequence error condition.
- The V(M) can take on the value 0-127, and may be used to determine if another REJ response frame should be sent on receipt of an N(S) sequence error while in the REJ exception condition.

4.6.2.2 N(S) Sequence error supplementary procedure

The first three paragraphs of Section 4.5.7.1, “N(S) sequence error”, apply. The remainder of the section is as follows:

- A receiving data link layer entity uses the REJ frame to initiate an exception recovery (re-transmission), following the detection of an N(S) sequence error. The receiving data link entity sets V(M) to the N(S) sequence number that caused the N(S) sequence error condition.
- Only one REJ exception condition for a given direction of information transfer is established at a time (that is, all REJ frames must have the same N(R) value until the REJ exception is cleared).
- A data link layer entity receiving a REJ command or response initiates sequential transmission (re-transmission) of I frames starting with the I frame indicated by the N(R) contained in the REJ frame.
- A REJ exception is cleared when the requested I frame is received, or when a SABME or DISC is received.
- When the receiving data link entity is in the REJ exception condition, if an N(S) sequence error exception occurs, check the N(S) of the received frame to see if the entity that received the REJ frame has re-transmitted in response to the REJ frame (that is, is N(S) within the range $V(R)+1 \leq N(S) \leq V(M)$).
  — If the N(S) of the received frame is within the above range:

    - send another REJ response frame
    - issue an MDL-ERROR-INDICATION to the connection management entity
    - set V(M) equal to N(S).
  - The transmitting side need not wait for T200 to expire before it re-transmits the lost frame.
- Set V(M) equal to the N(S) of the received frame, either:
  - if a N(S) sequence error occurs when the receiving data link layer entity is in the REJ exception condition
  - if it can not be determined whether or not the data link entity that received the REJ frame has re-transmitted in response to that frame (that is, if N(S)>V(M)).

4.7 Occurrence of MDL-Error-Indication within the basic states and actions to be taken by the management entity

4.7.1 Introduction

Figure 19, "Management Entity actions for MDL-ERROR-INDICATIONs - Part 1," on page 122, and Figure 20, "Entity actions for MDL-ERROR-INDICATIONs - Part II," on page 123, give the error situations in which the MDL-ERROR-INDICATION is generated. This primitive notifies the data link layer's Connection Management Entity of the occurred error situation. The associated error parameter contains the error code describing the unique error conditions. Figure 19, “Management Entity actions for MDL-ERROR-INDICATIONs - Part 1”, and Figure 20, “Entity actions for MDL-ERROR-INDICATIONs - Part II”, also identify the associated Connection Management actions to be taken from the network and the user side, based on the types of error conditions reported.

This section does not incorporate the re-transmission of REJ Response frames described in Section 4.6, “Re-transmission of REJ response frames”.

The “Error Code” column gives the identification value of each error situation to be included as a parameter with the MDL-ERROR-INDICATION.

The “Error Condition” column, together with “Affected States”, describes unique protocol error events and the basic state of the data link layer entity at the point that the MDL-ERROR-INDICATION is generated.

For a given error condition, the “Network Management Action” column describes the preferred action to be taken by the Network Management entity.

The “User Management Action” column describes the preferred action to be taken by the User Side Management entity on a given error condition.

4.7.2 Preferred management actions

- The various preferred Management Actions on an error situation may be described as one of the following:
  - Error Log - the network side connection management entity has the preferred action of logging the event into an error counter. The length and the operation of the counter mechanisms for the error situations is implementation dependent.
  - TEI Check- the network side layer management entity invokes the TEI check procedure.
  - TEI Verify- the user side layer management entity may optionally invoke a user TEI Verify request procedure that asks the network side layer management entity to issue a TEI Check verify procedure.
  - TEI Remove - the user side layer management entity may directly remove its TEI value from service.
  - In most of the described error situations, either:
    no action can be taken on the user side layer management
  - the action to be taken is implementation dependent, as Figure 19, “Management Entity actions for MDL-ERROR-INDICATIONs - Part 1”, and Figure 20, “Entity actions for MDL-ERROR-INDICATIONs - Part II” show.
- “Implementation dependent” means that it is optional whether the user side has incorporated any form of error counter to log (store) the reported event.
- If action is taken, layer management has to take into account that the data link layer has initiated a recovery procedure.

Figure 19 Management Entity actions for MDL-ERROR-INDICATIONs - Part 1

ERROR CODE	ERROR CONDITION	AFFECTED STATES (Note 1)	NETWORK MANAGEMENT ACTION	USER MANAGEMENT ACTION
Receipt of unsolicited response (error codes A to E)				
A	Supervisory (F=1)	7	ERROR LOG	implementation dependent
B	D M (F=1)	7,8	ERROR LOG	implementation dependent
C	U A (F=1)	4,7,8	TEI removal proc. or TEI check proc then if TEI: -free,remove TEI -single,no action -multiple, TEI removal proc.	TEI Identity verify procedure
D C	U A (F=0) U A (F=1)	4,5,6,7,8 4,7,8	remove TEI	TEI Remove
D	U A (F=0)	4,5,6,7,8		
E	Receipt of DMresp(F=0)	7,8	ERROR LOG	implementation dependent
Peer initiated re-establishment (error code F)				
F	SABME	7,8	ERROR LOG	implementation dependent

Note: 1 For the description of the affected states, see Section 4.9, “SDLs for the point-to-point data link procedures”.

Figure 20 Entity actions for MDL-ERROR-INDICATIONs - Part II

<table>
<tr><th>ERROR CODE</th><th>ERROR CONDITION</th><th>AFFECTED STATES (Note 1)</th><th>NETWORK MANAGEMENT ACTION</th><th>USER MANAGEMENT ACTION</th></tr>
<tr><td colspan="5">Unsuccessful retransmission (N200 retries)
(Error codes G, H, I)</td></tr>
<tr><td>G</td><td>SABME</td><td>5</td><td rowspan="3">TEI Check proc.
then if TEI:
-free,remove TEI;
-single,error log
-multiple, TEI removal proc.</td><td rowspan="3">TEI Identity verify procedure or remove TEI</td></tr>
<tr><td>H
G</td><td>DISC
SABME</td><td>5
5</td></tr>
<tr><td>H</td><td>DISC</td><td>5</td></tr>
<tr><td>I</td><td>STATUS ENQUIRY</td><td>5</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td colspan="5">Other errors (error codes J to O)</td></tr>
<tr><td>J</td><td>N(R) ERROR</td><td>7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td>K</td><td>Receipt of FRMR-Rspnse</td><td>7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td>L</td><td>Receipt of non-impl. frame</td><td>4,5,6,7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td>M
(2)</td><td>Receipt of I-field not permitted</td><td>4,5,6,7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td>N</td><td>Receipt of frame with wrong size</td><td>4,5,6,7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
<tr><td>O</td><td>N 201 ERROR</td><td>4,5,6,7,8</td><td>ERROR LOG</td><td>implementation dependent</td></tr>
</table>

Note: 1 For the description of the affected states, see Section 4.9, “SDLs for the point-to-point data link procedures”.

Note: 2 According to Section 4.5.7.5, “Frame rejection condition”, this error code will never be generated.

4.8 Provision of Point-to-point Signalling Connections

NOTE : This option is not applicable for this specification.

In certain applications, it may be advantageous to have a single point-to-point signaling connection at Layer 3; the allocation of the value 0 as a preferred TEI for that purpose is a network option. Use of the value 0 in such applications does not preclude using that value in other applications or networks.

4.8.1 General

- The parameter negotiation procedure is not applicable in this specification.
- Each data link layer entity has an associated data link connection management entity, that is responsible for initializing the link parameters necessary for correct peer-to-peer information transport.
- The method of initialization of the parameters follows one of these two methods:

1 initialization of the default values, as specified in Section 4.5.9, “Data link layer monitor function”

2 initialization based on the values supplied by its peer entity

- The latter method, uses the parameter negotiation procedure described in this Appendix. Typically, after the assignment of a TEI value to the management entity, its layer management entity notifies the data link connection management entity that parameter initialization is required.

  The data link connection management entity invokes the peer-to-peer notification procedure. After parameter initialization:

  — it notifies the layer management entity that parameter initialization occurred

  — the layer management entity issues the MDL-ASSIGN-REQUEST.

4.8.2 Parameter initialization

The parameter initialization procedure may invoke either the internal initialization, or automatic notification of data link parameter procedure.

4.8.3 Internal parameter initialization

When the layer management entity notifies the connection management entity of TEI assignment, the connection management entity:

- initializes the link parameters to the default values
- notifies the layer management of task completion.

4.8.4 Automatic notification of data link layer parameter values

- For each data link layer, an exchange of certain parameters may take place between the peer data link connection management entities before entering the TEI-assigned state. Initiate this exchange after acquiring a TEI, that is, following the:

— receipt of a DL-ESTABLISH REQUEST or a DL-UNIT DATA-REQUEST, after a power-up condition associated with non-automatic TEI user equipment

— receipt of the ID Assigned Response for automatic TEI assignment user equipment. This response contains the TEI received by the layer management entity.

- Following assignment of a TEI from the layer management entity, the data link connection management entity:

— issues an XID command with the P bit set to 0 and containing the Parameter message shown in Figure 21, “Parameter message encoding”

— starts the connection management TM20.

- The I field of the XID command frame reflects the parameters desired for future communications across this data layer connection.
- Upon receipt of the XID command frame, the peer data link connection management entity transmits an XID response, containing the list of Parameter values that the peer can support, with the F bit set to 0.
- If the data link connection management entity receives the above XID response prior to expiry of TM20:

— stop the timer

— notify the layer management entity of a successful parameter exchange

- However, if TM20 expires before receiving the response, the data link connection management entity shall:

— re-transmit the XID command

— increment the re-transmission counter

— re-start TM20.

Repeat this re-transmission process if TM20 expires again.

- Should either:

— the re-transmission counter equal NM20, or

— a XID response frame with a zero length I field be received

the data link connection management entity issues an indication to the layer management entity and initializes the parameters to the default values.

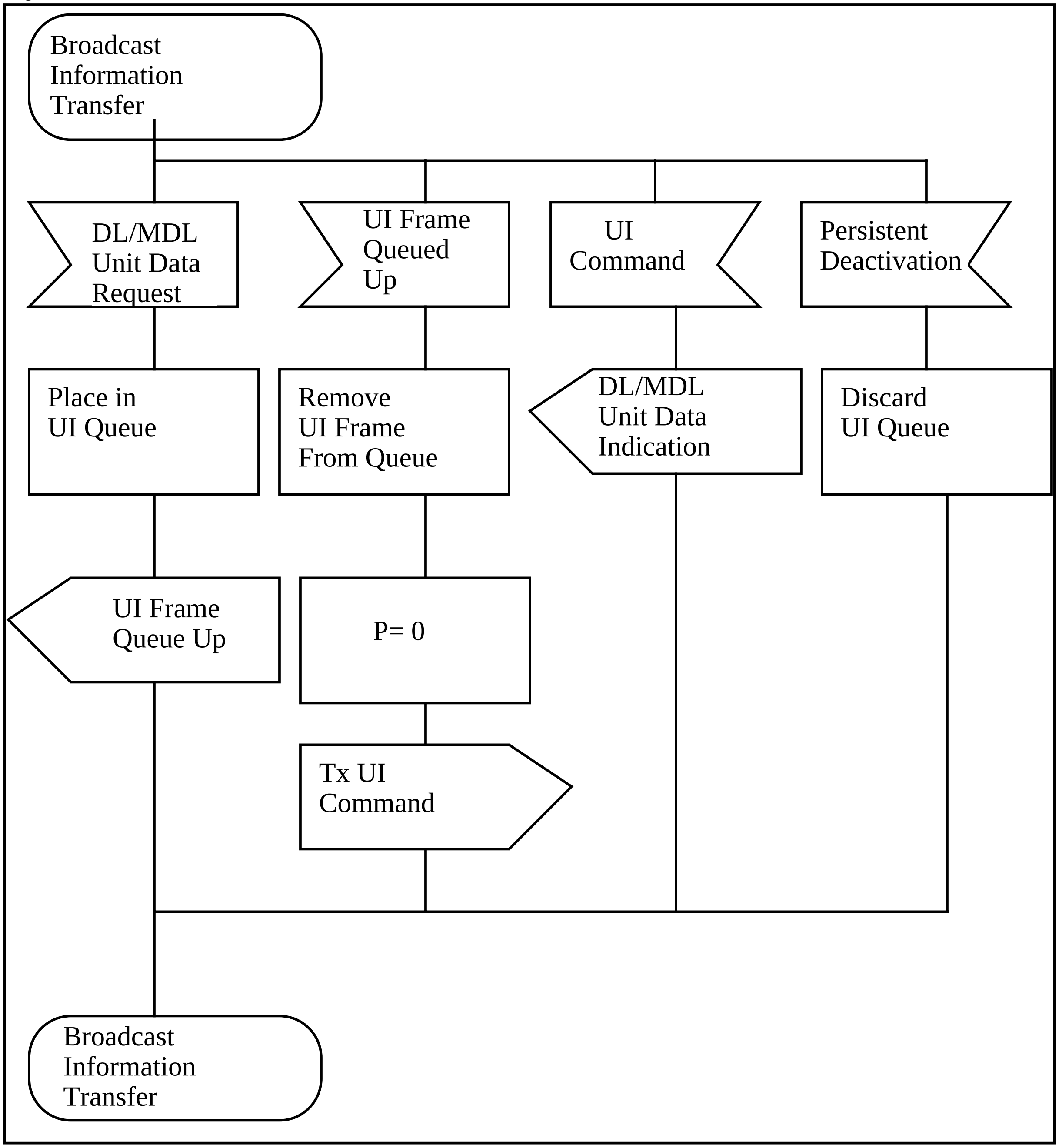
- The layer management entity may log this condition and issue the MDL-ASSIGN-REQUEST to the data link layer.
- The TM20 is set to 1 s, and counter NM20 to 3.

Figure 21 Parameter message encoding

Octet	8 7 6 5 4 3 2 1	
5	1 0 0 0 0 0 1 0	Format Identifier (FI)
6	1 0 0 0 0 0 0 0	Group Identifier (GI)
7	0 0 0 0 0 0 0 0	Group Length (GL)
8	0 0 0 0 1 1 1 0	
9	0 0 0 0 0 1 0 1	PI = Frame Size (Transmit)
10	0 0 0 0 0 0 1 0	PL = 2
11	2^{15} 2^{8}	PV=N201, Value of Transmitter
12	2^{7} 2^{0}	
13	0 0 0 0 0 1 1 0	PI = Frame Size (Receive)
14	0 0 0 0 0 0 1 0	PL = 2
15	2^{15} 2^{8}	PV = N201 Value of Receiver
16	2^{7} 2^{0}	
17	0 0 0 0 0 1 1 1	PI = Window Size (Transmit)
18	0 0 0 0 0 0 0 1	PL = 1
19	0 | 2^{6} 2^{0}	PV = K Value
20	0 0 0 0 1 0 0 1	PI = Retransmission Timer (T200)
21	0 0 0 0 0 0 0 1	PL = 1
22	2^{7} 2^{0}	T200 Value*

* Increments of 0.1 seconds; maximum range 25.5 seconds

Figure 22 SDLs for the Broadcast Data Link Procedures



4.9 SDLs for the point-to-point data link procedures

This section provides one example of an SDL representation of the point-to-point procedures of the data link layer, to assist in its understanding. This representation does not describe all of the possible actions of the data link layer entity. In particular, the non-partitioned representation does not show all possible interactions and imposes an order in the sequence of events that may not be necessary. A non-partitioned representation was chosen to minimize complexity in the SDL representation. This SDL representation should not therefore constrain implementations from exploiting the full flexibility of the procedures as presented within the text of this specification. The text description of the procedures is definitive.

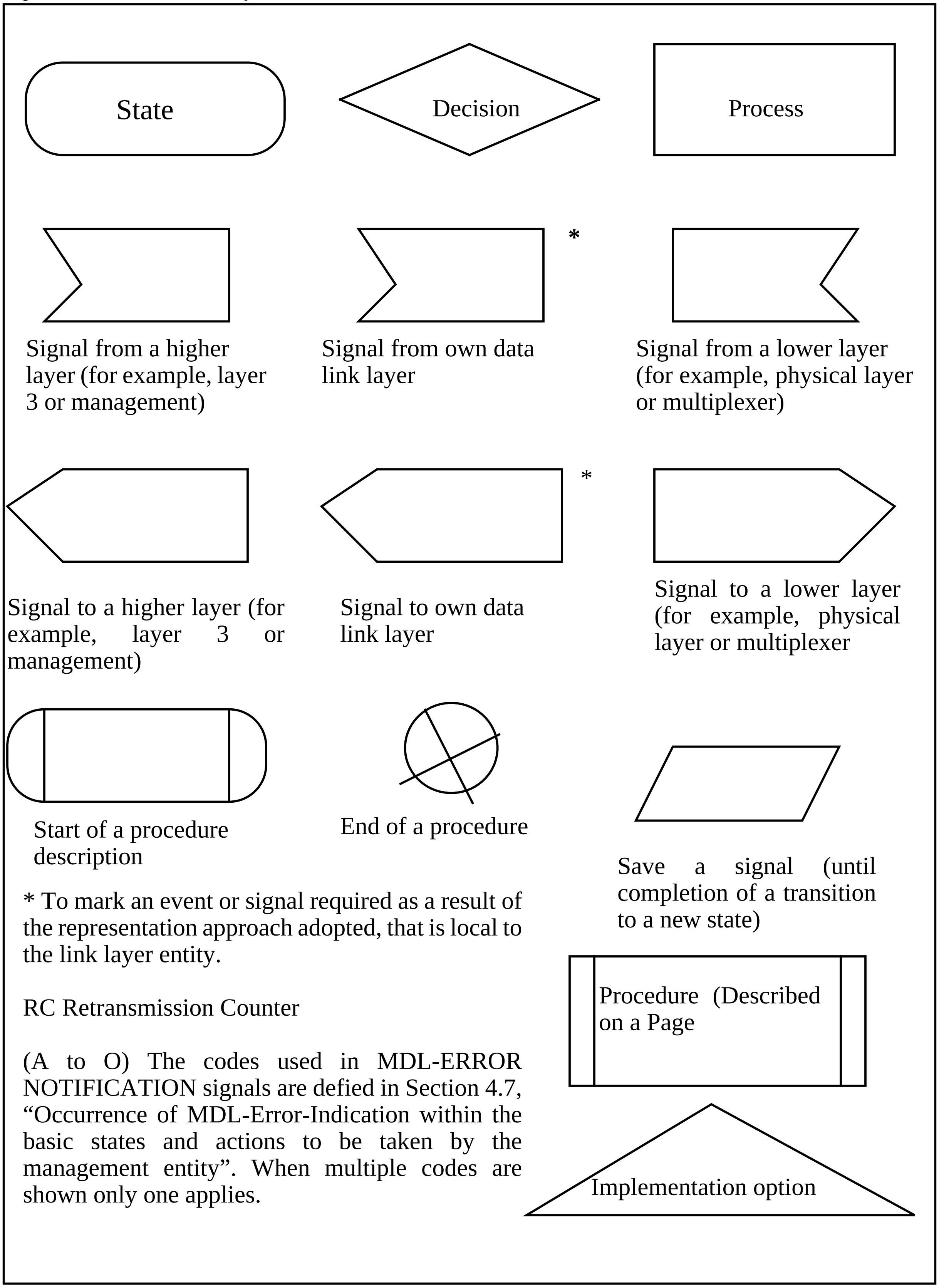
The representation is a peer-to-peer model of the point-to-point procedures of the data link layer and is applicable to the data link layer entities at both the user and network sides for all ranges of TEI values.

4.9.1 The use of queues

To enable a satisfactory representation of the data link layer entity, conceptual queues for the UI frame and I frame transmission have been explicitly brought out. These conceptual queues are finite, but unbounded, and should in no way restrict the implementation of the point-to-point procedures. Two additional signals have been provided to cause the servicing of these queues to be initiated, UI frame queued up, and I frame queued up.

The following symbols and abbreviations are used within the SDL representations. A full description of their meaning and application can be found in the CCITT Z series of recommendations:

Figure 23 Flow chart template

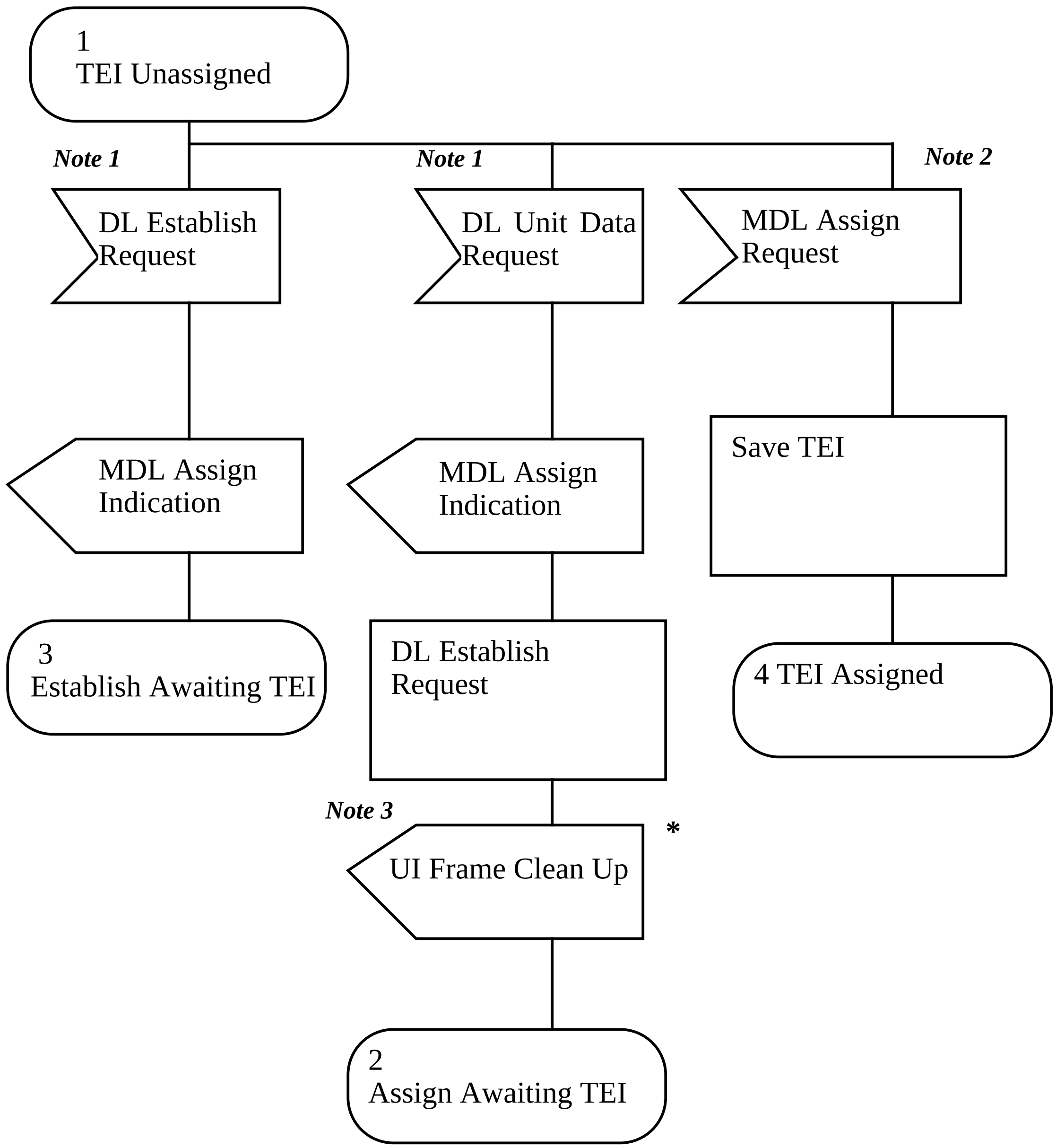


* To mark an event or signal required as a result of the representation approach adopted, that is local to the link layer entity.

RC Retransmission Counter

(A to O) The codes used in MDL-ERROR NOTIFICATION signals are defied in Section 4.7, “Occurrence of MDL-Error-Indication within the basic states and actions to be taken by the management entity”. When multiple codes are shown only one applies.

Figure 24 An SDL representation of the point -to-point data link procedures



Note: 1 The use of these events on the network side is for further study.

Note: 2 This function may be implemented over a geographically distributed architecture. This primitive may occur on initialization for fixed TEIs at the network side or as appropriate in order to correctly process a frame carrying a fixed TEI.

Chapter 5: Functional Call Control Signaling

5.1 General

This section contains the messages, information element (IE) encoding, and procedures for ISDN functional mode operation.

The messages, and IE encodings specified here are a complete set of those described in GR-268, *ISDN Interface Call Control Switching and Signaling Requirements*, and TR861, *ISDN Layer 3 Protocol Details for the Support of Supplementary Service*s. Unless indicated otherwise, all of the ISDN protocol and procedures specified herein are contained in this DMS-100 release. This release provides a comprehensive level of compliance to GR-268and CCITT recommendations Q.931 and Q.932.

Additional messages, procedures, and parameter encodings are specified to satisfy the signaling requirements of the interface. This additional signaling functionality has been added in such a way so as to align with the directions being taken in the relevant standardization bodies, CCITT, T1S1 and Bellcore, where clear directions have been given.

5.2 Overview of call control

5.2.1 Circuit-switched calls

5.2.1.1 Call states at the network side of the interface

The call states that may exist on the network side of the user-network interface are defined below:

- Null (State N0) - no call exists
- Call Initiated (N1) - exists for an outgoing call (from the user) when the network received a call establishment request but has not (yet) responded
- Overlap Sending (N2) - exists for an outgoing call when the network acknowledged the call establishment request from the user, and is prepared to receive additional information (if any) in the overlap mode

- Outgoing Call Proceeding (N3) - exists for an outgoing call when the network sent acknowledgment that it received all call information necessary to effect call establishment
- Call Delivered (N4) - exists for an outgoing call when the network indicated that remote user alerting was initiated
- Call Present (N6) - exists for an incoming (to the user) call when the network sent a call request, but has not (yet) received a satisfactory response
- Call Received (N7) - exists for an incoming call when the network received indication of alerting, but has not (yet) received an answer
- Connect Request (N8) - exists for an incoming call when the network received an answer, but has not (yet) awarded the call
- Incoming Call Proceeding (N9) - exists for an incoming call when the network received acknowledgment that the user received all call information necessary to effect call establishment
- Active (N10) - exists for an incoming call when the network awarded the call to the called user. It exists for an outgoing call when the network indicated that the remote user answered the call.
- Disconnect Request (N11) - exists when the network received a request from the user to clear the end-to-end connection (if any)
- Disconnect Indication (N12) - exists when the network disconnected the end-to-end connection (if any) within the network, and sent an invitation to disconnect the user-network connection
- Release Request (N19) - exists when the network requested the user to release, and is waiting for a response
- Call Abort (N22) - exists for an incoming call for the point to multi-point configuration, when the call is being cleared before being awarded to any user.

5.2.2 States associated with the Global Call Reference

5.2.2.1 Call states at the network side of the interface

The states which may exist on the network side of the user-network interface are:

- Null (Rest 0) - no transaction exists
- Restart Request (Rest 1) - exists for a re-start transaction when the network sent a re-start request but has not yet received an acknowledgment from the user

5.2.3 States associated with a Call-Independent connection

The call states that may exist on the network side of the user-network interface are defined in this section.

5.2.3.1 Call states at the network side of the interface

- Null (State N0) - no connection exists

- Call Independent Service (State N31) - exists for a call-independent connection after the network reserves a call reference for a network-initiated connection, or after the network accepts a user-initiated connection.

5.3 Protocol Version Control (PVC)

Protocol version control (PVC) is an optional procedure that allows the specific protocol version of various terminals to be identified and stored in the network. Using PVC, terminals can optionally query the stored information using the procedure described below. Using this protocol information, the network and the terminals then may tailor their respective protocols to effect communication.

A primary intention of PVC is to allow a terminal to continue to operate at a given functionality without forcing firmware upgrades as the office is upgraded to newer releases. The version of PVC that a terminal supports is manually datafilled in the network against the terminals service profile. Thus the differences in protocol on the point to point data link are transparent to the terminal. This manual datafill of PVC takes place regardless of whether the terminal vendor implements the optional PVC procedures.

Nortel BellCore TR-compliant Functional (NTTRF), Nortel Stimulus, and Nortel Meridian Feature Transparency (NTMFT) call control signaling methods are each identifiable within the network as a distinct protocol version. Within a particular version, different issue numbers are used to identify variations of the same protocol over time. For the Nortel Stimulus and Nortel Meridian Feature Transparency versions, the issue is defaulted to a value of 0.

5.3.1 Protocol versions and issue identification

As seen in Section 5.3, “Protocol Version Control (PVC)”, the NTTRF protocol version has issue code values. The purpose of setting up issue control within a protocol version is to inhibit terminal incompatible protocol from being sent to a terminal built to an earlier version of the specification.

Table 15 Protocol Version

Version Meaning	Issue Code Value	Specification
NT Stimulus	0	NIS-S208-2
NT BellCore TR compliant, Functional	1	NIS-S208-4
NT BellCore TR compliant, Functional (NI-1 and NI-2)	2	NIS-S208-6

5.3.2 Protocol description

There are two PVC operations:

1 version query (user-to-network), query current version issue

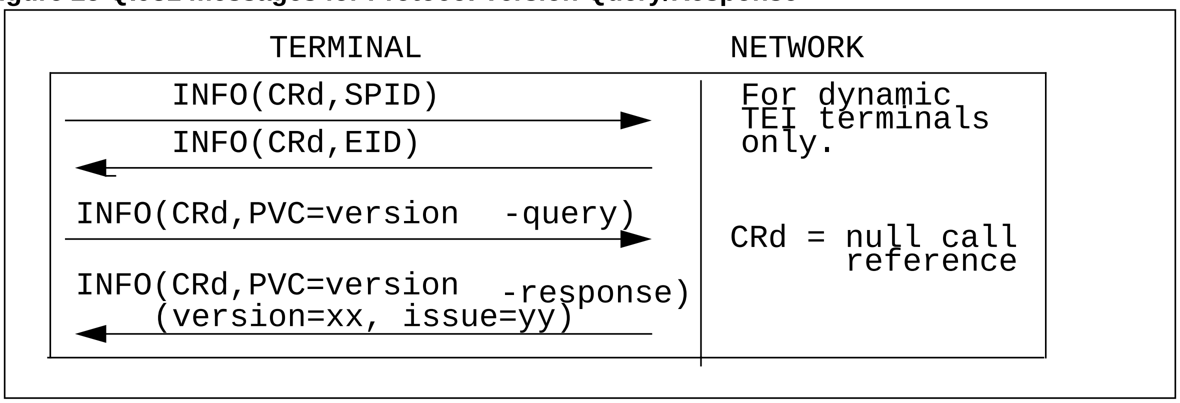
2 version response (network-to-user), respond to version query

> ***Note:*** Not an NI requirement; it is a DMS-100 option which terminals following National ISDN Guidelines are not recommended to use.

For PVC to be applicable to terminals implementing either or both stimulus or functional procedures, use the INFOrmation message-based sequence. Figure 25, “Q.931 messages for Protocol Version Query/Response”, details the message exchange between a terminal and network for querying the version-issue information stored in the network for the logical terminal.

The first two messages, SPID and EID, are only required for dynamic TEI terminals. Use the terminal initialization sequence to initialize the version query operation. The network uses the version response operation to respond with the stored value of the version-issue, or default version-issue for this logical terminal. There is no recovery action for lost messages.

Figure 25 Q.931 messages for Protocol Version Query/Response



5.4 Message functional definitions

Each definition includes the following information:

- a brief description of the message direction and use
- a table listing the IEs contained in the message; for each IE, the table indicates:
  - — the section of this specification in which it is described
  - — the direction in which it may be sent, that is, user to network (“u-to-n”) network to user (“n-to-u”) or both
  - — whether inclusion is mandatory (“M”), or optional (“O”), that is, provided if specified condition exists. Some explanatory notes (length(s) in octets) are provided to indicate when optional IEs are to be included in the message
  - — the length(s) in octets
  - — The IEs are listed in order of appearance in the message. The relative order of IEs is the same for all message types.
- further explanatory notes, as necessary.

5.4.1 Messages for Circuit-Mode connections

Table 16 Messages for circuit-mode connections

Messages for Circuit Mode connections	Reference
Call establishment messages	
ALERTing	Section 5.4.1.1, “ALERTing”
CALL PROCeeding	Section 5.4.1.2, “CALL PROCeeding”
CONNect	Section 5.4.1.3, “CONNect”
CONNect ACKnowledge	Section 5.4.1.4, “CONNect ACKnowledge”
PROGress	Section 5.4.1.16, “PROGress”
SETUP	Section 5.4.1.23, “SETUP”
SETUP ACKnowledge	Section 5.4.1.24, “SETUP ACKnowledge”
Call Clearing messages	
DiSConnect	Section 5.4.1.5, “DISConnect”
RELease	Section 5.4.1.18, “RELease”
RELease COMplete	Section 5.4.1.19, “RELease COMplete”
Terminal-identification messages	
INFOrmation	Section 5.4.1.10, “INFOrmation”
STATus	Section 5.4.1.26, “STATus”
STATus ENQuiry	Section 5.4.1.27, “STATus ENQuiry”
Supplementary Service Control messages	
HOLD	Section 5.4.1.7, “HOLD”
HOLD ACKnowledge	Section 5.4.1.8, “HOLD ACKnowledge”
HOLD REJect	Section 5.4.1.9, “HOLD REJect”
KEY HOLD	Section 5.4.1.11, “KEY HOLD”
KEY RELease	Section 5.4.1.12, “KEY RELease”
KEY SETUP	Section 5.4.1.13, “KEY SETUP”
KEY SETUP ACKnowledge	Section 5.4.1.14, “KEY SETUP ACKnowledge”
NOTIFY	Section 5.4.1.15, “NOTIFY”
RETRieve	Section 5.4.1.20, “RETRieve”
RETRieve ACKnowledge	Section 5.4.1.21, “RETRieve ACKnowledge”
RETRieve REJect	Section 5.4.1.22, “RETRieve REJect”
Call Independent Signaling messages	
FACility	Section 5.4.1.6, “FACility”
REGister	Section 5.4.1.17, “REGister”
RELease COMplete	Section 5.4.1.19, “RELease COMplete”
SEGMENT	Section 5.4.1.25, “SEGMENT”
STATus	Section 5.4.1.26, “STATus”
STATus ENQuiry	Section 5.4.1.27, “STATus ENQuiry”

5.4.1.1 ALERTing

ALERTing is sent by the called user to the network, and by the network to the calling user, to indicate that called user alerting has been initiated..

Table 17 ALERTing

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Channel Identification	Section 5.5.5.9, “Channel Identification information element”	u-to-n	O	3
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	M	3
Redirecting Number	Section 5.5.5.26, “Redirecting Number information element”	n-to-u	O	4-16
Redirection Number	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
Locking Shift **(%)**	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note: **(%)** denotes codeset change

- **Channel Identification -** included if the ALERTing is the first response to the SETUP for the basic call. If the channel identified by the called user is different from the one specified in the SETUP, the network initiates clearing as specified in Section 5.7.1.3, “Call clearing”.

  If the incoming SETUP indicates “no channel” (e.g., ACO and EKTS), the Channel Identification information element may optionally be included in the CONNect, and assigned as “any channel”, “preferred B1/B2”, or “exclusive B1/B2”. Further details on channel identification procedures for these supplementary services can be found under the description of these services in Chapter 6: Supplementary Services.

- **Progress Indicator** - included if the user is to be informed of an event that occurred during the life of a call
- **Signal** - included if the network is providing additional information describing tones
- **Re-directing Number** - included if the call has been re-directed, and the re-directing address is known
- **Re-direction Number** - included if the call has been re-directed, and the re-directed address is known
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text -** when available, it will be included by the network to notify the user of certain supplementary service information related to the call.

The length of this information element is variable, and the maximum length (*****) is dependent on its contents.

5.4.1.2 CALL PROCeeding

CALL PROCeeding is sent by the called-user to the network, or by the network to the calling user, to indicate that the requested call establishment has been initiated, and no more call establishment information will be accepted.

Table 18 CALL PROceeding

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Channel Identification	Section 5.5.5.9, “Channel Identification information element”	both	note	3
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Notification indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Called Party Number	Section 5.5.5.4, “Called Party Number information element”	n-to-u	O	4-27
Called Party Subaddress	Section 5.5.5.5, “Called Party Subaddress information element”	n-to-u	O	4-23
Redirection Number	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
Locking Shift **(%)**	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note: **(%)** denotes codeset change

- **Channel Identification -** if this is the first message in response to a SETUP, mandatory in the network-to-user direction, It is included in the user-to-network direction if this is the first response to the SETUP for a basic call. If the channel identified is different from the one specified in the SETUP, the network initiates clearing as specified in Section 5.7.1.3, “Call clearing”.

  If the incoming SETUP indicates “no channel” (for example, ACO and EKTS), the CID IE may optionally be included in the CONNect, and assigned as:

  — any channel

  — preferred B1/B2

— exclusive B1/B2

Further details on Channel Identification procedures for supplementary services are found under the descriptions of these services in Chapter 6: "Supplementary Services"

- **Progress Indicator** - included if the user is to be informed of an event that occurred during the life of a call
- **Notification Indicator** - included if the user is to be informed of information pertaining to call
- **Information Request** - included in the network-to-user direction, if the network either requests additional information, or indicates completion of the information request
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **Called Party Number** - included for supplementary services such as Automatic Dial, to inform the user of the actual called number used by the network
- **Called Party Subaddress** - included, if available, in the network-to-user direction during call pickup
- **Redirection Number** - included if the call has been re-directed, and the address where the call was re-directed is known
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. This information element’s length is variable, and its maximum length (*****) depends upon its contents.

5.4.1.3 CONNect

A CONNect is sent by the called user to the network, and by the network to the calling user to indicate call acceptance by the called user.

Table 19 CONNect

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Connected number	Section 5.5.5.10, “Connected Number information element”	n-to-u	O	4-16
Channel Identification	Section 5.5.5.9, “Channel Identification information element”	u-to-n	O	3
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Notification indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication (**+**)	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
User-User (**+**)	Section 5.5.5.33, “User-User information element”	both	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (**%**) denotes codeset change

Note 2: **+** = Not currently supported

- **Connected Number -** included if the connected number is known and is different from the original called party number
- **Channel Identification -** included if this message is the first response to a SETUP for basic call. If it is different for the case of an exclusive channel specified in the SETUP, the network initiates clearing as specified in Section 5.7.1.3, “Call clearing”

  If the incoming SETUP message indicates “no channel” (e.g., ACO or EKTS), the Channel Identification information element may optionally be included in the CONNect, and assigned as either:

  — any channel

  — preferred B1/B2

  — exclusive B1/B2

  Further details on channel identification procedures for these supplementary services can be found under the description of these services in Chapter 6: "Supplementary Services".

- **Progress Indicator** - included if the user is to be informed of an event that occurred during the life of the call
- **Notification Indicator** - included to inform the user of information pertaining to a call
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **User-User** - optionally supported; provides movement of information between ISDN users transparently
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*) dependents on its contents.

5.4.1.4 CONNect ACKnowledge

A CONNect ACKnowledge is sent by the network to the called user to indicate the user has been awarded the call. It may also be sent by the calling user to the network, to allow symmetrical call control procedures.

Table 20 CONNect ACKnowledge

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Connected number	Section 5.5.5.10, “Connected Number information element”	n-to-u	O	4-16
Channel Identification	Section 5.5.5.9, “Channel Identification information element”	n-to-u	O	3
Notification indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

- **Connected Number** - included when the address of the remote party connected to the call is available to the network
- **Channel Identification** - only allowed when the initial incoming SETUP indicates “no channel”. If the channel is successfully assigned, it is indicated as exclusive in the Channel Identification information element
- **Notification Indicator** - included if the user is to be informed of information pertaining to a call
- **Signal** - included if the network is providing additional information describing tones
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call, or to clear the display. Its length is variable, and its maximum length (*****) dependents on its contents.

5.4.1.5 DISConnect

A DISConnect is sent by the user when requesting the network to clear an end-to-end connection, or sent by the network to indicate that the end-to-end connection is cleared.

Table 21 DISConnect

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Cause	Section 5.5.5.8, “Cause information element”	both	M (note 2)	4-5
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Redirection Number	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
User-User **+**	Section 5.5.5.33, “User-User information element”	both	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (**%**) denotes codeset change; **+** = Not currently supported

Note 2: Cause is mandatory because the DISconnect is the first clearing message. If a DISConnect is received with the Cause information element missing, or having invalid contents, the actions taken are the same as if a DISconnect with cause #31 “normal, unspecified” were received.

- **Information Request** - included in the network-to-user direction if the network requests additional information, or it indicates completion of the information request
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **Redirection Number** - included if the call has been redirected, and the address where the call was redirected is known
- **User-User** - optionally supported: provides movement of information between ISDN users transparently
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text -** included by the network to notify the user of certain supplementary service information related to the call for display purposes, or to clear the display. The length of this information element is variable, and its maximum length (*****) is dependent on its contents.

5.4.1.6 FACility

A FACility may be sent by the network or user to request or acknowledge a service. The service to be invoked, and its associated parameters, are specified in the Facility information element.

Table 22 FACility

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Extended Facility (Note 1)	Section 5.5.5.12, “Extended Facility information element”	n-to-u	M	*
Facility (Note 2)	Section 5.5.5.13, “Facility information element”	both	M	8 - *

Note 1: The Extended Facility IE is used for Parameter Downloading only and is not included in the message when Service Profile Management is used.

Note 2: The Facility IE is used for Service Profile Management only is not included in the message when Parameter Downloading is used.

- **Extended Facility** - carries a single component between the network and the user. Its length is variable, and its maximum length (*) depends on its contents.

- **Facility** -the request or acknowledgment of an application service, the invocation and operation of services identified by the service discriminator, and the operation value within the component. Its length is variable, and its maximum length (*****) dependents on its contents.

5.4.1.7 HOLD

A HOLD is sent by the user, or the network, to request the HOLD service for an existing call.

Table 23 HOLD

Information Element	**Reference**	**Direct**	**Type**	**Length**
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication (**+**)	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5

Note: **+** =Not currently supported

- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature.

5.4.1.8 HOLD ACKnowledge

A HOLD ACKnowledge is sent by the user, or network, to indicate that the HOLD was successfully performed.

Table 24 HOLD ACKnowledge

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication (+)	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note: + = Not currently supported

- **Notification Indicator -** included if the user is to be informed of information pertaining to a call
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication -** included in the network-to-user direction, if the user is to be informed of the current status of the identified feature
- **Display Text -** when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*) dependents on its contents.

5.4.1.9 HOLD REJect

A HOLD REJect is sent by the user, or network, to indicate denial of a request to hold a call.

Table 25 HOLD REJect

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Cause	Section 5.5.5.8, “Cause information element”	both	M	4-5

5.4.1.10 INFOrmation

An INFOrmation is sent by the user, or network, to provide additional information. It may be used to provide information for call establishment (e.g., overlap-sending) or miscellaneous call-related information.

Table 26 INFOrmation

Information Element	**Reference**	**Direct**	**Type**	**Length**
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	1-3
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	1
Message Type	Section 5.5.4, “Message type”	both	M	1
Cause	Section 5.5.5.8, “Cause information element”	n-to-u	O	4-5
Connected number	Section 5.5.5.10, “Connected Number information element”	n-to-u	O	4-16
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Keypad	Section 5.5.5.19, “Keypad information element”	u-to-n	O	3-34
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Activation	Section 5.5.5.14, “Feature Activation information element”	u-to-n	O	3-4
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Service Profile Identification	Section 5.5.5.29, “Service Profile Identification information element”	both	O	3-22
First Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	n-to-u	O	4-6
Second Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	n-to-u	O	4-6
Third Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	n-to-u	O	4-6
Endpoint Identifier	Section 5.5.5.11, “Endpoint Identifier information element”	n-to-u	O	3-4
Called Party Number	Section 5.5.5.4, “Called Party Number information element”	both	O	6-29
Redirection Number	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
Locking Shift **(%)**	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*
Redirecting Number	Section 5.5.5.26, “Redirecting Number information element”	n-to-u	O	4-16
Protocol Version Control **(%)**	Section 5.5.7.3, “Protocol Version Control information element”	both	O	3-5 (Note 3)

Note 1: **(%)** - Denotes codeset change

Note 2: **+** - Not currently supported

Note 3: - A maximum of 5 octets is supported at this time.

- **Cause** - included under certain supplementary service error conditions
- **Connected Number** - included if the connected number is known and is different from the original called party number
- **Progress Indicator** - included if the user is to be informed of an event that occurred during the life of a call
- **Keypad** - included by the user to transfer called party number information to the network during overlap sending. The Keypad information element is also included by the user to transfer other supplementary service information (for example, dial access code)
- **Information Request** - included in the network-to-user direction if the network requests additional information or indicates completion of the information request
- **Signal** - included if the network is providing additional information describing tones
- **Feature Activation** - included in the user-to-network direction for invocation of supplementary services, as defined in Chapter 6: "Supplementary Services"
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **Service Profile Identification** - included for terminal initialization procedures
- **Bearer Capability** - only included for downloading TSP information during Automated SPID initialization. This IE can be included up to three times in an INFOrmation message
- **Endpoint Identifier** - included to identify the endpoint identifier assigned to a terminal
- **Called Party Number** - provides call routing information, type of number, numbering plan identification, and digits dialed. Included in the user to network direction for downloading TSP information during Automated SPID initialization
- **Redirection Number** - included if the call has been redirected, and the address where the call was redirected is known
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length **(*)** dependents on its contents

- **Protocol Version Control** - an optional procedure allowing the specific protocol version of various terminals to be identified and stored in the network.

5.4.1.11 KEY HOLD

A KEY HOLD is sent by the network to inform the non-selected members of the EKTS group that the incoming call was answered.

Table 27 KEY HOLD

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Cause	Section 5.5.5.8, “Cause information element”	n-to-u	O	4-5
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

- **Cause** - included under certain supplementary service error conditions
- **Notification Indicator** - included if the user is to be informed of information pertaining to privacy on an EKTS call
- **Signal** - included if the network is providing additional information describing tones
- **Display Text -** when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*****) is dependent on its contents.

5.4.1.12 KEY RELease

A KEY RELease, sent by the network, notifies an EKTS member that the call is not to be cleared.

Table 28 KEY RELease

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	2
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Feature Indication (+)	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*****

Note: (**%**) = Denotes codeset change + = Not currently supported

- **Notification Indicato**r - informs the user of information pertaining to a call
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **Locking Shift** - included if network or national specific information elements are included. It is used to indicate the new active codeset. The specified codeset remains active until another locking shift information element is encountered, specifying the use of another codeset
- **Display Text** -when display information is available, included by the network to notify the user of certain supplementary service information related to the call, or to clear the display. Its length is variable, and its maximum length (*****) is dependent on its contents.

5.4.1.13 KEY SETUP

A KEY SETUP is sent by the network, to members of an EKTS group, indicating that an outgoing EKTS call was initiated.

Table 29 KEY SETUP

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	2
Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	n-to-u	M	4-6
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Endpoint Identifier	Section 5.5.5.11, “Endpoint Identifier information element”	n-to-u	O	3-4
Called Party Number	Section 5.5.5.4, “Called Party Number information element”	n-to-u	M	4-27
User-User (**+**)	Section 5.5.5.33, “User-User information element”	n-to-u	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*
Call Appearance	Section 5.5.7.1, “Call Appearance information element”	n-to-u	O	1

Note 1: (%) = Denotes codeset change

Note 2: + = Not currently supported

- **Notification Indicator -** included if the user is to be informed of information pertaining to a call
- **User-User** - optionally supported; provides movement of information between ISDN users transparently
- **Locking Shift -** included if network or national specific IEs are included.
- **Display Text -** when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (***)** dependents on its contents
- **Call Appearance -** included to identify the intercom group for an intercom call.

5.4.1.14 KEY SETUP ACKnowledge

A KEY SETUP ACKnowledge is sent by the user in response to a KEY SETUP sent by the network.

Table 30 KEY SETUP ACKnowledge

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	u-to-n	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	u-to-n	M	2-3
Message Type	Section 5.5.4, “Message type”	u-to-n	M	2

5.4.1.15 NOTIFY

A NOTIFY is sent by the network to indicate information pertaining to a call.

Table 31 NOTIFY

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	n-to-u	M	4-6
Cause	Section 5.5.5.8, “Cause information element”	n-to-u	O	4-5
Connected number	Section 5.5.5.10, “Connected Number information element”	n-to-u	O	4-16
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication (+)	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Calling Party Number	Section 5.5.5.6, “Calling Party Number information element”	n-to-u	O	4-16
Calling Party Subaddress (+)	Section 5.5.5.7, “Calling Party Subaddress information element”	n-to-u	O	4-23
Called Party Number	Section 5.5.5.4, “Called Party Number information element”	n-to-u	O	10
Called Party Subaddress	Section 5.5.5.5, “Called Party Subaddress information element”	n-to-u	O	4-23
Redirecting Number	Section 5.5.5.26, “Redirecting Number information element”	n to u	O	4-16
Redirection Number	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
User-User (**+**)	Section 5.5.5.33, “User-User information element”	n-to-u	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (%) = Denotes codeset change

Note 2: **+** = Denotes not supported

- **Bearer Capability** - included to indicate the Bearer capability that the NOTIFY applies to, as applicable for supplementary services
- **Connected Number** - when available, included for supplementary services such as Executive Busy Override
- **Notification Indicator** - included if the user is to be informed of information pertaining to the call
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature
- **Calling Party Number** - included when applicable for supplementary services
- **Calling Party Subaddress** - included to update a subaddress associated with the origin of the call
- **Called Party Subaddress** - included to update a subaddress associated with the called interface
- **Redirection Number** - included when applicable for supplementary services
- **User-User** - optionally supported; provides movement of information between ISDN users transparently.
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*) is dependent on its contents

5.4.1.16 PROGress

The network sends a PROGress to indicate the progress of a call, in the event of interworking or in relation with the provision of in-band information/patterns.

Table 32 PROGress

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Cause	Section 5.5.5.8, “Cause information element”	n-to-u	O	4-5
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	M	4
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
User-User (**+**)	Section 5.5.5.33, “User-User information element”	n-to-u	O	3-131
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note: + = Not currently supported

- **Cause** - included to provide additional information when there is both in-band treatment applied to the call and also a cause which maps to that in-band treatment. Otherwise, it is not included
- **Progress Indicator** - included if the user is to be informed of an event that occurred during the life of a call
- **Notification Indicator** - included if the user is to be informed of information pertaining to the call
- **Signal** - included if the network is providing additional information describing tones
- **User-User** - optionally supported; provides movement of information between ISDN users transparently
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*****) is dependent on its contents.

5.4.1.17 REGister

A REGister is sent by the user or network to assign a new call reference for call-independent connections.

Table 33 REGister

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Extended Facility (Note 1)	Section 5.5.5.12, “Extended Facility information element”	u-to-n	M	*
Facility (Note 2)	Section 5.5.5.13, “Facility information element”	both	M	11-*

Note 1: The Extended Facility information element is included only when a terminal is requesting Parameter Downloading

Note 2: The Facility information element is only included when a terminal is requesting Service Profile Management

- **Extended Facility -** carries a single component between the network and the user. Its length is variable, and its maximum length (*) depends on its contents.

- **Facility** -the request or acknowledgment of an application service, the invocation and operation of services identified by the service discriminator, and the operation value within the component. Its length is variable, and its maximum length (*****) dependents on its contents.

5.4.1.18 RELease

A RELease is sent, from either the user or network, to indicate that:

- the equipment sending the message has disconnected
- intends to release the channel and call reference
- the receiving equipment should release the channel and prepare to release the call reference after sending RELease COMplete.

Table 34 RELease

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Cause	Section 5.5.5.8, “Cause information element”	both	Note 3	4-6
Channel Identification (**+**)	Section 5.5.5.9, “Channel Identification information element”	n-to-u	O	3
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Redirection Number (**+**)	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
User-User (**+**)	Section 5.5.5.33, “User-User information element”	n-to-u	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (**%**) = Denotes codeset change

Note 2: **+** = Not currently supported

Note 3: Cause is mandatory if the RELease is the first clearing message, including when it is sent as a result of an error handling condition. Otherwise, it is not included. Where the RELease is sent due to expiry of T305 (after sending DISConnect), the cause number should be the same as that originally included in the DISConnect.

- **Channel Identification** - mandatory in the network-to-user direction. If not included in the user-to-network direction, its absence is interpreted as “any channel acceptable”
- **Information Request** - included in the network-to-user direction to request additional information, or indicate completion of the information request
- **Signal** - included if the network is providing additional information describing tones

- **Feature Indication** - included in the network-to-user direction, if the user is to be informed of the current status of the identified feature
- **Redirection Number**- included if the call has been redirected and the address to which the call has been redirected is known
- **User-User** - optionally supported; provides movement of information between ISDN users transparently
- **Locking Shift** - included if network or national specific information elements are included
- **Display Text** - included by the network to notify the user of certain supplementary service information related to the call for display purposes, or to clear the display. Its length is variable, and its maximum length (*****) dependents on its contents.

5.4.1.19 RELease COMplete

A RELease COMplete is sent by the user or network, to indicate that:

- the equipment sending the message has released the channel (if any) and call reference
- the channel is available for re-use
- the receiving equipment shall release the channel and call reference

Table 35 RELease COMplete

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	O	1
Cause	Section 5.5.5.8, “Cause information element”	both	O	4-5
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Redirection Number (**+**)	Section 5.5.5.27, “Redirection Number information element”	n-to-u	O	6-13
User-User (**+**)	Section 5.5.5.33, “User-User information element”	n-to-u	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (%) = Denotes codeset change; + =Not currently supported

Note 2: Cause may be included when the RELease COMplete is sent as a result of an error handling condition.

Note 3: Cause is mandatory if this is the first clearing message, including when the RELease COMplete is sent as a result of an error handling condition. Otherwise, it is not included.

- **Information Request** - included in the network-to-user direction, if the network requests additional information, or indicates completion of the information request
- **Signal** - included if the network is providing additional information describing tones
- **Feature Indication** - included in the network-to-user direction, if the user is to be informed of the current status of the identified feature
- **Redirection Number** - included if the call has been re-directed and the address to which the call has been redirected is known.
- **User-User** - optionally supported; provides movement of information between ISDN users transparently

- **Display Text** - included by the network to notify the user of certain supplementary service information related to the call for display purposes, or to clear the display. Its length is variable, and its maximum length (*) dependents on its contents.

5.4.1.20 RETRieve

A RETRieve is sent by the user or network to request retrieval of a held call.

Table 36 RETRieve

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, "Protocol discriminator"	u-to-n	M	1
Call Reference	Section 5.5.3, "Call Reference information element"	u-to-n	M	2-3
Message Type	Section 5.5.4, "Message type"	u-to-n	M	1
Channel Identification	Section 5.5.5.9, "Channel Identification information element"	note 2	note 2	3

Note 1: Only the user-to-network direction, as shown in the message layout above, is currently supported.

Note 2: If the Channel Identification is not included, it is interpreted as "any channel acceptable". In the user-to-network direction this information element is optional. In the network-to-user direction it is mandatory, however, the network-to-user direction is not supported at this time.

5.4.1.21 RETRieve ACKnowledge

A RETRieve ACKnowledge is sent by the user or network to indicate that the retrieve function has been successfully performed.

Table 37 RETRieve ACKnowledge

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Connected number	Section 5.5.5.10, “Connected Number information element”	n-to-u	O	4-16
Channel Identification (+)	Section 5.5.5.9, “Channel Identification information element”	note	M	3
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	n-to-u	O	1
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*

Note 1: (**%**) Denotes codeset change

Note 2: + = Not currently supported

Note 3: Direction is shown as “Both”, however only the network-to-user direction, as shown in the message layout above, is currently supported.

- **Connected Number** - when this information is available to the network, included to notify the user of the address of the remote party connected to the call.
- **Channel Identification** - to be handled in both directions, however only the network-to-user direction is currently supported.
- **Notification Indicator** - included if the user is to be informed of information pertaining to a call.
- **Signal** - included if the network is providing additional information describing tones.
- **Feature Indication** - included in the network-to-user direction to inform the user of the current status of the identified feature.
- **Display Text** - included by the network to notify the user of certain supplementary service information related to the call for display purposes. Its length is variable, and its maximum length (*) is dependent on its contents.

5.4.1.22 RETRieve REJect

A RETRieve REJect indicates an inability to perform the requested retrieve function.

Table 38 RETRieve REJect

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Cause	Section 5.5.5.8, “Cause information element”	n-to-u	M	4-5

Note: Direction is shown as “Both”, however only the network-to-user direction is currently supported.

5.4.1.23 SETUP

A SETUP is sent by the calling user to the network, or by the network to the called user to initiate call establishment. When SETUP is sent by the network, the broadcast data link is always used.

Table 39 SETUP

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Bearer Capability	Section 5.5.5.2, “Bearer Capability information element”	both	M	4-6
Channel Identification (+)	Section 5.5.5.9, “Channel Identification information element”	Note 1	O	3
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Keypad	Section 5.5.5.19, “Keypad information element”	u-to-n	O	3-34
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	M	3
Feature Activation	Section 5.5.5.14, “Feature Activation information element”	u-to-n	O	3-4
Endpoint Identifier	Section 5.5.5.11, “Endpoint Identifier information element”	n-to-u	O	3-4
Information Rate	Section 5.5.5.17, “Information Rate information element”	Note 2	O	6
Transit Delay Selection and Indication (+)	Section 5.5.5.31, “Transit Delay Selection and Indication information element”	Note 2	O	5
Packet Layer Binary parameters (+)	Section 5.5.5.22, “Packet-Layer Binary Parameters information element”	Note 2	O	3
Packet Layer Window Size (+)	Section 5.5.5.23, “Packet-Layer Window Size information element”	Note 2	O	3-4
Packet Size (+)	Section 5.5.5.24, “Packet Size information element”	Note 2	O	3-4
Calling Party Number	Section 5.5.5.6, “Calling Party Number information element”	both	O	4-16
Calling Party Subaddress (+)	Section 5.5.5.7, “Calling Party Subaddress information element”	both	O	4-23
Called Party Number	Section 5.5.5.4, “Called Party Number information element”	both	O	6-29
Called Party Subaddress	Section 5.5.5.5, “Called Party Subaddress information element”	both	O	4-23
Redirecting Number	Section 5.5.5.26, “Redirecting Number information element”	n-to-u	O	4-16
Transit Network Selection	Section 5.5.5.32, “Transmit Network Selection information element”	u-to-n	O	6-7
Low-Layer Compatibility	Section 5.5.5.20, “Low-Layer Compatibility information element”	both	O	4-16

Information Element	Reference	Direct	Type	Length
High-Layer Compatibility	Section 5.5.5.16, “High-Layer Compatibility information element”	both	O	4-5
User-User (**+**)	Section 5.5.5.33, “User-User information element”	both	O	3-131
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	u-to-n	O	1
Operator System Access	Section 5.5.6.1, “Operator System Access information element”	u-to-n	O	3
Display Text	Section 5.5.6.2, “Display Text information element”	n-to-u	O	4-*
Locking Shift (**%**)	Section 5.5.5.1.2, “Locking Shift procedure”	both	O	1
Closed User Group (**+**)	Section 5.5.7.2, “Closed User Group information element”	Note 3	O	4-7
Reverse Charging Indication (**+**)	Section 5.5.7.5, “Reverse Charging Indication information element”	n-to-u	O	3
Redirecting Subaddress (**+**)	Section 5.5.7.4, “Redirecting Subaddress Information Element”	Note 4	O	4-23
Call Appearance	Section 5.5.7.1, “Call Appearance information element”	Note 5	O	3-4

Note: (**%**) = Denotes codeset change; + = Not currently supported

Note 1: Channel identification information element is mandatory in the network-to-user direction. However, for some features (e.g., ACO and EKTS), the network codes the Channel identification information element as “no channel indicated”, and a channel for the offered call must be negotiated. If not included in the user-to-network direction, its absence is interpreted as “any channel acceptable”.

Note 2: Included for packet-mode calls when notification is unconditional and in the network-to-user direction only.

Note 3: Closed User Group (CUG) is included for packet-mode calls when notification is unconditional, and a CUG selection or CUG/OA selection facility is received in the X.25 call request packet.

Note 4: Redirecting Subaddress is included if the redirecting number is delivered, and the subaddress is provided by the forwarding party; N/A for packet.

Note 5: Call Appearance is included to identify the intercom group for an intercom call. It is included as specified in EKTS.

Note 6: Restricted to non-packet-mode bearer capabilities.

Note 7: Also applies to packet-mode in the network-to-user direction.

- **Progress Indicator** - included if an interworking situation occurred
- **Keypad** - used either for en bloc or overlap sending when the called party number information element is not used
- **Signal** - used by the network to convey information to the user regarding tones and alerting signals
- **Feature Activation** - included in the user-to-network direction for invocation of supplementary services, as defined in Section 5.5.5.18, “Information Request information element”
- **Endpoint Identifier** - included to identify the terminal(s) to which the message is destined (only included for EKTS terminals; not currently supported for hunt terminals).
- **Information Rate** - indicates the information rate signaled on the incoming X.25 packet call to the terminating packet subscriber.
- **Transit Delay Selection/and Indication** - indicates the maximum permissible transit delay applicable on a per virtual call basis.
- **Packet Layer Binary Parameters** -indicates the requested layer 3 parameter values for the incoming X.25 packet-mode call to the terminating packet subscriber.
- **Packet Layer Window Size** - indicates the requested layer 3 window size to be used on each direction for the incoming X.25 packet call to the terminating packet subscriber.
- **Packet Size** - indicates the requested packet sizes to be used in each direction for the incoming X.25 packet call to the terminating packet subscriber.
- **Calling Party Number** - required in the user-to-network direction if the calling party number to be used is not the default number for the interface, or if the calling party subaddress is included in the SETUP. In the network-to-user direction, this information is made available to the called user upon subscription to Calling Number Delivery. (See Section 8.4.12, “Calling number delivery service”)
- **Calling Party Subaddress** - if subscribed to in the user-to-network direction, included to identify a subaddress associated with the origin of the call. This subaddress is present in the network-to-user direction when supplied by the calling user and is successfully transferred through the network. (For the network-to-user direction, its presence is only valid if calling party number is also present in the SETUP). (Note 7)
- **Called Party Number** - mandatory in the network-to-user direction for basic call. It may not be present when certain supplementary services are in effect (see Section 5.7.1.2.1, “Incoming Call”).
- **Called Party Subaddress** - included to verify a subaddress associated with the called interface. (Note 7)
- **Redirecting Number** - included to identify the number from which call re-direction was invoked.
- **Transit Network Selection** - provides information such as Type of Network, Network identification plan, and the Network identification.

Alternatively, the Keypad information element may be used for this purpose.

- **Low-Layer Compatibility** - if subscribed to in the user-to-network direction, and provided in the outgoing SETUP; included to allow remote users to check compatibility, unless it could not be successfully transferred through the network. (Note 6)
- **High-Layer Compatibility** - included to allow remote users to check compatibility. (Note 6)
- **User-User** - optionally supported; provides movement of information between ISDN users transparently.
- **Locking Shift** - included if network or national specific information elements are included.
- **Operator System Access** - used to indicates the required operator through Type of access. Alternatively, use the Keypad information element for this purpose.
- **Display Text** - when display information is available, included by the network to notify the user of certain supplementary service information related to the call. Its length is variable, and its maximum length (*) is dependent on its contents.
- **Reverse Charging Indication** - included by the network in the SETUP for packet- mode calls when the user subscribes to Unconditional Notification, and an X.25 reverse charging facility is included in the X.25 incoming call packet.
- **Call Appearance** - included to identify the intercom group for an intercom call.

5.4.1.24 SETUP ACKnowledge

A SETUP ACKnowledge is sent by the network to the calling user to indicate call establishment has been initiated, but will not proceed until additional information is exchanged.

Table 40 SETUP ACKnowledge

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Channel Identification	Section 5.5.5.9, “Channel Identification information element”	n-to-u	M	3
Progress Indicator	Section 5.5.5.25, “Progress Indicator information element”	n-to-u	O	4
Notification Indicator	Section 5.5.5.21, “Notification Indicator information element”	n-to-u	O	3
Information Request	Section 5.5.5.18, “Information Request information element”	n-to-u	O	3
Signal	Section 5.5.5.30, “Signal information element”	n-to-u	O	3
Feature Indication	Section 5.5.5.15, “Feature Indication information element”	n-to-u	O	4-5

- **Progress Indicator** - included if an interworking situation has occurred
- **Notification Indicator** - included if the user is to be informed of information pertaining to a call
- **Information Request** - included in the network-to-user direction if the network requests additional information, or the network indicates completion of the information request
- **Signal** - used by the network to convey information to the user regarding tones and alerting signals
- **Feature Indication** - included in the network-to-user direction if the user is to be informed of the current status of the identified feature

5.4.1.25 SEGMENT

The switch sends the SEGMENT message when the layer 3 messages are longer than the length of frames that the data link layer can support and the message is partitioned in several segments

Table 41 Segmented Message

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1
Segmented Message	Section 5.5.5.28, “Segment Message information element”	n-to-u	M	4
	Continuation of Extended Facility information element from previous message.			*

The length of this information element variable, and its maximum length (*) dependents on its contents.

5.4.1.26 STATus

A STATus, when sent by the user, can only be in response to a STATus ENQuiry. It may be sent by the network to report certain error conditions.

Table 42 STATus

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	both	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	both	M	2-3
Message Type	Section 5.5.4, “Message type”	both	M	1
Cause	Section 5.5.5.8, “Cause information element”	both	M	4-6
Call State	Section 5.5.5.3, “Call State information element”	both	M	3

Cause- describes the reason for generating certain messages, provides diagnostic information in the event of procedural errors, and indicates the location of the cause indicator

Call State - describes the current status of the call independent connection.

5.4.1.27 STATus ENQuiry

A STATus ENQuiry is sent by the network at any time during a call signaling connection to solicit a STATUS from the user.

Table 43 STATus ENQuiry

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Section 5.5.2, “Protocol discriminator”	n-to-u	M	1
Call Reference	Section 5.5.3, “Call Reference information element”	n-to-u	M	2-3
Message Type	Section 5.5.4, “Message type”	n-to-u	M	1

5.5 Message structure

The figures and text in this section describe message contents. Within each octet, the bit designated “bit 1” is transmitted first, followed by bits 2, 3, 4, and so forth. Similarly, the octet shown at the top of each figure is sent first.

This section defines the encoding of all information elements contained within the protocol messages specified in Section 5.4, “Message functional definitions”. Only those information elements currently defined in this section apply to the message sequences in this software release.

5.5.1 Overview

Within this protocol, every message consists of the following elements:

1 Protocol Discriminator

2 Call Reference

3 Message Type

4 Other information elements, as required

Information elements 1, 2, and 3, above, are common to all the messages and must always be present, while information element(s) 4 are specific to each message type.

This organization is illustrated in the example shown in Table 44, “General Message Organization example”.

Table 44 General Message Organization example

Bits								Octet #
8	7	6	5	4	3	2	1	
Protocol Discriminator								1
0	0	0	0	Length of Call Reference value (in octets)				2
Call reference flag and value								3
0	Message Type							etc.
Other Information Elements as Required								

- The maximum message length is 260 octets.
- A particular message may contain more information than a particular (user or network) equipment needs, or can understand.
- All equipment should be able to ignore any extra information, not required for the proper operation of that equipment, present in a message. For example, the recipient may ignore the calling party number, if it is of no interest to the receiver.
- Unless specified otherwise, a particular information element may be present only once in a given message.
- The term “default” implies that the value defined should be used in the absence of any assignment or the negotiation of alternative values.

- When a field, such as the reference field value, extends over more than one octet, the order of bit values progressively decreases as the octet number increases.
- The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of that field.

5.5.2 Protocol discriminator

The protocol discriminator distinguishes messages for user-network call control from other messages. It is the first part of every message and is coded according to Table 45, “Protocol discriminator”.

Table 45 Protocol discriminator

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
Q. 931 (I.451) user-network call control message Protocol Discriminator								1
0	0	0	0	1	0	0	0	

Note: Q.931(I.451) user network call control messages.

5.5.3 Call Reference information element

The call reference identifies the call request at the local user-network interface to which the particular message applies. It does not have end-to-end significance across ISDNs.

Note: The term call also refers to a call independent signaling connection.

- It is the second part of every message.
- Its length is indicated in octet 1, bits 1-4.
- The maximum length of the call reference value is 2 octets.
- The terminal should support call reference lengths of both 1 and 2 octets.
- The actions taken by the receiver are based on the numerical value of the call reference, and are independent of the length of the Call Reference information element (see Table 46, “Examples of encoding for Call Reference information element”).
- The Call Reference information element includes the call reference value and flag.
- Call reference values are assigned by the origination side of the interface for a call.
  - They are unique to the origination side only within a particular D-channel layer 2 logical link connection.
  - Its value is assigned at the beginning of a call, and remains fixed for the lifetime of the call.
  - After a call ends, its call reference value may be reassigned.
  - Two identical call reference values on the same D-channel layer 2 logical link connection may be used when each value pertains to a call originated at opposite ends of the link.

- — The call reference flag takes the value 0 or 1.
  - – The flag identifies which end of the layer 2 logical link originated a call reference value.
  - – The origination side always sets the call reference flag to 0.
  - – The destination side always sets the call reference flag to a 1.
  - – Hence the call reference flag identifies who allocated the call reference value for this call, and the only purpose of the call reference flag is to resolve simultaneous attempts to allocate the same value.
- The Call Reference information element containing a null call reference is one octet long and is coded 0000 0000, as shown in Table 46, “Examples of encoding for Call Reference information element”.
- The null call reference is used only for stimulus invocation of supplementary services.It is used for terminal identification procedures only

Table 46 Examples of encoding for Call Reference information element

Bits								**Call Reference information element**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Octet**
0	0	0	0	Length of CR value (in octets)				Octet 1
0								Octet 2 The message is sent from the side that originates the CR (CR Flag = 0, bit 8)
1								Octet 2 The message is sent to the side that originates the CR (CR Flag = 1, bit 8)
Null Call Reference								
0	0	0	0	Length of CR value (in octets)				Octet 1
One-Octet Call Reference value								
0	0	0	0	Length of CR value (in octets)				
0	0	0	0	0	0	0	1	Octet 1
0/1 flag	0	0	1	1	1	0	1	Octet 2
Two-Octet Call Reference value								
0	0	0	0	Length of CR value (in octets)				
0	0	0	0	0	0	1	0	Octet 1
0/1 flag	0	0	0	0	0	0	0	Octet 2
0	0	0	1	1	1	0	1	Octet 3

5.5.4 Message type

Message type, as illustrated in Table 47, "Message type,” on page 172, identifies the function of the message being sent. It is the third part of every message. Code it as shown there. (Bit 8 is reserved for possible future use as an extension bit.)

Table 47 Message type

Bits								**Message types**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Octet**
0	message type							Octet 1
1	Network Specific Message Type							Octet 2 (*) (included if octet 1 is coded “0000 0000”
0	0	0	0	0	0	0	0	Escape to network specific message type
message types								
0	0	0	Call Establish messages					
			0	0	0	0	1	ALERTing
			0	0	0	1	0	CALL PROCeeding
			0	0	1	1	1	CONNect
			0	1	1	1	1	CONNect ACKnowledge
			0	0	0	1	1	PROGress
			0	0	1	0	1	SETUP
			0	1	1	0	1	SETUP ACKnowledge
0	0	1	Call Information Phase messages					
			0	0	1	0	0	HOLD
			0	1	0	0	0	HOLD ACKnowledge
			1	0	0	0	0	HOLD REJect
			1	0	1	0	1	RETRieve
			1	0	0	1	1	RETRieve ACKnowledge
			1	0	1	1	1	RETRieve REJect
0	1	0	Call Clearing messages					
			0	0	1	0	1	DISConnect
			0	1	1	0	1	RELease
			1	1	0	1	0	RELease COMplete
			0	0	1	1	0	RESTart
			0	1	1	1	0	RESTart ACKnowledge
0	1	1	Miscellaneous messages					
			0	0	0	0	0	SEGMENT
			0	0	0	1	0	FACility
			0	0	1	0	0	REGister
			1	1	0	1	1	INFOrmation
			0	1	1	1	0	NOTIFY
			0	0	1	0	0	REGister
			1	1	1	0	1	STATus
			1	0	1	0	1	STATus ENQuiry

5.5.4.1 Network specific message types

Use a 2-octet element to encode network specific message types (refer to Table 60, “Call State information element”) for supplementary services. Encode the first octet as all zeros, indicating an escape to a network specific coding scheme. Bit 8 of octet 2 is coded as “1”.

Table 48 Network specific message types

Bits								Network-specific Message (octet 2)
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	-	-	-	-	-	-	-	(Network-specific messages)
1	1	1	1	1	0	1	1	KEY HOLD
1	1	1	1	1	1	0	0	KEY RELease
1	1	1	1	1	1	0	1	KEY SETUP
1	1	1	1	1	1	1	0	KEY SETUP ACKnowledge

5.5.5 Other Information Elements

5.5.5.1 Coding rules

The coding of other information elements follows the coding rules described below. They are formulated to allow each equipment which processes a message to find information elements important to it, and yet remain ignorant of information elements unimportant to that equipment.

Two categories of information elements are defined, as shown in Table 49, “Single octet information element format”, and Table 50, “Variable length info element format variable length info element format”.

1 Single Octet information elements

2 Variable Length information elements

For the information elements, the coding of the information element identifier bits for codeset 0 is summarized in Table 51, “Information element identifier”.

- Descriptions of the information elements below are organized in alphabetical order.
- However, there is a particular order of appearance for each information element in a message.
- The code values of the information element identified for the variable length formats are assigned in ascending numerical order, according to the actual order of appearance of each information element in a message. This allows the receiving equipment to detect the presence or absence of a particular information element without scanning through an entire message.
- If an information element is received that does not adhere to this ordering principle in either the network or terminal, ignore it.
- Single octet information elements may appear at any point in the message. They are considered valid over all codesets.

- In the DMS-100, information elements are transmitted in ascending order of information element identifier value within a specific codeset.
- All information elements belonging to the CCITT Q.931 codeset appear at the beginning of each message.
- Upon initial examination the active codeset is assumed to be zero (that is, Q.931). Immediately following the last information element in the codeset 0 message, the Locking Shift IE is coded to shift content analysis to a higher order codeset (e.g., 6 = “network specific”). See Section 5.5.5.1.3, “Non-Locking Shift procedure”, for more information on locking shift.
- Where the description of information elements contains spare bits, they are indicated as being coded to 0. To allow compatibility with future implementation, do not reject messages simply because a spare bit is set to 1.
- Octet 2 of a variable-length information element indicates the total length its contents (that is, the length starting with octet 3), regardless of the coding of the first octet. It is the binary value of the number of octets of the contents, with bit 1 as the least significant bit.
- There is no length field in the single octet information element structure.
- An optional variable-length information element may be present, but empty. The receiver should interpret this as equivalent to being absent.
- Similarly, the receiver should interpret an absent optional information element as equivalent to being empty.

The following rules apply for the coding of variable length information elements:

- Bit 8 is marked “0/1 ext” if another octet follows. Bit 8 is marked “1 ext” if this is the last octet in the extension domain.
- Optional octets are marked with asterisks (that is,*).

Table 49 Single octet information element format

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	IE Identifier			IE contents				Octet 1

Table 50 Variable length info element format variable length info element format

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	IE Identifier			IE contents				Octet 1
IE length (in octets)								Octet 2
IE contents								Octet 3
IE contents								and so forth

Table 51 Information element identifier

Bits								Message types
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1				-	-	-	-	**Single Length IE**
1	0	0	1	0	X	X	X	Locking shift
0	-	-	-	-	-	-	-	**Variable Length IE**
	0	0	0	0	0	0	0	Segmented Message (NI-2)
	0	0	0	0	1	0	0	Bearer Capability
	0	0	0	1	0	0	0	Cause
	0	0	0	1	1	0	1	Extended Facility (NI-2)
	0	0	1	1	1	0	0	Facility (NI-1)
	1	0	0	1	1	0	0	Connected Number
	0	0	1	0	1	0	0	Call State
	0	0	1	1	0	0	0	Channel Identification
	0	0	1	1	1	1	0	Progress Indicator
	0	1	0	0	1	1	1	Notification Indicator
	0	1	0	1	1	0	0	Keypad
	0	1	1	0	0	1	0	Information Request
	0	1	1	0	1	0	0	Signal
	0	1	1	1	0	0	0	Feature Activation
	0	1	1	1	0	0	1	Feature Indication
	0	1	1	1	0	1	0	Service Profile Identifier
	0	1	1	1	0	1	1	Endpoint Identifier
	1	0	0	0	0	0	0	Information Rate (For Packet Mode)
	1	0	0	0	0	1	1	Transition Delay Selection and Indication (for PMD)
	1	0	0	0	1	0	0	Packet Layer Binary Parameters (for PMD)
	1	0	0	0	1	0	1	Packet Layer Window Size (for PMD)
	1	0	0	0	1	1	0	Packet Size (for PMD)
	1	1	0	1	1	0	0	Calling Party Number
	1	1	0	1	1	0	1	Calling Party Subaddress
	1	1	1	0	0	0	0	Called Party Number
	1	1	1	0	0	0	1	Called Party Subaddress
	1	1	1	0	1	0	0	Redirecting Number
	1	1	1	0	1	1	0	Redirection Number
	1	1	1	1	0	0	0	Transit Network Selection
	1	1	1	1	0	0	1	Restart Indicator
	1	1	1	1	1	0	0	Lower Layer Compatibility
	1	1	1	1	1	0	1	High Layer Compatibility
	1	1	1	1	1	1	0	User Information (Not currently supported)

5.5.5.1.1 Extensions of codesets

- There are 136 possible information element identifier values using the formatting rules described in Section 5.5.5.1, “Coding rules”. There are 8 from the single octet information element format, and 128 from the variable length information element format.
- One value in the single octet format is specified for shift operations Section 5.5.5.1.2, “Locking Shift procedure”. One other value in both the single octet and variable format is reserved. This leaves 133 information element identifier values available for assignment.
- It is possible to expand this structure to eight codesets of 133 information element identifier values each.
- One common value in the single octet format is used in each codeset to facilitate shifting from one to another.
- The contents of this shift item identifies the codeset to be used for the next information element or elements.
- The codeset in use at any given time is referred to as the “active codeset”.
- By convention, codeset 0 is the initially active default codeset.
- Codeset 5 is reserved for information elements specific to a national network.
- Codeset 6 is reserved for information elements specific to the local network (either public telephone company or private company).
- The coding rules specified in Section 5.5.5.1, “Coding rules”, apply for information elements belonging to any active codeset.
- Transitions from one active codeset to another, by means of the locking shift procedure, may only be made to one with a higher numerical value than the one being left.
- A terminal recognizes a shift information element and determines the length of the next information element.
- As a minimum, this enables a terminal unable to interpret a particular non-codeset 0 information element to at least determine the start of a subsequent information element that it should be able to interpret.

5.5.5.1.2 Locking Shift procedure

- The locking shift procedure uses the locking shift information element (single octet) to indicate the new active codeset.
- The specified codeset remains active until another locking shift information element is encountered, which requires the use of another codeset.
- Codeset 0 is active at the start of message content analysis.
- If a locking shift to codeset 5, a National specific codeset, is encountered, the next information elements are typically interpreted according to the identifiers assigned in codeset 5.

- For a locking shift to codeset 6, the same procedure follows until either another shift information element is encountered, or the end-of-message is reached.
- Use this procedure only to shift to a higher order codeset than the one being left.
- The locking shift is valid only within the message containing the locking shift information element.
- The locking shift element uses the single octet information element format and coding.

Table 52 Locking Shift information element

Bits								**Octet 1**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	Shift Identifier			0	Bit 4 = 0 implies shift procedures			
	0	0	1		New Codeset Identification (bits 1-3}			
					0	0	0	Code Set 0 (Q.931 IEs)
					1	0	1	Code Set 5 (national specific IEs)
					1	1	0	Code Set 6 (IEs specific to local serving network)

5.5.5.1.3 Non-Locking Shift procedure

The non-locking shift procedure provides a temporary shift to the specified lower or higher codeset. Sending of a non-locking shift information element is not supported by this specification.

- When the network receives a message containing the non-locking shift information element, it recognizes the non-locking shift information element and ignores the information element following it.
- Both the non-locking shift information element and the information element following it are then discarded and the network takes action as follows:
  - — If, after discard, the remaining message is missing a mandatory information element (for example, the discarded information element following the non-locking shift information element was a mandatory information element), the network returns cause # 96 in a subsequent message as described in Section , “Mandatory Information Element Missing”.
  - — Otherwise, the network follows the procedures for handling an unrecognized, non-mandatory information element as described in Section 5.7.1.4.7, “Non-mandatory information element errors”.
- The non-locking shift element uses the single octet information element format and coding.

Table 53 Non-Locking Shift information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	Shift Identifier			1	New Code Set Identification			Octet 1
	0	0	1					
				Bit 4= 1, implies nonlocking shift procedure				

5.5.5.2 Bearer Capability information element

This information element indicates provision by the network, of one of the bearer capabilities as defined in GR-268 and CCITT Recommendations I.230, I.231 and I.232 (1988). No default bearer capability is assumed by the absence of this information element. Code it as shown below.

Table 54 Bearer capability information element

8	7	6	5	4	3	2	1	**Octet**
0	Bearer Capability Information Element Identifier							1
	0	0	0	0	1	0	0	
Length of bearer capability contents								2
1 Ext	Coding Standard		Information Transfer Capability					3
1 Ext	Transfer Mode		Information Transfer Rate					4
0/1 Ext	Layer 1 ID		User Information Layer 1 Protocol					5
	0	1						
1 Ext	0	0	User rate (This octet will be present if octet 5 is set to 0010 0001, indicating rate adaption)					5 a
1 Ext	User Information Layer 2 Protocol for Packet - only used for AutoSPID							6
1 Ext	User Information Layer 3 Protocol for Packet - only used for AutoSPID							7

Figure 26 Coding standard (Octet 3)

8	7	6	5	4	3	2	1		**Octet 3**
1 Ext	Coding Standard								
	0	0	CCITT standard as in Recommendation Q.931						
			All other values reserved						
			Information Transfer Capability						
			0	0	0	0	0	speech	
			0	1	0	0	0	Unrestricted digital information (note 1)	
			0	1	0	0	1	3.1 kHz audio (note 2)	
			1	0	0	0	1	7 kHz audio	
								All other values reserved	

Note 1: 64kbps restricted, circuit-mode information may not be implemented on some

networks.

Note 2: 3.1 kHz audio will receive identical treatment as Speech.

Note 3: 7 kHz audio is not supported on ISDN terminals that support simultaneous two B-channel access. The 7kHz audio bearer capability is no longer part of National ISDN.

Transfer Mode (Octet 4)

8	7	6	5	4	3	2	1	**Bits**	**Octet**
0	Extension bit 8 = 0 description continues through next octet								4
1	Extension bit 8 = 1 last octet of description								
1 Ext	7	6	Transfer Mode						
	0	0	Circuit Mode						
	1	0	Packet Mode (This value is not implemented)						
			All other values reserved						
			Information Transfer Rate						
			5	4	3	2	1		
			1	0	0	0	0	64 kbit/s (used for circuit mode)	

Octets 4a and 4b are specified in CCITT but are not specified in GR-268. Default values will to be assumed for octets 4a and 4b as follows.

8	7 6 5	4 3	2 1	
0/1 Ext	Structure	Config.	establish.	Octet 4a*
1 Ext	Symmetry	Information Transfer Rate (dest. → origination)		4b*

Octet 4a The value of the structure attribute is assumed to be:

Transfer Mode	Transfer Capability	Structure
circuit	Speech	8 KHz integrity
circuit	Unrestricted digital	8 KHz integrity
circuit	Restricted digital (note)	8 KHz integrity
circuit	3.1 KHz audio	8 KHz integrity
circuit	7-kHz audio	8 KHz integrity

The configuration is assumed to be point-to-point and the method of establishment is assumed to be “demand”.

Note: 64kbps restricted, circuit-mode information may not be implemented on some networks.

Octet 4b The symmetry is assumed to be bi-directional and the destination to origination information transfer rate is assumed to be the same as that specified in octet 4.

- (Octets 5, 5a) Layer and Protocol Identification - identifies the protocols and data rate adaption used upon the user information on the access channel at the user/network interface.

Table 55 User information layer 1 Protocol (Octet 5)

Bits					Meaning of Octet 5
5	**4**	**3**	**2**	**1**	
0	0	0	0	1	Rate Adaption based on CCITT I, X, and V Series. (To indicate the data rate, bit 8 octet 5 is set to 0 and the following octet indicates the user information data rate. See encoding of octet 5a.)
0	0	0	1	0	Recommendation G.711 Mu-law Speech
0	0	1	0	1	Recommendation G.722 and G.725 (7 kHz audio)
All other values reserved					

Table 56 User Rate (Octet 5a)

Bits					Meaning of Octet 5a (Synchronous Rate)
5	**4**	**3**	**2**	**1**	
0	1	1	1	1	Rate adaption from 56 kb/s (Rec. I.463)
All other values reserved					

Table 57 User Information Layer 2 Protocol (Octet 6)

Bits							Meaning of Octet 6 (User Information Layer 2 Protocol)
7	**6**	**5**	**4**	**3**	**2**	**1**	
1	0	0	0	0	1	0	LAPD (Recommendation Q.921/I.441) (only used for AutoSPID)
1	0	0	0	1	1	0	LAPB (Recommendation X.25, link level) (not implemented)
All other values are reserved							

Table 58 User Information Layer 3 Protocol (Octet 7)

Bits							Meaning of Octet User Information Layer 3 Protocol (Octet 7)
7	**6**	**5**	**4**	**3**	**2**	**1**	
1	1	0	0	1	1	0	Recommendation X.25, packet level (only used for AutoSPID)
							All other values are reserved

The encodings of this information element, for the bearer capabilities implemented by DMS-100 are shown in Table 59, “Encoding”.

Table 59 Encoding

Encoding								**Attributes**	**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
(**1**) Speech, Circuit-mode (Octet 5a, 6 and 7 are not present)									
1	0	0	0	0	0	0	0	Transfer capability = speech	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit-mode 64 kb/s	4
1	0	1	0	0	0	1	0	Layer 1 protocol ID = Mu-la	5
(**2**) 3.1 kHz, circuit-mode (Octet 5a, 6 and 7 are not present)									
1	0	0	0	1	0	0	0	Transfer capability = 3.1 kHz	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit, 64 kb/s	4
1	0	1	0	0	0	1	0	Layer 1 protocol ID = Mu-law	5
(**3**) 64 kb/s, unrestricted digital information, rate adapted from 56 kb/s (Octets 6 and 7 are not present)									
1	0	0	0	1	0	0	0	Transfer capability = unrestr. digital	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit-mode 64 kb/s	4
0	0	1	0	0	0	0	1	Layer 1 protocol ID = Rate adaption	5
1	0	0	0	1	1	1	1	Data rate = 56 kb/s	5a
(**4**) 64 kb/s, unrestricted digital information, circuit-mode (Octets 5, 5a, 6, and 7 are not present)									
1	0	0	0	1	0	0	0	Transfer capability = unrestricted digital	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit-mode	4
(**5**) 64 kb/s restricted, circuit-mode (64 kb/s restricted, circuit-mode information may not be implemented on some networks; Octets 5, 5a, 6, and 7 are not present)									
1	0	0	0	1	0	0	1	Transfer capability = restricted digital	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit, 64 k/pd	4
(**6**) 7 kHz audio, circuit mode (Octet 5a, 6, and 7 are not present)									
1	0	0	1	0	0	0	1	Transfer capability = 7 kHz	3
1	0	0	1	0	0	0	0	Transfer mode and rate = circuit, 64 kb/s	4
1	0	1	0	0	1	0	1	Layer 1 protocol ID = Recomm. G.722/G.725	5
(**7**) Packet Mode Data - only used for AutoSPID, not on-demand (Octets 5, 5a are not present)									
1	0	0	0	1	0	0	0	Transfer capability = unrestricted digital	3
1	1	0	1	0	0	0	0	Transfer mode and rate = packet-mode	4
1	1	0	0	0	0	1	0	User information layer 2 protocol = LAPD	6
1	1	1	0	0	1	1	0	User information layer 3 protocol = X.25, packet level	7

5.5.5.3 Call State information element

The Call State information element describes the current status of the call independent connection.

The Call State information element is coded as shown in Table 60, “Call State information element”.

Table 60 Call State information element

8	7	6	5	4	3	2	1	**octet**
0	Call State Information Element Identifier							1
	0	0	1	0	1	0	0	
Length of call state contents								2
Call State Value (state value is coded in binary)								3

Table 61 Call State information element

State No.	User State	Network State
0	Null	Null
1	Call Initiated	Call Initiated
2	Overlap Sending	Overlap Sending
3	Outgoing Call Proceeding	Outgoing Call Proceeding
4	Call Delivered	Call Delivered
6	Call Present	Call Present
7	Call Received	Call Received
8	Connect Request	Connect Request
9	Incoming Call Proceeding	Incoming Call Proceeding
10	Active	Active
11	Disconnect Request	Disconnect Request
12	Disconnect Indication	Disconnect Indication
19	Release Request	Release Request
22	N/A	Call Abort
31	Call Independent	Call Independent

Note: A terminal must track at least the Null and Active states and must respond to a STATus ENQuiry from the network if in the Active state. Terminals should track all states, and respond to a STATus ENQuiry from the network when in any state other than Null.

5.5.5.4 Called Party Number information element

The Called Party Number information element identifies one called party of a call. The Called Party Number information element also identifies the primary DN of a TSP when provided by the Automated SPID feature.

It is coded as shown in Table 62, “Called Party Number information element”.

Table 62 Called Party Number information element

8	7	6	5	4	3	2	1	**Octet**
0	Called Party Number information element Identifier							1
	1	1	1	0	0	0	0	
Length of called party number contents								2
1 Ext	Type of Number							3
	0	0	0	Unknown (note1)				
	0	0	1	International number				
	0	1	0	National number				
	0	1	1	Network specific number				
	1	0	0	Subscriber number				
	1	1	0	Abbreviated number				
				All other values are reserved				
				Numbering Plan Identification				
	Unknown			0	0	0	0	
	Telephony/ISDN Numbering Plan (Rec. E.164			0	0	0	1	
	Data numbering plan (REC X.121) **+ (Note 3)**			0	0	1	1	
	Private numbering plan			1	0	0	1	
	Al other values are reserved							
0	Number Digits (IA5 characters)							4 * etc.

Note 1: The type of number “unknown” is frequently used when the network has no knowledge of the type of number in the number digits field. In this case, the number digits field is organized according to the network dial plan, for example, prefix or escape digits may be present.

Note 2: The number digit in octet 4 precedes the digit in octet 5, etc. The address digit which would be “dialed” first is located in octet 4.

Note 3: ***** This octet may be omitted.

Note 4: + = Packet mode calls are not currently supported

Note 5: Prefix and escape digits are not included for all values except “unknown”.

Table 63 Number digits (Octet 4 etc.)

Bits							**Address Digit value**
7	**6**	**5**	**4**	**3**	**2**	**1**	
0	1	1	0	0	0	0	0
0	1	1	0	0	0	1	1
0	1	1	0	0	1	0	2
0	1	1	0	0	1	1	3
0	1	1	0	1	0	0	4
0	1	1	0	1	0	1	5
0	1	1	0	1	1	0	6
0	1	1	0	1	1	1	7
0	1	1	0	0	0	0	8
0	1	1	0	0	0	1	9
0	1	0	1	0	1	0	* (note)
0	1	0	0	0	1	1	# (note)

Note: Use of “*” and “#” is only valid if the TON/NPI associated with the CDN is coded to Unknown/Unknown.

5.5.5.5 Called Party Subaddress information element

The Called Party Subaddress information element identifies a subaddress associated with the called interface. It is coded as shown in Table 64, “Called Party Subaddress information element”.

Table 64 Called Party Subaddress information element

<table>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>octet</td></tr>
<tr><td rowspan="2">0</td><td colspan="7">Called Party Subaddress Information element identifier</td><td rowspan="2">1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="8">Length of called party subaddress information</td><td>2</td></tr>
<tr><td rowspan="7">1 Ext</td><td colspan="3" rowspan="4">Type of Subaddress</td><td rowspan="2">odd/ even indication</td><td colspan="3">Spare</td><td rowspan="2">3</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0</td><td colspan="4">even number of digits in subaddress</td></tr>
<tr><td>1</td><td colspan="4">odd number of digits in subaddress</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td colspan="5">NSAP (X.213/ISO 8348 AD2)</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td colspan="5">user specified</td></tr>
<tr><td></td><td></td><td></td><td colspan="5">All other values are reserved</td></tr>
<tr><td colspan="8">Subaddress Information</td><td>4 * etc.</td></tr>
</table>

Note 1: * This octet may be omitted.

Note 2: Subscription parameters are found in Chapter 8: "Subscription parameters".

5.5.5.6 Calling Party Number information element

The Calling Party Number information element is to identify the origin of a call. It is coded as shown in Table 65, “Calling Party Number information element”.

Table 65 Calling Party Number information element

<table>
<tr><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>octet</td></tr>
<tr><td rowspan="2">0</td><td colspan="7">Calling Party Number Information Element Identifier</td><td rowspan="2">1</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">Length of calling party number contents</td><td>2</td></tr>
<tr><td>0/1 Ext</td><td colspan="3">Type of Number</td><td colspan="4">Numbering Plan Identification</td><td>3</td></tr>
<tr><td rowspan="2">1 Ext</td><td colspan="2" rowspan="2">Presentation Indicator</td><td colspan="3">spare</td><td colspan="2" rowspan="2">Screening Indicator</td><td rowspan="2">3a*</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>0 Spare</td><td colspan="7">Number digits (IA5 characters)</td><td>4 * etc.</td></tr>
<tr><td colspan="9">The number digit in octet 4 precedes digit in octet 5, etc.</td></tr>
</table>

***Note:* *** This octet may be omitted.

Table 66 Octet 3

7	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning of Octet 3**
Type of Number			**Number Plan Identification**				
0	0	0					Unknown
0	0	1					International Number
0	1	0					Network Specific Number (Not currently supported)
1	0	0					Subscriber Number (Note 1)
1	1	0					abbreviated Number
			4	**3**	**2**	**1**	**Numbering Plan Identification**
			0	0	0	0	Unknown
			0	0	0	1	Telephony/ISDN Numbering Plan (Rec. E.164)
			0	0	1	1	Data Numbering Plan (Rec. X.121) Not currently supported
			1	0	0	1	Private Numbering plan
							All other values reserved

Note 1: Only supported in user to network direction

Note 2: Prefix and escape digits are not to be included in the “Number Digits” field.

Table 67 Octet 3a

7	6	5	4	3	2	1	Presentation indicator
0	0						Presentation allowed (see note 1)
0	1						Presentation restricted (see note 1)
1	0						Number not available due to interworking
1	1						Reserved
		Spare					**Spare bits (5-4-3)**
		5	**4**	**3**	**2**	**1**	**Screening Indicator**
		0	0	0	0	0	User-provided, not screened (see note 2)
		0	0	0	0	1	User-provided, verified and passed (see note 2)
		0	0	0	1	0	User-provided, verified and failed (see note 2)
		0	0	0	1	1	Network-provided (see note 2)

Note 1: If the user subscribes to Privacy Change Allowed (PCA), then “Presentation restricted” and “Presentation allowed” are supported in the user-to-network direction. If the user has not subscribed to PCA, then the number privacy subscription default of “Presentation allowed” or “Presentation restricted” is used. All Presentation Indicator values except “Reserved” are supported in the network-to-user direction; however, “Presentation restricted” is currently used only when the calling user has subscribed to presentation restriction of their number.

Note 2: All Screening indicator values are supported in the user to network direction but are currently ignored. The screening indicator sent forward through the network is coded to User-provided, verified and passed, when screening is performed and is successful, otherwise the screening indicator is coded as Network Provided.

Table 68 Number digits (Octet 4, and so forth)

Bits							Address digit value
7	**6**	**5**	**4**	**3**	**2**	**1**	
0	1	1	0	0	0	0	0
0	1	1	0	0	0	1	1
0	1	1	0	0	1	0	2
0	1	1	0	0	1	1	3
0	1	1	0	1	0	0	4
0	1	1	0	1	0	1	5
0	1	1	0	1	1	0	6
0	1	1	0	1	1	1	7
0	1	1	1	0	0	0	8
0	1	1	1	0	0	1	9
							All other values are reserved

5.5.5.7 Calling Party Subaddress information element

The Calling Party Subaddress information element identifies a subaddress associated with the origin of a call. It is coded as shown in Table 69, “Calling Party Subaddress information element”.

Table 69 Calling Party Subaddress information element

8	7	6	5	4	3	2	1	**Octet**
0	Called Party Subaddress information element Identifier							1
	1	1	1	0	0	0	1	
Length of Called Party Subaddress information								2
1 Ext	Type of Subaddress			odd/ even indication	Spare			3
					0	0	0	
				0	even number of digits in subaddress			
				1	odd number of digits in subaddress			
	0	0	0	NSAP (X.213/ISO 8348 AD2)				
	0	1	0	user specified				
				All other values are reserved				
Subaddress Information								4 * etc.

Note 1: Subscription parameters are found in Chapter 8: "Subscription parameters".

***Note 2:* *** This octet may be omitted.

5.5.5.8 Cause information element

The Cause information element describes the reason for generating certain messages, to provide diagnostic information in the event of procedural errors, and to indicate the location of the cause originator. It is coded as shown in Table 70, “Cause information element”. Diagnostic information is not available for every cause value.

Table 70 Cause information element

Bits								**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Cause information element Identifier							1
	0	0	0	1	0	0	0	
Length of cause contents								2
1 EXT.	Coding Standard		Spare 0	General Location				3
1 EXT.	Cause Value							4
	Class			Value				
+ Diagnostic (if any) (This octet may be omitted, unless diagnostic are to be provided) (More than one optional octet (i.e., octet 5) is not supported at this time.)								5 etc.

Table 71 (Octet 3)

Bits							Octet 3
7	**6**	**5**	**4**	**3**	**2**	**1**	
Coding Standard		spare bit = 0	**General Location**				
0	0	0					CCITT standard
1	1	0					Network-specific 1-4
1	0	0					National specific
		0					All other values reserved
		0	**General Location**				
		0	0	0	0	0	User (see note 1)
		0	0	0	0	1	Private network serving local user (see note 2)
		0	0	0	1	0	Public network serving local user (see note 1)
		0	0	0	1	1	Transit network (see note 2)
		0	0	1	0	0	Public network serving remote user (see note 2)
		0	0	1	0	1	Private network serving remote user (see note 2)
		0	0	1	1	1	International network (see note 2)
		0	1	0	0	0	Network beyond interworking point (see note 2)
							All other values reserved

Note 1: Only codeset of 0010 is used in the network-to-user direction. In the user-to-network direction, use the codepoint of 0000 for general location of user. These values may not be sent in all situations

Note 2: These values may not be sent in all situations.

Cause Value (octet 4)/Diagnostics (octets 5 and so forth)

The cause value is divided in two fields, a class (bits 5-7) and a value within the class (bits 1-4). The class indicates the general nature of the event.

Table 72 Cause value (Octet 4)

Class	Event
000	normal event
001	normal event
010	network congestion
011	service or option not available
100	service or option not implemented
101	invalid message (for example, parameter out of range
110	protocol error (for example, unknown message)
111	interworking

Table 73 CCITT Standardized Cause Value

Cause value Class value							**Cause no.**	**Cause**	**Diagnostics**
7	**6**	**5**	**4**	**3**	**2**	**1**			
0	0	0	0	0	0	1	1	unassigned number	none
0	0	0	0	0	1	0	2	no route to specified transit network	none
0	0	0	0	0	1	1	3	no route to destination	none
0	0	0	0	1	1	0	6	channel unacceptable	none
0	0	0	0	1	1	1	7	call awarded and delivered in an established channel +	none
0	0	1	0	0	0	0	16	normal call clearing	none
0	0	1	0	0	0	1	17	user busy	none
0	0	1	0	0	1	0	18	no user responding	none
0	0	1	0	0	1	1	19	user alerting, no answer	none
0	0	1	0	1	0	1	21	call rejected	none
0	0	1	0	1	1	0	22	number changed	none
0	0	1	1	0	1	0	26	non-selected use clearing	none
0	0	1	1	0	1	1	27	destination out of order	none
0	0	1	1	1	0	0	28	invalid number format (incomplete number)	none
0	0	1	1	1	0	1	29	facility rejected	Fac. ID
0	0	1	1	1	1	0	30	response to STATus	none
0	0	1	1	1	1	1	31	normal unspecified	none
0	1	0	0	0	1	0	34	no channel/circuit available	none
0	1	0	1	0	0	1	41	temporary failure	none
0	1	0	1	0	1	0	42	switch equipment congestion	none
0	1	0	1	0	1	1	43	user information discarded	Info element
0	1	0	1	1	0	0	44	requested circuit/channel not available	Identifier
0	1	0	1	1	1	1	47	resources unavailable, unspecified	none
1	1	0	0	0	0	0	50	requested facility not subscribed	none
0	1	1	0	0	1	0	54	incoming calls barred	none
0	1	1	0	1	1	0	57	BC not authorized	none
0	1	1	1	0	1	0	58	BC not presently available	none
0	1	1	1	1	1	1	63	service or option not available, unspecified	none
1	0	0	0	0	0	1	65	BC not implemented, channel type not implemented	none
1	0	0	0	0	1	0	66	channel type not implemented +	none
1	0	0	0	1	0	0	69	requested facility not implemented	none
1	0	0	0	1	1	0	70	only restricted digital information bearer	none
1	0	0	1	1	1	1	79	service or option not implemented, unspecified	none
1	0	1	0	0	0	1	81	invalid CR value	none
1	0	1	0	0	1	0	82	identified channel does not exist	none
1	0	1	1	0	0	0	88	incompatible destination	none

Cause value Class value							**Cause no.**	**Cause**	**Diagnostics**
1	0	1	1	1	1	1	95	invalid message	none
1	1	0	0	0	0	0	96	mandatory IE is missing	info element identifier
1	1	0	0	0	0	1	97	message type non-existent or not implemented	message type
1	1	0	0	0	1	1	99	IE non-existent or not implemented	info element
1	1	0	0	1	0	0	100	invalid IE contents	info element
1	1	0	0	1	0	1	101	message not compatible with call state	message type
1	1	0	0	1	1	0	102	recovery on timer expiry	none
1	1	0	1	1	1	1	111	protocol error, unspecified	none
1	1	1	1	1	1	1	127	interworking, unspecified	none
All other values are reserved									

Note: + = not currently supported

Note: IE identifier and message type in the diagnostics field are one or two octets long.

The diagnostics field must be included for cause values 96, 97, 98, 99, 100, and 101.

Table 74 Network-specific cause values

Cause value Class value							**Cause no.**	**Cause**	**Diagnostics**
0	0	0	1	0	0	0	8	call is proceeding	none
0	0	1	1	1	0	0	28	**+** special intercept announcement	none
0	0	1	1	1	0	1	29	**+** special intercept announcement undefined code	none
0	0	1	1	1	1	0	30	**+** special intercept announcement number assigned	none
0	0	1	1	1	1	1	31	**+** special intercept announcement call blocked due to group restriction	none
0	1	1	0	0	1	1	51	bearer capability incompatible with service request	none
0	1	1	0	1	0	1	53	service operation violated; short term denial (val=0), long term denial (val=1)	none
1	1	0	0	1	0	1	101	**+** protocol error threshold exceeded	none
All other values are reserved									

Note: + = not currently supported

Table 75 National-specific cause values

Cause value Class value							Cause no.	Cause	Diagnostics
0	0	0	0	0	0	1	4	vacant code	none
0	0	0	0	0	1	0	8	**+** prefix 0 dialed in error	none
0	0	0	0	0	1	1	9	prefix 1dialed in error	none
0	0	0	0	1	0	0	10	prefix 1 not dialed	none
0	0	0	1	1	1	0	11	**+** excessive digits received; call is proceeding	none
All other values are reserved									

Note: + = not currently supported

5.5.5.8.1 Definition of CCITT-standardized causes

The following list contains definitions for each of the causes.

Normal Class

- Cause 1 - Unassigned (unallocated) number - the destination requested by the calling user can not be reached because, although the number is in a valid format, it is not currently assigned (allocated).
- Cause 2 - No route to specified transit network - the equipment sending this cause has received a request to route the call through a particular transit network it does not recognize. The equipment sending this cause does not recognize the transit network either because it does not exist or because that particular network, while it does exist, does not serve the equipment sending this cause.
- Cause 3 - No route to destination - destination requested by the calling user can not be reached because the network (through which the call has been routed) does not serve the destination desired.
- Cause 6 - Channel unacceptable - a called user cannot negotiate for a B-channel other than that specified in the SETUP.
- Cause 7 - Call awarded and being delivered in an established channel - the user has been awarded the incoming call, and that call is being connected to a channel already established to that user for similar calls(e.g., packet-mode, X.25 virtual calls)
- Cause 16 - Normal call clearing - the call is being cleared because one of the users involved requested that it be cleared.
- Cause 17 - User busy - the called user is unable to accept another call because there is no resources available to handle the new call. It is noted that the user equipment is compatible with the call.
- Cause 18 - No user responding - used when a user does not respond to a call establishment message with either an ALERTing or CONNect indication within the prescribed period of time.
- Cause 19 - User alerting, no answer - no valid CONNect has been received and the call has been cleared. The network sent a call clearing message to the calling user.

- Cause 21 - Call rejected - the equipment sending this cause does not wish to accept this call (although it could have accepted it), because the equipment sending this cause is neither busy nor incompatible.
- Cause 22 - Number changed - returned to a user when the called number, indicated by the calling party number, is no longer assigned.
- Cause 26 - Non-selected user clearing - the user has not been awarded the incoming call.
- Cause 27 - Destination out of order - the destination specified by the user can not be reached because the interface to the destination is not functioning correctly. The term “not functioning correctly” indicates that a signaling message was unable to be delivered to the remote user; for example, a physical or data link layer failure at the remote user or user equipment offline, or called DN has been manually placed in timer busy state, and so forth.
- Cause 28 - Invalid number format (incomplete number) - the destination indicated by the calling user can not be reached because the number is not in a valid format or is not complete.
- Cause 29 - Facility rejected - returned when a facility requested by the user can not be provided by the network.
- Cause 30 - Response to STATus ENQuiry - included in the STATus when the reason for generating it was the prior receipt of a STATus ENQuiry.
- Cause 31 - Normal, unspecified - used to report a normal event only when no other cause in the normal class applies.

Network Congestion Class

- Cause 34 - Circuit/channel congestion - there is no appropriate circuit/channel, presently available, to handle the call request.
- Cause 41 - Temporary failure - the user or network is not functioning correctly, and the condition is not likely to last a long time.
- Cause 42 - Switching equipment congestion or B-channel negotiation - the switching equipment generating this cause is experiencing a period of high traffic.
- Cause 43 - User information discarded - the network could not deliver user information to the remote user as requested, for example, user-to-user information, low layer compatibility or subaddress, and so forth.

  Note: This cause does not apply to an unsuccessful call, but is used for congestion control and setup status information.
- Cause 44 - Requested channel not available - the channel requested by the user during local channel negotiation is not currently available (for example, engaged or out of service for maintenance).
- Cause 47 - Resource unavailable - used to report a network resource unavailable event only when no other cause in the network congestion class applies.

Service or Option Not Available Class

- Cause 50 - Requested facility not subscribed - the user has not subscribed to this facility and can not access it at this time.
- Cause 54 - Incoming calls barred - the called user will not accept the call delivered in the SETUP.
- Cause 57 - Bearer capability not authorized - the user requested a bearer capability implemented by the equipment which generated this cause, but the user is not authorized to use it.
- Cause 58 - Bearer capability not presently available - indicates that the user has requested a bearer capability which is implemented by the equipment which generated this cause but which is not available at this time.
- Cause 63 - Service or option not available, unspecified - is used to report a service or option not available event, only when no other cause in this class applies.

Service or Option Not Implemented Class

- Cause 65 - Bearer capability not implemented - the equipment sending does not support the bearer capability requested.
- Cause 66 - Channel type not implemented - the called party has reached a channel type not supported.
- Cause 69 - Requested facility not implemented - the requested facility is not implemented and can not be accessed at this time.
- Cause 70 - Only restricted digital information bearer capability is available - the user requested an unrestricted bearer capability, but that the equipment sending this cause only supports the restricted version of the requested bearer capability.
- Cause 79 - Service or option not implemented, unspecified - reports a service or option not implemented event only when no other cause in this class applies.

Invalid Message Class

- Cause 81 - Invalid call reference value - the equipment sending this cause received a message with a call reference not currently in use on the user-network interface.
- Cause 82 - Identified channel does not exist - the equipment sending this cause has received a request to use a channel not activated on the interface for a call.
- Cause 88 - Incompatible destination - the equipment sending this cause received a request to establish a call to a destination in which the required compatibility attributes (for example, data rate) can not be accommodated.
- Cause 95 - Invalid message, unspecified - reports an invalid message event only when no other cause in this class applies.

Protocol Errors Class

- Cause 96 - Mandatory information element is missing - the equipment sending this cause has received a message with one or more mandatory information elements missing. Therefore, the message can not be processed.

- Cause 97 - Message type non-existent or not implemented - the equipment sending this cause received a message with a message type it does not recognize either because this is a message not defined, or defined but not implemented by the equipment sending this cause.
- Cause 99 - Information element non-existent or not implemented - the equipment sending this cause received a message which includes the information elements not recognized because the information element identifier is not defined, or it is defined, but not implemented by the equipment sending the cause. However, the information element is not required to be present in the message for the equipment sending the cause to process the message.
- Cause 100 - Invalid information element contents - the equipment sending this cause received an information element which it has implemented, but the contents are invalid (for example, truncated, invalid extension bit, invalid field values, and so forth).
- Cause 101 - Message not compatible with call state - the equipment sending this cause received a message that procedures indicate is not a permissible message to receive at this time.
- Cause 102 - Recovery on timer expiry - no further call progress in call establishment has been received, and has timed out. Send a clearing to the user.
- Cause 111 - Protocol error, unspecified - used to report a protocol error event only when no other cause in this class applies.

Interworking Class

- Cause 127 - Interworking, unspecified - there has been interworking with a network which does not provide causes for actions it takes; thus, the precise cause for a message which is being sent can not be ascertained.

5.5.5.8.2 Definition of Network-specific causes

The following list contains definitions for each of the causes.

Normal Class

- Cause 1 - Vacant code - included in the PROGress to the calling user when the NPA or NXX is unassigned and the call is routed to vacant code treatment.
- Cause 2 - Prefix 0 dialed in error - the prefix 0 is invalid for the entered number.
- Cause 3 - Prefix 1 dialed in error - included in the PROGress to the calling user when the call is a local 7 digit direct dial call or the prefix digit 1 is dialed in error on a local call.
- Cause 4 - Prefix 1 not dialed - included in the PROGress to the calling user when the call is a 10 digit call where prefix digits are specified as mandatory, or the prefix digit 1 is not dialed on a toll call.
- Cause 8 - Call is proceeding - the call is proceeding at the destination interface.
- Cause 14 - Excessive digits received, call is proceeding - more address digits than expected as part of code interpretation procedures for a call origination were received, and the received address information was truncated.

Service or Option Not Available Class

- Cause 51 - Bearer capability incompatible with service request - a request for an action was rejected because the action is not compatible with the call’s bearer capability.
- Cause 53 - Service operation violated - the user violated the service operation.

Protocol Error Class

- Cause 101 - Protocol error threshold exceeded - the call is cleared because a threshold is being exceeded for multiple protocol errors occurring during an active call.

5.5.5.9 Channel Identification information element

The Channel identification information element identifies a channel within the interface controlled by these signaling procedures as shown in Table 76, "Channel Identification information element”.

Table 76 Channel Identification information element

Bits								Meaning and Octet number
8	7	6	5	4	3	2	1	
0	Channel Identification IE							Channel Identification Information Element Identification (**Octet 1**)
	0	0	1	1	0	0	0	
								Length of channel identification contents **(Octet 2)**
8								(**Octet 3**)
0								this octet continues through next octet (Note 4.)
1								Extension Bit (1 Means last octet)
	7							**Interface Identifier present**
	0							interface implicitly identified (The interface that includes the D-channel carrying this IE is indicated.)
	1							interface explicitly identified in optional octet 3a +
		6						**Interface Type**
		0						Basic Access Interface
			5					**Spare bit**
			0					value is always 0
				4				**Preferred/Exclusive (Note 3)**
				0				Preferred - indicated channel is preferred
				1				Exclusive - only the indicated channel is acceptable
					3			**D-channel indicator**
					0			D-channel not indicated
					1			D-channel indicated **+**
						2	**1**	**Channel Selection Information (Note 2**)
						0	0	No B channel indicated
						0	1	channel B1 on Basic Access interface
						1	0	channel B2 on Basic Access interface
						1	1	Any Channel

Note 1: + = not currently supported

Note 2: “No channel” is sent in the network-to-user direction for some supplementary services, e.g., ACO, and EKTS.

Note 3: This bit is always set to 1 in the n-to-u direction. In the u-to-n direction set it to: 1 for the first response to an incoming SETUP; 0 for the selection of “Any channel”; and either 0 or 1 as appropriate for all other cases.

Note 4: (Optional octets 3, 3a, 3b, and 3c as described in CCITT Recommendation Q.931 are not applied/implemented on Basic Rate Interface at this time.)

5.5.5.10 Connected Number information element

The Connected Number information element indicates which number is connected to a call. It may be different from the calling or called party number(s) because of changes (for example, call redirection) during the lifetime of the call. It is coded as shown in Table 77, “Connected Number information element”.

Table 77 Connected Number information element

Bits								**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Connected Number information element Identifier							1
	1	0	0	1	1	0	0	
Length of connected number contents								2
1/0 EXT.	Type of Number			Numbering Plan Identification				3
1/0 EXT.	Presentation Indicator		Spare			Screening Indicator		3a*
			0	0	0			
0 Spare	Number Digits (IA characters)							4* etc.

Note 1: ***** This octet may be omitted.

Note 2: May not be supported in the future.

5.5.5.11 Endpoint Identifier information element

The Endpoint Identifier information element indicates the user service identifier and terminal identifier for the terminal identification, and to indicate a specific terminal for the purpose of terminal selection. The Endpoint Identifier information element is coded as shown in Table 78, “Endpoint Identifier information element”.

Table 78 Endpoint Identifier information element

Bits								**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Endpoint Identifier information element Identifier							1
	0	0	1	1	1	0	1	
Length of Endpoint Identifier Concerns								2
1 EXT.	User Service Identifier							3
1 EXT.	Int.	Terminal Identifier						4*

Note: * This octet may be omitted.

- Octet 3 - User Service Identifier (USID) - a selection parameter identifying a group of terminals on a interface that share a common service profile and may be addressed together. It has values from 0 to 127.

  When used in the terminal initialization procedures, it contains a value from 0-126, assigned by the switch and is uniquely associated with the identified service profile.

  When used in messages broadcast at layer 2 to select the terminals which share a service profile, it is coded with a unique value corresponding to the appropriate service profile on the interface.

  — This parameter may be coded as all “1”s (127) to select all terminals on the interface.

  — Upon receipt of this element, a terminal considers itself as being addressed if the value received matches its stored value or if the value received is coded as 127.

  — When the USID is coded as 127, octet 4 is not used and may be omitted.

  — When selecting all terminals associated with a particular service profile and USID value, octet 4 is not needed and may be omitted.

- Interpreter (octet 4 - bit 7) - indicates how the TID is to be interpreted.

  — In the initialization procedure, this bit is set to “0”.

  — To select a particular terminal, set this bit to “0”, and the TID value the value assigned to the terminal in the initialization procedure.

  — To select all but a particular terminal associated with a service profile, set the TID and USID parameters to the values identifying the particular terminal and service profile, and the Interpreter bit is set to “1”.

  — To select all terminals which share a service profile, octet 4 is not necessary and is omitted. If octet 4 is included, the Interpreter bit is set to “0”.

- Terminal Identifier (TID) (octet 4 - bits 6-1) - a selection parameter which identifies a single terminal within a group designated by a USID value. It has values from 0-63.

  — When used in the initialization procedures, it is coded from 0-62.

  — To identify a particular terminal, the TID is coded with the value assigned in the initialization procedure.

  — When selecting all terminals which share a service profile, octet 4 is not necessary and may be omitted. However, if octet 4 is included, the TID is coded as all “1”s (63).

5.5.5.12 Extended Facility information element

The Extended Facility information element carries a single component between the network and the user. This information element is used in parameter downloading and is coded as shown in Section Table 79, “Extended Facility information element”.

Table 79 Extended Facility information element

Bits								Meaning	Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Extended Facility information element identifier								1
	0	0	0	1	1	0	1		
0/1	Length of Extended Facility information contents								2
Length continued									2 a (Note 1)
Length continued									2 b
1 Ext	Spare		Protocol profile						3
1 Ext	0	0	1	0	0	1	0	CMIP protocol	
			1	0	0	0	1	Supplementary Services (Remote Operations Protocol)	
Component (APDU)									4 etc. (Note 2)

Note 1: Must be included if length is greater than 255 octet

Note 2: Length values will have to follow the encoding rules given in Table 88, “Component Type tags”.

5.5.5.13 Facility information element

The Facility information element indicates the request or acknowledgment of an application service, the invocation and operation of services identified by the service discriminator, and the operation value within the component. Its maximum length in a given message is service dependent, consistent with that of the message.

The Facility information element is coded as shown in Table 80, "Facility information element".

Table 80 Facility information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Facility information element Identifier							1
	0	0	1	1	1	0	0	
Length of facility contents								2
1 EXT.	1	1	Service Discriminator					3
			1	0	0	0	1	
			1	0	0	1	0	
			1	0	0	1	1	
			All other values reserved					
Component								4 etc.

Table 81 Service Discriminator (Octet 3)

Bits					**Service Discriminator**
5	**4**	**3**	**2**	**1**	**Octet 3**
1	0	0	0	1	Supplementary service
1	0	0	1	0	Management service
1	0	0	1	1	Switched Computer Services **%**
All other values are reserved					

Note 1: Bits 7 to 6 in octet 3 have been set to "11" to indicate that the service discriminator and component operation value are locally unique, and thus may not have significance on other manufacturers' access interfaces. Object Identifiers, currently being discussed in CCITT, may in the future become the standard mechanism to realize this requirement. Other values for bits 7 to 6 are reserved.

Note 2: **(**%) Value "Switch computer services" is the only value required in this interface specification.

5.5.5.13.1 Component

A sequence of data elements each of which is made up of a tag, a length, and contents. There are four types of components, each identified by a unique component tag. The following components are supported:

— Invoke
— Return result

— Return error
— Reject

The structure of each type of component is shown in Table 82, “Invoke component” through Table 84, “Return Error component”.

Table 82 Invoke component

Invoke Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	Table 88, “Component Type tags” Table 88, “Component Type tags”	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	Table 89, “Component Identifier tags” Table 86, “Format of the length field (short form)”	Mandatory	6 7 8
Linked identifier tag Linked identifier length Linked identifier	Table 89, “Component Identifier tags”	Optional	9 10 11
Operation value tag Operation value length Operation value	Table 90, “Operations” (Note 3)	Mandatory	12 13 14
Argument (Note 2)	(Note 3)	Optional	15 and so forth

Note 1: The component length is coded to indicate the number of octets contained in the component, excluding the component type tag and the component length octets.

Note 2: This is a parameter of the Invoke component type.

Note 3: The coding is service dependent

.

Table 83 Return Result component

Return Result Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	Table 88, “Component Type tags”	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	Table 89, “Component Identifier tags”	Mandatory	6 7 8
Sequence Tag Sequence Length (Note 4)	Table 93, “Sequence and Set tags”	Optional (Note 1)	9 10
Operation value tag Operation value length Operation value	Table 90, “Operations” (Note 6)	Optional (Note 2)	11 12 12
Result (Note 5)	Table 90, “Operations” (Note 6)	Optional	14 and so forth.

Note 1: If the Return result component does not include any result, the sequence and operational value is omitted. Table 93, "Sequence and Set tags" shows the coding for the sequence tag.

Note 2: If a result is included, the operation value is mandatory and is the first element in the sequence.

Note 3: The component length is coded to indicate the number of octets contained in the component, excluding the component type tag and the component length octets.The sequence length is coded to indicate the number of octets contained in the sequence, excluding the sequence type tag and the sequence length octets.

Note 4: The component length is coded to indicate the number of octets contained in the sequence, excluding the sequence type tag and the sequence length octets.

Note 5: This is a parameter of the Return result component type.

Note 6: The coding is service dependent.

Table 84 Return Error component

Return Error component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	Table 88, "Component Type tags"	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	Table 89, "Component Identifier tags"	Mandatory	6 7 8
Error value tag Error value length Error value	Table 91, "Error Value tag"	Mandatory	9 10 11
Parameter (Note 2)	(Note3)	Optional	12, and so forth

Note 1: The component length is coded to indicate the number of octets contained in the component, excluding the component type tag and the component length octets.

Note 2: This is a parameter of the Return error component type.

Note 3: The coding is service dependent.

Table 85 Reject Component

Return Error component		Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)		Table 88, “Component Type tags”	Mandatory	4 5
	Invoke identifier tag Invoke identifier length Invoke identifier	Note 1:, “* This octet may be omitted.”	Mandatory	6 7 8
	Problem tag Problem length Problem	Table 92, “Problem Tags”	Mandatory	9 10 11

Note 1: The component length is coded to indicate the number of octets contained in the component, excluding the component type tag and the component length octets.

- Length of Each Component or Data Element
  - — Lengths up to 127 octets are coded using the short form of the length field.
    - – The length format is set to 0 and the remaining 7 bits are the length of the contents in octets.
    - – Bit 7 is the Most Significant Bit (MSB) and bit 1 is the Least significant Bit (LSB).

Table 86 Format of the length field (short form)

Bits							
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Length Format (0)	MSB			Length of contents			LSB

  - — Lengths greater than 127 octets are coded using the long form of the length field.
    - – The length format is set to 1 and the remaining 7 bits of the first octet are the length of the length field, less this first octet.
    - – Bit 7 is the MSB, and bit 1 is the LSB of this first octet.
    - – The remaining octets (maximum of 2) are the length of the contents in octets.
    - – Bit 8 of the second octet is the MSB, and bit 1 of the last octet is the LSB.

— Code the length of contents using the minimum number of octets, with no leading octets having the value 0.

Table 87 Format of the length field (long form)

Bits							
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Length 1 Format	MSB		Length field size) - 1				LSB
MSB			Length of contents				LSB

- Component Types - every component is specified with a component type tag. Table 88, “Component Type tags” contains the tags for the component types.

Table 88 Component Type tags

Bits								Component Type tags	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
1	0	1	0	0	0	0	1	Invoke	A1
1	0	1	0	0	0	1	0	Return result	A2
1	0	1	0	0	0	1	1	Return error	A3
1	0	1	0	0	1	0	0	Reject	A4

- Component Identifiers - An invoke identifier is used to identify an operation invocation and is reflected in the Return result or Return error that responds to it.

  — An Invoke may refer to another Invoke through the linked identifier.

  — When a protocol error occurs, the invoke identifier is reflected in the Reject component, but if it is not available, a null is returned.

  — Invoke and linked identifiers are one octet long. The null has zero length.

  The component identifiers, invoke identifier and linked identifier, are unique within a call reference. That is, the same identifiers can be used simultaneously in separate call references without ambiguity.

Table 89 Component Identifier tags

Bits								Component Identifier tags	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	0	0	0	0	0	1	0	Invoke Identifier	02
1	0	0	0	0	0	0	0	Linked Identifier	80
0	0	0	0	0	1	0	1	Null	05

- Operations - specifies the service or operation being requested. An operation value is an integer value and its meaning is specific to each service. Operation values are unique within each service discriminator.

Table 90 Operations

Bits								Operation Value tags	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	0	0	0	0	0	1	0	Operation value - Integer	02
								Supplementary Services Operation values	
0	0	0	1	1	0	0	0	Additional information	18
								Management Services Operation values	
0	0	0	0	0	0	0	1	Service Profile Management begin	01
0	0	0	0	0	0	1	0	Service Profile Management info	02

- Errors - Operations report errors as specified for each operation.

Table 91 Error Value tag

Bits								Error Value tag	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	0	0	0	0	0	1	0	Error value - Integer	02

- Problems - Protocol problems are indicated in groups. Table 92, “Problem Tags” specifies the tags for these groups, and the problem values associated with each problem group

Table 92 Problem Tags

Bits								Problem tags	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	0	0	0	0	0	0	0	General problem	00
0	0	0	0	0	0	0	1	Invoke problem	01
0	0	0	0	0	0	1	0	Return Result problem	02
0	0	0	0	0	0	1	1	Return error problem	03
								Coding of general problem	
0	0	0	0	0	0	0	0	Unrecognized component	00
0	0	0	0	0	0	0	1	Mistyped component	01
0	0	0	0	0	0	1	0	Badly structured component	02
								Coding of Invoke problem	
0	0	0	0	0	0	0	0	Duplicate invocation	00
0	0	0	0	0	0	0	1	Unrecognized operation	01
0	0	0	0	0	0	1	0	Mistyped argument	02
0	0	0	0	0	0	1	1	Resource limitation	03
0	0	0	0	0	1	0	0	Initiator releasing	04
0	0	0	0	0	1	0	1	Unrecognized linked identifier	05
0	0	0	0	0	1	1	0	Linked response unexpected	06
0	0	0	0	0	1	1	1	Unexpected child operation	07
								Coding of Return Result problem	
0	0	0	0	0	0	0	0	Unrecognized invocation	00
0	0	0	0	0	0	0	1	Result response unexpected	01
0	0	0	0	0	0	1	0	Mistyped result	02
								Coding of Return Error problem	
0	0	0	0	0	0	0	0	Unrecognized invocation	00
0	0	0	0	0	0	0	1	Error response unexpected	01
0	0	0	0	0	0	1	0	Unrecognized error	02
0	0	0	0	0	0	1	1	Unexpected error	03
0	0	0	0	0	1	0	0	Mistyped parameter	04

The specific problem codes for each problem class are described below.

General Problems

- Unrecognized component - the received component is not one of the remote operations defined components (that is, the component type tag is invalid).
- Mistyped component - the content of the received component does not conform to the expected content of the specific component (for example, an Invoke component is missing an operation).
- Badly structured component - the received component does not conform to the data element encoding rules (for example, a data element is encoded with an invalid length field).

Invoke Problems

- Duplicate invocation - the received invoke identifier parameter is already in use and is not available for reuse.
- Unrecognized operation - the received operation is not a valid operation value, or is a valid operation value but is received in a state or message in which it is not allowed.
- Mistyped argument - the contents of the argument for the received Invoke component are invalid.
- Resource limitation - as a result of resource limitations, the end receiving the operation is not able to perform the operation.
- Initiator releasing - the end receiving the operation is unwilling to perform the operation because it is about to release the connection.
- Unrecognized linked identifier - there is no operation in progress with an invoke identifier equal to the specified linked identifier.
- Linked response unexpected - the operation identified by the linked identifier is an operation in progress, but is not an operation for which linked operations are allowed.
- Unexpected child operation - the child operation is not one that the parent operation identified by the linked identifier allows.

Return result problems

- Unrecognized invocation - no operation with the specified invoke identifier is in progress.
- Result response unexpected - the invoked operation does not report a result, but a Return Result was received.
- Mistyped result - the contents of the result for the Return Result component are invalid.

Return error problems

- Unrecognized invocation - no operation with the specified invoke identifier is in progress.
- Error response unexpected - the invoked operation does not report a failure, but a Return error was received.
- Unrecognized error - the reported error is not a valid value.

- Unexpected error - the reported error is a valid error value for the operation, but is not expected in response to the operation based on the contents of the Invoke component argument (for example, an error value is returned associated with an optional parameter was included in the Invoke component).
- Mistyped parameter - the contents of the parameter of the Return error component are invalid.
- Parameters - Parameters included with a component (that is, argument of Invoke, result of Return result, or parameter of Return error) are indicated in the operation specification. They may include optional and default parameters. Parameters are one of the following:
  - — a sequence of parameters
  - — a set of parameters
  - — a specific parameter with its own tag
  - — null (absent)

  If more than one parameter is required, they follow a sequence or set tag, as specified for the operation. Each parameter in a set or sequence is allowed to be a set or sequence.

Table 93 Sequence and Set tags

Bits								Sequence and Set tags	Hex value
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	0	1	1	0	0	0	0	Sequence tag	30
0	0	1	1	0	0	0	1	Set tag	31
All other values are reserved									

5.5.5.14 Feature Activation information element

The Feature Activation information element allows for a terminal to provide information on actions at the man-machine interface; that is, to indicate that a feature activator has been activated.

Table 94 Feature Activation information element

Bits								**Meaning**	**Octet**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Feature Activation information element Identifier								1
	0	1	1	1	0	0	0		
Length of Feature Activation Contents									2
1/0 Ext.	Feature Identifier Number								3
	0	0	0	0	0	0	0	Reserved (Note 3)	
	0	0	0	0	0	0	1	Feature 1 (Note 2)	
	0	0	0	0	0	1	0	Feature No. 2	
								.	
	1	0	0	0	0	0	0	Feature No. 64	
1	Feature Identifier Number (continuation)								3a*

Note 1: * This octet may be omitted.

Note 2: The network ignores any values which are not in the range 1 to 64.

Note 3: Reserve Feature Identifier value 0 for the Contextual Feature Operator (CFO); it is not currently supported and is no longer required for National ISDN.

The feature identifier number is a unique number assigned to a feature. it identifies the feature being requested or updated. The association of a particular number to a particular feature may be different for each user.

Bit 8 in octet 3 is used to extend the feature identifier number field. The identifier numbers for a one octet field range from 1 - 127. For a multi-octet field, the order of bit values progressively decreases as the octet number increases.

Examples of the meaning that may be assigned the feature identifier are:

- Automatic callback re-try acceptance
- automatic flexible routing
- ISDN call pickup for assigned pickup group
- call forward control for assigned DN/Call Type
- invoke calling number privacy for this call
- invoke calling number publicity for this call make busy
- X-way conference calling (X = 3)
- contextual feature operator (CFO)

5.5.5.15 Feature Indication information element

The Feature Indicator information element is for the network to optionally convey feature indications to a terminal. It may be repeated in a message to convey multiple feature indications to a terminal. It is coded as shown in Table 95, “Feature Indication information element”.

Table 95 Feature Indication information element

BITS								Meaning		Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**			
0	Feature Indication information element Identifier									1
	0	1	1	1	0	0	1			
Length of Feature Indication Contents										2
0/1 EXT.	Feature Identification Number									3
1	Feature Identification Number (Continuation)									3a *
SPARE				Status Indicator						4
0	0	0	0							
				0	0	0	0	Idle	Feature is in an idle state	
				0	0	0	1	Active	Feature is in an active state	
				0	0	1	0	Prompt	Prompt for user input (note 3)	
				0	0	1	1	Pending	Feature is pending (note 4)	
				All other values are reserved						

Note 1: * This octet may be omitted.

Note 2: Feature Identification Number (octets 3 and 3a) This field is coded as described for the Feature Activation IE.

Note 3: Currently applicable to features which require programming, for example, Call Forwarding activation.

Note 4: Currently applicable to features requiring delayed notification.

Code the feature identifier value as the binary coding of a decimal number. Use only one octet for numbers from 1 - 127, and two octets for 128 - 16,383 Examples of the feature identifier are as follows:.

- automatic flexible routing
- ISDN call pickup
- call forwarding
- invoke calling number privacy for this call
- invoke calling number publicity for this call make busy
- X-way conference calling (X = 3).

5.5.5.16 High-Layer Compatibility information element

The High-Layer Compatibility information element, along with the Bearer Capability information element, provide a way for the remote user to check compatibility. It is not interpreted by the network but is carried transparently and delivered to the remote user(s).

The network will not inspect the contents of the high-layer compatibility information element; it simply ensures that the maximum permitted length of this information element is not exceeded. This element is not applicable to packet-mode call types, and its coding is fully described in CCITT Recommendation Q.931. The encoding that the network accepts is illustrated in Table 96, “High-Layer Compatibility information element”.

Table 96 High-Layer Compatibility information element

BITS								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	High-Layer Compatibility information element Identifier							1
	1	1	1	1	0	0	1	
Length of High-layer compatibility information								2
1 Ext	Coding Standard							3 (Note 2)
	0	0	CCITT standardized coding, as described below					
	0	1	Reserved for other international standards (Note 1)					
	1	0	National standard (Note1)					
	1	1	Standard defined for the network (public or private) present at the network side of interface. (Note 1					
			Interpretation			Presentation method of protocol profile		
			5	4	3	2	1	
			1	0	0	0	1	
0/1 Ext	High Layer Characteristics Identification							4
1 Ext	Extended High Layer Characteristics Identification (This octet may be present when octet 4 indicates Maintenance or Management)							4 a *

Note 1: Use these other coding standards only when the desired high layer compatibility cannot be represented with the CCITT standardized coding

Note 2: See Octet 3 Interpretation for full meaning of this byte.

- Coding at Originating Party Interface - The High-Layer Compatibility IE is accepted only when the calling party subscribers parameter allow, and the information is less than or equal to 3 octets (element less than or equal to). If these conditions are met, the High-Layer Compatibility information element is passed to the terminating side of the call; if the conditions are not met, it is discarded.

The High-Layer Compatibility information element is not required for the SETUP, but is not be accepted in any other message.

- Coding at Terminating Party Interface - If the High-Layer Compatibility information element is supplied by the calling party and passed by the originating network, it is included in the SETUP.

Note: Subscription parameters are found in Chapter 8: "Subscription parameters".

Table 97 Octet 3 Interpretation

Bits					**Interpretation (Octet 3)**
5	**4**	**3**			**Meaning**
1	0	0			First (primary or only) high layer characteristics identification (in Octet 4) to be used in the call.
					All other values are reserved
			2	**1**	**Presentation method of protocol profile**
			0	1	High layer protocol profile (without specification of attributes)
					All other values are reserved.

Note 1: “Interpretation” indicates how to interpret the “High layer characteristics identification” (in Octet 4).

Note 2: Currently, “Interpretation” has only a single value. However, when enhanced, it can indicate how to interpret the “High layer characteristics identification” in the same IE when multiple “High layer characteristics identifications” are used, and exact relationship among them needs to be identified (for example, sequential usage, alternative list, simultaneous usage). Such enhancements, in conjunction with the possible negotiation procedures, are left for further study.

Note 3: Currently, “presentation method of protocol profile” has only a single value, that is, a “profile value” indicates a service to be supported by high layer protocols as required. Necessity of other presentation methods, for example, service indications in the forum of layer-by-layer indication of protocols to be used in high layers, is left for further study.

Table 98 High layer characteristics identification (Octet 4)

Bits							High layer characteristics identification (Octet 4)
7	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning**
0	0	0	0	0	0	1	Telephony
0	0	0	0	1	0	0	Facsimile group 2/3
0	1	0	0	0	0	1	Facsimile group 4 document application profile
0	1	0	0	1	0	0	Document application profile for formatted mixed-mode
0	1	0	0	1	0	0	Document application profile for formatted mixed-mode.
0	1	0	1	0	0	0	Document application profile for processable-form
0	1	1	0	1	0	1	Document application profile for videotex interworking between gateways
0	1	1	0	1	0	1	Telex
0	1	1	1	0	0	0	Message handling systems
1	0	0	0	0	0	1	OSI application (Note 1)
1	0	1	1	1	1	0	Reserved for maintenance (Note 2)
1	0	1	1	1	1	1	Reserved for management (Note 2)
1	1	1	1	1	1	1	Reserved
All other values are reserved							

Note 1: Further compatibility checking is executed by the OSI high layer protocol.

Note 2: When this coding is included, octet 4 may be followed by octet 4a.

The coding above applies in case of “Coding standard” = “CCITT standard” and “Presentation method of protocol profile” = “High layer protocol profile”.

Code points are added only to those services for which CCITT recommendations are available.

Table 99 Extended high layer characteristics (Octet 4a)

Bits							Extended high layer characteristics identification (Octet 4a)
7	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning**
0	0	0	0	0	0	1	Telephony
0	0	0	0	1	0	0	Facsimile group 2/3
0	1	0	0	0	0	1	Facsimile group 4 document application profile
0	1	0	0	1	0	0	Document application profile for formatted mixed-mode
0	1	0	1	0	0	0	Document application profile for processable-form
0	1	1	0	0	0	1	Teletext
0	1	1	0	0	1	0	Document application profile for videotex interworking between gateways
0	1	1	0	1	0	1	Telex
0	1	1	1	0	0	0	Message handling system
1	0	0	0	0	0	1	OSI application
1	0	1	1	1	1	0	Not available for assignment
1	0	1	1	1	1	1	Not available for assignment
1	1	1	1	1	1	1	Reserved
All other values are reserved							

5.5.5.17 Information Rate information element

Note: This information element is not currently supported.

The Information Rate information element indicates the information rate signaled on the incoming X.25 packet call to the terminating packet subscriber. It is coded as shown in Table 100, “Information Rate Information element”, and Table 101, "Incoming information (Octet 3)”.

Table 100 Information Rate Information element

Bits								**Information rate**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Information element indicator**
0	1	0	0	0	0	0	0	Octet 1
0	0	0	0	0	0	1	0	Octet 2 Length of information rate IE
1 Ext	0 0 Spare		Incoming Information transfer rage					Octet 3
1 Ext	0 0 Spare		Outgoing information transfer rate					Octet 4
1 Ext	0 0 Spare		Minimum incoming information rate					Octet 5
1 Ext	0 0 Spare		Minimum outgoing information rate					Octet 6

Table 101 Incoming information (Octet 3)

Bits					**Incoming information (Octet 3)**
5	**4**	**3**	**2**	**1**	**Synchronous Rate**
0	0	0	0	0	reserved
0	0	0	0	1	reserved
0	0	0	1	0	reserved
0	0	0	1	1	75 b/s
0	0	1	0	0	150 b/s
0	0	1	0	1	300 b/s
0	0	1	1	0	600 b/s
0	0	1	1	1	1200 b/s
0	1	0	0	0	2400 b/s
0	1	0	0	1	4800 b/s
0	1	0	1	0	9600 b/s
0	1	0	1	1	19.2 kb/s
0	1	1	0	0	48 kb/s
0	1	1	0	1	reserved
0	1	1	1	0	reserved
0	1	1	1	1	reserved

Note: 16 kb/s and 64 kb/s throughput classes are added when CCITT provides codepoints for them.

5.5.5.18 Information Request information element

The Information Request information element allows the network to request additional information from the user during invocation of certain supplementary services. It is coded as shown in Table 102, “Information Request information element”.

Table 102 Information Request information element

BITS									Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Information Request information element Identifier								1
	0	1	1	0	0	1	0		
Length of information request contents									2
1 Ext	Info Request indicator	Type of Information							3 etc.
	0	information request completed							
	1	prompt for additional information							
		Type of Information						**Types**	
		0	0	0	0	0	0	undefined	
		0	0	0	0	0	1	authorization codes **+**	
		0	0	0	0	1	0	address digit	
		0	0	0	0	1	1	terminal identification	
		All other values are reserved							

Note: + = Not supported at this time, use the value for “undefined” for the time being to support “authorization code” only.

Value “terminal identification” is only one required in this interface specification.

5.5.5.19 Keypad information element

The Keypad (KP) information element conveys IA5 characters, for example, entered by means of a terminal keypad. The Keypad information element is coded as shown in Table 103, “Keypad information element”.

Table 103 Keypad information element

BITS								Meaning	Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Keypad information element Identifier								1
	0	1	0	1	1	0	0		
Length of Keypad contents									2
0	Keypad Information (IA5 characters)								3 etc.
	0	1	1	0	0	0	0	0	
	0	1	1	0	0	0	1	1	
	0	1	1	0	0	1	0	2	
	0	1	1	0	0	1	1	3	
	0	1	1	0	1	0	0	4	
	0	1	1	0	1	0	1	5	
	0	1	1	0	1	1	0	6	
	0	1	1	0	1	1	1	7	
	0	1	1	1	0	0	0	8	
	0	1	1	1	0	0	1	9	
	0	1	0	1	0	1	0	*	
	0	1	0	0	0	1	1	#	
	All other values are reserved								

Table 104 Example encodings of Called Party Number in Keypad

Public Network Dialling Plan Prefixed by 9 in Centrex
9+
0
NXX-XXXX
0 + NXX-XXXX
1 + NXX-XXXX
0 + NPA + NXX-XXXX
1 + NPA + NXX-XXXX
01 + CC + N (S) N
011 + CC + N (S) N
N11 (e.g., 411, 611)
10TNS + NXX-XXXX
10TNS + NPA + NXX-XXXX
10TNS + 0 + NXX-XXXX
10TNS + 0 + NPA + NXX-XXXX
10TNS + 01 + CC + N (S) N
10TNS + 0
00
1 + 800 + NNX-XXXX

Note 1: NXX-XXXX is a 7 digit number coded as:

— “N” in the range 2-9

— “X” in the range 0-9

Note 2: NPA represents a string of 3 digits coded as:

— “N” in the range 2-9

— “P” in the range 0-9

— “A” in the range 0-9

Note 3: TNS is in the range 0-9999.

5.5.5.20 Low-Layer Compatibility information element

The Low-Layer Compatibility information element, and Bearer Capability information element, provide a way for the remote user to check compatibility. This information element is not interpreted by the network, but is carried transparently and delivered to the remote user(s).

The contents of this information element are not inspected by the network; the network simply ensures that the information elements maximum allowed length is not exceeded. Coding of this information element can be found in CCITT Recommendation Q.931. The encoding that the switch accepts is shown in Table 105, "Low-Layer Compatibility Information element Identifierr”.

Table 105 Low-Layer Compatibility Information element Identifierr

Bits								Octet #
8	7	6	5	4	3	2	1	
0	Low-Layer Compatibility information element Identifier							1
	1	1	1	1	1	0	0	
Length of Lower-Layer compatibility Information								2
1	Compatibility Information							3 etc.

- Coding at Originating Party Interface - The Lower-Layer Compatibility information element is accepted in a SETUP, only if the subscription parameter of the calling party allows it, and the information element is less than or equal to 14 octets (element less than or equal to 16 octets).

  If the above conditions are met the network passes the information to the terminating side of the call; if the conditions are not met, it is discarded. Lower-Layer Compatibility is an optional information element that is only included in a SETUP.

- Codings at Terminating Party Interface - The Lower-Layer Compatibility information element is sent in a SETUP if it was supplied by the calling party and passed by the originating network.

Note: Subscription parameters are found in Chapter 8: "Subscription parameters".

5.5.5.21 Notification Indicator information element

The Notification Indicator information element indicates information pertaining to a call. It can appear twice in a message to report multiple events. Table 106, “Notification Indicator information element” shows its structure.

Table 106 Notification Indicator information element

Bits								Octet #
8	7	6	5	4	3	2	1	
0	Notification Indicator							1
	0	1	0	0	1	1	1	
Length of notification indicator contents								2
1 Ext	Notification Description							3
ASN.1 Encoded Data Structure								4, etc. *

Note: (*) Octet 4 and subsequent octets will be omitted in most cases. These octets are currently only used by the Rapid Messaging feature.

Table 107 Notification description (Octet 3)

Bits							Octet 3
7	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning**
0	0	0	0	0	1	1	Discriminator for extension to ASN.1 encoded component**
0	1	0	0	0	0	0	Connected through conference facility (controller) *
0	1	0	0	0	0	1	Connected through conference facility (conferee) *
0	1	0	0	0	1	0	Two-party call *
0	1	0	0	0	1	1	Conference facility released *
0	1	0	0	1	0	0	Connected to ESB *
0	1	0	0	1	0	1	Connect to Attendant Console*
0	1	0	0	1	1	0	Remote party disconnected *
0	1	0	0	1	1	1	Bridged call
0	1	0	1	0	0	0	Call no longer bridged *
0	1	0	1	0	0	1	Retrieve held call *
0	1	0	1	0	1	0	No longer connected to Attendant Console *
0	1	0	1	1	0	1	Conference bridge full *
0	1	0	1	1	1	0	Conference bridge port available *
1	1	0	0	0	0	0	Call is a waiting call
1	1	1	0	0	0	1	Call information/event
1	1	1	0	1	0	0	Service Profile Update
1	1	1	0	1	0	1	User bridged onto call
1	1	1	0	1	1	0	ACB monitoring discontinued +
1	1	1	0	1	1	1	Call on hold
1	1	1	1	0	0	0	Monitored user idle +
1	1	1	1	0	0	1	Remote hold +
1	1	1	1	0	1	0	Remote hold released +
1	1	1	1	0	1	1	Call is forwarded
1	1	1	1	1	0	0	Privacy enabled
1	1	1	1	1	0	1	Privacy disabled
1	1	1	1	1	1	0	Call retrieved from hold

Note 1: + = not currently supported; * = may not be supported in the future
** = Currently used only for the Rapid Messaging feature.

Note 2: All other values are reserved.

Table 108 ASN.1 Encoded Data Structure Content (Octet 4, etc.)

Data Elements	Value
Sequence Data Element	Sequence Tag & Length, see Table 109, "Sequence Data Element", and Table 110, "Length Data Element, Short Form Length Format"
Notification Value Data Element	Values are defined for individual services such as Rapid Messaging, see Table 111, "Notification Value Data Element."
Arguments	Any arguments defined by the Notification Value

Note: Octet 4 is only included when the Rapid Messaging feature applies, and when octet 3 is encoded as "Discriminator for extension to ASN.1 encoded component". The Rapid Messaging feature uses the Sequence Data Element and the Notification Value Data Element but does not use any additional Arguments for the Notification Values.

Table 109 Sequence Data Element

8	7	6	5	4	3	2	1	
0	0	1	1	0	0	0	0	
Sequence tag								Octet 1
Sequence length								2
Sequence length continued								3†

† included if Sequence length value spans 2 octets

Note: The Sequence Data Element will actually occur in Octets 4 and 5 of the Notification Indicator IE when it is used by the Rapid Messaging feature.

The Sequence length in the Sequence Data Element indicates the total number of octets in the following sequence, excluding the octets used for the sequence tag and sequence length. The length is encoded using the Length Data Element. The Length Data Element is coded as shown in Table 110, "Length Data Element, Short Form Length Format", when the short form length format is used. Note that Octet 3 of the Sequence Data Element is not used when the short form length format of the Length Data Element is used.

The short form of the Length Data Element may be used to encode lengths up to 127 octets. Bit 8 is set to 0 and the remaining seven bits are a binary encoding of the length, with Bit 1 being the least significant bit.

Table 110 Length Data Element, Short Form Length Format

8	7	6	5	4	3	2	1
0	Length of contents						

Note: For the Rapid Messaging feature, a sequence length of 7 octets is always used, coded in the Short Form Length format given above. The "Length of contents" value for a sequence length of 7 octets is "000 0111".

Table 111 Notification Value Data Element.

8	7	6	5	4	3	2	1	
Notification value tag								Octet 1
Notification value length								2
Notification value								3, etc.

Note: The Notification Value Data Element will actually occur in Octets 6 through 12 of the Notification Indicator IE when it is used by the Rapid Messaging feature.

Table 112 Notification Value Tags

8	7	6	5	4	3	2	1	Meaning
0	0	0	0	0	0	1	0	Integer
0	0	0	0	0	1	1	0	Object identifier
All other values are reserved.								

Note: For the Rapid Messaging feature, a Notification value tag of "Object identifier" is always used.

Notification value length: The notification value length in the Notification Value Data Element will be coded using the Short Form Length format described in Table 110, "Length Data Element, Short Form Length Format". The length of this Length element will always be one octet.

For the Rapid Messaging feature, a notification value length of 5 octets is always used, coded in the Short Form Length format given in Table 110, "Length Data Element, Short Form Length Format". The "Length of contents" value for a notification value length of 5 octets is "000 0101".

Notification value: The notification value in the Notification Value Data Element will be encoded as a 2's complement binary number in the fewest possible number of octets if the Integer tag is used, or as an object identifier if the Object identifier tag is used.

For the Rapid Messaging feature, an Object identifier is always used as the Notification value, and the Object Identifier encoded in the Notification value field is always 5 octets in length.

Object Identifier: An object identifier is a sequence of non-negative integer values encoded as subidentifiers. The first two integer values (X,Y) of the sequence are used to form the first subidentifier (40*X+Y), and each subsequent integer value is the next subidentifier. Each subidentifier is coded separately, as shown in Table 113, "One-Octet Subidentifier Format for Object Identifiers", and then concatenated to form the object identifier value.

Table 113 One-Octet Subidentifier Format for Object Identifiers

8	7	6	5	4	3	2	1
0	Subidentifier						

A subidentifier is coded as an unsigned binary number in 1 octet. The subidentifiers are concatenated to form the Object Identifier coding.

The Rapid Messaging feature uses three Bellcore-defined Object Identifier values, and each of these Object Identifier values contains six integers coded in five subidentifer octets. The first five integer values, which uniquely identify the Rapid Messaging feature, are fixed and do not vary: {1 3 17 102 4}. The last integer value is either {1}, {2}, or {3}, depending on which of the following Notification Values are sent by the Rapid Messaging feature:

- Out-of-Service Condition Imminent (Integer Value 1)
- Out-of-Service Condition Applied (Integer Value 2)
- Terminal Restored to In-Service Condition (Integer Value 3).

The integer sequence {1 3 17 102 4 1} is encoded as an object identifier as follows:

- Integer values 1, 3 (X,Y) form the first subidentifier (40*X) + Y, which is 43.
- The second subidentifier is 17 and the third subidentifier is 102.
- The fourth subidentifier is 4 and the fifth subidentifier is 1.

The integer sequence {1 3 17 102 4 2} is encoded as an object identifier as follows:

- Integer values 1, 3 (X,Y) form the first subidentifier (40*X) + Y, which is 43.
- The second subidentifier is 17 and the third subidentifier is 102.
- The fourth subidentifier is 4 and the fifth subidentifier is 2.

The integer sequence {1 3 17 102 4 3} is encoded as an object identifier as follows:

- Integer values 1, 3 (X,Y) form the first subidentifier (40*X) + Y, which is 43.
- The second subidentifier is 17 and the third subidentifier is 102.
- The fourth subidentifier is 4 and the fifth subidentifier is 3.

Table 114, "Out-of-Service Condition Imminent Object Identifier”, Table 115, "Out-of-Service Condition Applied Object Identifier”, and Table 116, "Terminal Restored to In-Service Condition Object Identifier” specify the respective codings for these three Rapid Messaging Object Identifier values.

Table 114 Out-of-Service Condition Imminent Object Identifier

8	7	6	5	4	3	2	1	
0	0	1	0	1	0	1	1	Octet 1
0	0	0	1	0	0	0	1	Octet 2
0	1	1	0	0	1	1	0	Octet 3
0	0	0	0	0	1	0	0	Octet 4
0	0	0	0	0	0	0	1	Octet 5

Table 115 Out-of-Service Condition Applied Object Identifier

8	7	6	5	4	3	2	1	
0	0	1	0	1	0	1	1	Octet 1
0	0	0	1	0	0	0	1	Octet 2
0	1	1	0	0	1	1	0	Octet 3
0	0	0	0	0	1	0	0	Octet 4
0	0	0	0	0	0	1	0	Octet 5

Table 116 Terminal Restored to In-Service Condition Object Identifier

8	7	6	5	4	3	2	1	
0	0	1	0	1	0	1	1	Octet 1
0	0	0	1	0	0	0	1	Octet 2
0	1	1	0	0	1	1	0	Octet 3
0	0	0	0	0	1	0	0	Octet 4
0	0	0	0	0	0	1	1	Octet 5

Note: These Object Identifiers will actually occur in Octets 8 through 12 of the Notification Indicator IE when it is used by the Rapid Messaging feature.

Table 117, "Full Coding Of Notification Indicator IE (Octets 1 through 12) for Rapid Messaging Notification Indicators" illustrates the full coding of the Notification Indicator Information Element (from Octet 1 to Octet 12) when these Rapid Messaging Notification Indicators are included. The Notification Description Octet, Sequence Data Element, Notification Value Data Element, and Object Identifier values are shown for the three separate Notification Indicators used by the Rapid Messaging Feature. (In Octet 11, “DCMPMC” is an acronym for the generic Bellcore name for the Rapid Messaging feature.)

Table 117 Full Coding Of Notification Indicator IE (Octets 1 through 12) for Rapid Messaging Notification Indicators

8	7	6	5	4	3	2	1	Octet #	Octet Contents
0	0	0	1	1	1	0	0	1	Notification Indicator Information Element Identifier
0	0	0	0	1	0	1	0	2	Length of Notification Indicator Contents = 10 octets
1	0	0	0	0	0	1	1	3	Notification Description = Discriminator for extension to ASN.1 encoded component
0	0	1	1	0	0	0	0	4	Sequence Data Element, Sequence Tag
0	0	0	0	0	1	1	1	5	Sequence Data Element, Sequence Length = 7 octets
0	0	0	0	0	1	1	0	6	Notification Value Data Element, Notification Value Tag = Object Identifier
0	0	0	0	0	1	0	1	7	Notification Value Data Element, Notification Value Length = 5 octets
0	0	1	0	1	0	1	1	8	Notification Value Data Element, Notification Value, Object Identifier Octet 1 = Bellcore ISDN Supplementary Services {1 3 17 102}, Subidentifier 1 = 43 (40*1 + 3)
0	0	0	1	0	0	0	1	9	Notification Value Data Element, Notification Value, Object Identifier Octet 2 = Bellcore ISDN Supplementary Services {1 3 17 102}, Subidentifier 2 = 17
0	1	1	0	0	1	1	0	10	Notification Value Data Element, Notification Value, Object Identifier Octet 3 = Bellcore ISDN Supplementary Services {1 3 17 102}, Subidentifier 3 = 102
0	0	0	0	0	1	0	0	11	Notification Value Data Element, Notification Value, Object Identifier Octet 4, Subidentifier 4 = DCMPMC (Rapid Messaging) {4}
0	0	0	0	0	0	0	1	12	Notification Value Data Element, Notification Value, Object Identifier Octet 5, Subidentifier 5 = Out-of-Service Condition Imminent {1}

- or -

8	7	6	5	4	3	2	1	Octet #	Octet Contents
0	0	0	0	0	0	1	0	12	Notification Value Data Element, Notification Value, Object Identifier Octet 5, Subidentifier 5 = Out-of-Service Condition Applied {2}

- or -

8	7	6	5	4	3	2	1	Octet #	Octet Contents
0	0	0	0	0	0	1	1	12	Notification Value Data Element, Notification Value, Object Identifier Octet 5, Subidentifier 5 = Terminal Restored to In-Service Condition {3}

5.5.5.22 Packet-Layer Binary Parameters information element

Note: This information element is not currently supported.

The Packet-Layer Binary Parameters information element indicates the requested layer 3 parameter values for the incoming X.25 packet-mode call to the terminating packet subscriber. It should be coded as shown in Table 118, “Packet-Layer Binary Parameters information element”.

Table 118 Packet-Layer Binary Parameters information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Packet-Layer Binary Parameters Information Element Identifier							1
	1	0	0	0	1	0	0	
Length of packet-layer binary parameters information element								2
0	0	0	0	0	0	0	1	
1 Ext	Spare		Fast Select		Exp. Data	Receipt Conf	Modulus	3
	0	0						

Code the various parts of the IE as shown in Table 119, “Packet-layer Binary Parameters information element coding”.

Table 119 Packet-layer Binary Parameters information element coding

Bits					Meaning	Octet 3
5	**4**	**3**	**2**	**1**	**Fast Select**	
0	X				fast select not requested	
1	0				fast select not requested with no restriction	
1	1				fast select not requested with restriction	
		3			**Expedited data**	
		0			no request	
		1			Request Indicated	
			2		**Delivery confirmation**	
			0		Link - by - link confirmation	
			1		end - to - end confirmation	
				1	**Modulus**	
				0	modulus 8 sequencing	
				1	modulus 128 sequencing	

5.5.5.23 Packet-Layer Window Size information element

Note: This information element is not currently supported.

This information element indicates the requested layer 3 window sizes to be used in each direction for the incoming X.25 packet call to the terminating packet subscriber. Code it as shown in Table 120, “Packet-Layer Window Size information element”.

Table 120 Packet-Layer Window Size information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Packet-Layer Window Size Information Element Identifier							1
	1	0	0	0	1	0	1	
Length of packet-layer window size information element								2
1 spare	Forward Value							3
1 spare	Backward Value							4 *

***Note:* *** May be omitted. When omitted indicates a request for a default window size.

The fields of the Packet-Layer Window Size information element should be coded as follows:

- Forward value (octet 3, bits 1–7) binary encoded
- Backward value (octet 4, bits 1–7) binary encoded.

5.5.5.24 Packet Size information element

Note: This information element is not supported at this time.

This information element indicates the requested packet sizes to be used in each direction for the incoming X.25 packet call to the terminating packet subscriber. Code it as shown in Table 121, “Packet Size information element”.

Table 121 Packet Size information element

Bits								Packet Size Information Element	
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Octet meanings**	**Octet**
0	1	0	0	0	1	1	0	Packet Size information element Identifier	1
Length of packet size information element									2
1 spare	Forward value								3
1 Spare	Backward value							Backward value (may be omitted). When omitted indicate request for default packet size.	4

Code the fields of this IE as follows:

- Forward value - Packet size value, binary encoded (the value 000 0000 is reserved)
- Backward value - Packet size value, binary encoded (the value 000 0000 is reserved).

5.5.5.25 Progress Indicator information element

The Progress Indicator information element describes an event that occurred during the life of a call. Its structure is shown in Table 122, “Progress Indicator information element”.

Table 122 Progress Indicator information element

Bits								Meaning	
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		**Octet**
0	Progress Indicator information element Identifier								**1**
	0	0	1	1	1	1	0		
Length of progress indicator contents									**2**
1 Ext.	**Coding Standard**		**Spare**	**General Location**					**3**
	7	**6**	**5**	**4**	**3**	**2**	**1**		
	0	0						CCITT standard	
	0	1						Reserved	
	1	0						National standard	
	1	1						Network-Specific standard	
			5					**Spare**	
			0					Bit (this value always = 0)	
				4	**3**	**2**	**1**	**General Location**	
				0	0	0	0	User	
				0	0	0	1	Private network serving local user (Note 3)	
				0	0	1	0	Public network serving local user	
				0	0	1	1	transit network (Notes 1 and 3)	
				0	1	0	0	public network serving remote user (Note 3)	
				0	1	0	1	private network serving remote user (Note 3)	
				0	1	1	1	International network (Notes 2 and 3)	
				1	0	1	0	network beyond interworking point (Note 3)	
								All other values are reserved	
1 Ext.	Progress Description								**4**

Note 1: The “transit network” codepoint does not apply to the CCITT-standardized coding standard.

Note 2: The “international network” codepoint applies only to the Network-specific coding standard.

Note 3: These values may not be sent in all situations.

Table 123 Octet 4 Progress description

Bits							Number	Octet 4
7	**6**	**5**	**4**	**3**	**2**	**1**		**CCITT Standardized Values (Coding Standard = 00)**
0	0	0	0	0	0	1	1	Call is not end-to-end ISDN further call progress information may be available inband
0	0	0	0	0	1	0	2	Called equipment is non-ISDN
0	0	0	0	0	1	1	3	Calling equipment is non-ISDN
0	0	0	1	0	0	0	8	In-band information or appropriate pattern is now available
All other values are reserved								
National Standard (coding Standard = 10)								
7	6	5	4	3	2	1	10	Delay in response at called interface
All other values are reserved								

5.5.5.26 Redirecting Number information element

The Redirecting Number information element identifies the number from which call redirection/diversion was invoked. Code the Redirecting Number information element as shown in Table 124, “Redirecting Number information element”.

Table 124 Redirecting Number information element

Bits								
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Octet**
0	Redirecting Number information element Identifier							1
	1	1	1	0	1	0	0	
Length of redirecting number information								2
0/1 Ext	Type of Number			Numbering Plan Identification				3
0/1 Ext.	Presentation Indicator		**Spare**			Screening Indicator		3* a
			0	0	0			
1 EXT	**Spare**			Reason for Redirection				3 *b
	0	0	0					
Spare 0	Number digits (IA5 characters)							4 * etc.

Note: The balance of the contents for this IE is coded the same as the CGN IE, Section 5.5.5.4, “Called Party Number information element”.

For the coding of the Reason for Redirection see Table 126, “Reason for Redirection (Octet 3b)”.

5.5.5.27 Redirection Number information element

The Redirection Number information element identifies the number to which call redirection/ diversion should be or has been invoked.

Table 125 Redirection Number information element

<table>
<tr><th colspan="8">Bits</th><th rowspan="2">Octet #</th></tr>
<tr><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th></tr>
<tr><td rowspan="2">0</td><td colspan="7">Redirection Number information element Identifier</td><td rowspan="2">1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
<tr><td colspan="8">Length of redirecting number contents</td><td>2</td></tr>
<tr><td>0/1 Ext.</td><td colspan="3">Type of Number</td><td colspan="4">Numbering Plan Identification</td><td>3</td></tr>
<tr><td rowspan="2">0/1 Ext.</td><td colspan="2" rowspan="2">Present Indicator</td><td colspan="3">Spare</td><td colspan="2" rowspan="2">Screening Indicator</td><td rowspan="2">3 a *</td></tr>
<tr><td>0</td><td>0</td><td>0</td></tr>
<tr><td>1 EXT</td><td colspan="3">Spare</td><td colspan="4">Reason for Redirection</td><td>3 b *</td></tr>
<tr><td>0 spare</td><td colspan="7">Number of digits (IA5 characters)</td><td>4 etc. *</td></tr>
</table>

Note: * This octet may be omitted

Table 126 Reason for Redirection (Octet 3b)

Bits				**Octet 3b**
4	**3**	**2**	**1**	**Reason for Redirection**
0	0	0	0	unknown
0	0	0	1	call forwarding busy
0	0	1	0	call forwarding no reply
1	0	0	1	call forwarding DTE out of order **+** (not supported at this time)
1	0	1	0	call forwarding by the called equipment **+**(not supported at this time)
1	1	0	1	call transfer
1	1	1	0	call pickup
1	1	1	1	call forwarding unconditional
All other values reserved				

The balance of contents for this IE is coded the same as the CGN IE, (Section 5.5.5.6, “Calling Party Number information element”).

5.5.5.28 Segment Message information element

The Segmented Message information element is used to identify the type of message that is segmented. It is included only in a SEGMENT message. This information element is coded as shown in Section Table 127, “Segmented Message information element” .

Table 127 Segmented Message information element

Bits								Octet #
8	7	6	5	4	3	2	1	
0	Segmented Message information element Identifier							1
	0	0	0	0	0	0	0	
Length of Segmented Message								2
0	0	0	0	0	0	1	0	
0/1	Number of segments remaining							3
0	Subsequent segments (Switch will code the number of remaining as a binary coding of a decimal number within the range 0 to 19)							
1	First segment							
0	Segmented Message Type (FACILITY)							4
	1	1	0	0	0	1	0	

5.5.5.29 Service Profile Identification information element

The Service Profile Identification information element is populated by either the user or the network during AutoSPID to initiate automatic assignment of the user service identifier and terminal identifier.

The SPID information element’s structure is shown in Table 128, “Service Profile Identification information element”.

Table 128 Service Profile Identification information element

Bits								Octet #
8	7	6	5	4	3	2	1	
0	Service Profile Identification information element Identifier							1
	0	1	1	1	0	1	0	
Length of Service Profile Identification								2
0 Spare	Service Profile Identifier (SPID) (IA5 characters)							3 etc.

SPID (octets 3 etc.) - The SPID parameter is contained in octet 3, and so forth, and should be coded in IA5 characters. It may have up to 20 characters.

The initiation of AutoSPID is done by the terminal sending the SPID information element with the SPID coded as the Universal SPID = 01 0101 0101 0101. See Section 6.7.4.3, “Automated SPID Selection”

5.5.5.30 Signal information element

The Signal information element allows the network to optionally convey information to a user regarding tones and alerting signals. It is coded as shown in Table 129 "Signal information element".

Table 129 Signal information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Signal information element Identifier							1
	0	1	1	0	1	0	0	
Length of Signal								2
0	0	0	0	0	0	0	1	
Signal value								3 etc.

Signal value	Bits								Meaning
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Network Specific signal value** (Octet 3)
1	0	0	0	0	0	0	1		Recall dial tone on
2	0	0	0	0	0	1	0		Barge-in tone on
122	1	1	1	1	0	1	0		Incoming additional call tone
123	1	1	1	1	0	1	1		Priority additional call tone
125	1	1	1	1	1	0	1	1	Expensive route warning tone (not supported)
									All other values reserved

Signal value	Bits								Meaning(
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Signal value** (Octet 3)
0	0	0	0	0	0	0	0	0	Dial tone on
1	0	0	0	0	0	0	0	1	Ring back (audible ring) tone on
3	0	0	0	0	0	0	1	1	Network congestion/reorder tone on
4	0	0	0	0	0	1	0	0	Busy tone on
5	0	0	0	0	0	1	0	1	Confirm tone on
7	0	0	0	0	0	1	1	1	Call waiting tone (additional call tone) (not supported)
63	0	0	1	1	1	1	1	1	Tones off
64	0	1	0	0	0	0	0	0	Alerting on - pattern 0: normal alerting
65	0	1	0	0	0	0	0	1	Alerting on - pattern 1: Incoming call (distinctive)
66	0	1	0	0	0	0	1	0	Alerting on - pattern 2: Requested call offered
67	0	1	0	0	0	0	1	1	Alerting on - pattern 3: Intercom alert
68	0	1	0	0	0	1	0	0	Alerting on - pattern 4: Reminder ring
70	0	1	0	0	0	1	1	0	Alerting on - pattern 6: English ringing
79	0	1	0	0	1	1	1	1	Alerting off

5.5.5.31 Transit Delay Selection and Indication information element

Note: This information element is not supported at this time.

This information element requests the maximum permissible transit delay applicable on a per virtual call basis. It is coded as shown in Table 130, “Transit Delay Selection and Indication information element”.

Table 130 Transit Delay Selection and Indication information element

Bits								**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Transit Delay Selection and Indication information element Identifier							1
	1	0	0	0	0	1	1	
Length of Transit Delay Selection and Indication								2
0 EXT	Spare							3 etc.
	0	0	0	0	0	Transit delay selection and indication value		
0 EXT	(if bit 8 0 this octet continues through the next octet)							
1 EXT	if bit 8 1 this octet is last							

- The transit selection and indication value should be in milliseconds and binary coding. Bit 2 of octet 3 should be used as the highest order bit, and bit 1 of octet 3b should be used as the lowest order bit.
- The transit delay value should occupy a total of 16 bits.

5.5.5.32 Transmit Network Selection information element

- The Transit Network Selection (TNS) information element provides information such as the type of network, the network identification plan, and the network identification.
- The Type of Network (TON) may be either Nationally-Standardized or User Specified (private identification).
- The Network Identification Plan may be either Unknown, InterLATA Carrier Identification code, or User-Specific Identification Code.
- The contents of the Network Identification vary according to the Network Identification Plan.
  - — An InterLATA Carrier Identification Code specifies the Network Identification containing a 3-digit code representing an InterLATA Carrier.
  - — A User-Specified Identification Code indicates that the Network Identification contains an access code to private-leased circuits. The number of digits in the access code is identified in the length of Transit Network Identification.
- If the Keypad (KP) information element is present in conjunction with the TNS or Called Party Number information element, the digits in the KP IE

represent a feature access code. The first digits in the called number are those in the KP IE.

- The TNS (optional) is only present in the SETUP at the originating party interface and is not present in any message at the terminating party interface.

Table 131 Transit Network Selection information element

Bits								Meaning	Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Transit Network Selection information element Identifier								1
	1	1	1	1	0	0	0		
Length of Transit Network Selection									2
1 Ext.	**Type of Network Identification**								3 etc.
	7	**6**	**5**					Type of Network Identification	
	0	0	0					User specified (private identification)	
	0	1	0					Nationally standardized identification	
								All other values reserved	
				Network Identification Plan					
				4	**3**	**2**	**1**	**Network Identification Plan**	
				0	0	0	0	Unknown/user-specified (not supported at this time)	
				0	0	0	1	interLATA carrier identification code	
				0	0	1	0	User-specified identification code	
								All other values reserved	
0 Spare	Network Identification								

5.5.5.33 User-User information element

Note: This information element is not supported at this time.

The User-User information element conveys information between ISDN users. The information is not interpreted by the network, but carried transparently to the remote user during call establishment and call clearing.

The information is not inspected and the networks accepts all codings of the protocol discriminator and user information fields. The network will not allow the maximum length (131 octets) to be exceeded. Table 132, “User-User information element” shows the information element’s structure.

Table 132 User-User information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	User-user Information Element Identifier							1
	1	1	1	1	1	1	0	
Length of user-user information								2
Protocol discriminator								3
User information								4 etc.

5.5.6 National-Specific information elements (codeset 5)

The information elements defined in this section are national-specific, code them using the Locking Shift to codeset 5.

Table 133 Information Element Identifier coding (Codeset 5)

Bits								Information element Identifier coding (Codeset 5)
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	Variable Length IE
0	0	0	0	0	0	0	1	Operator System Access
0	0	1	0	1	0	1	0	Display Text
	All other values are reserved							

5.5.6.1 Operator System Access information element

The Operator System Access information element indicates the required operator system services through the Type of Access field.

- Public/Principal access directs the call to an operating company operator.
- Public/Alternative access directs the call to an interexchange carrier operator.
- Private/Principal access directs the call to private network attendant systems or Private Branch Exchange (PBX).
- It is present only in the SETUP at the originating party interface and not in any message at the terminating party interface.

Table 134 Operator System Access information element

Bits								**Meaning**	**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Operator System Access IE Identifier								1
	0	0	1	1	1	0	1		
Length of Operator System Access									2
1 Ext.	Type of Service								3
	7	**6**	**5**	**4**	**3**				
	0	0	0	0	0			Unspecified	
	All other values reserved								
						Type of Access			
						2	**1**		
						0	0	Public/Principal (default operator system)	
						0	1	Public/alternate determined by user subscription	
						1	0	Private/Principal used for operator system	
						All other values reserved			

5.5.6.2 Display Text information element

The Display Text information element supplies network formatted display information that may be displayed on a terminal having a display capability, when supporting this information element and its associated procedures.

- It can be included in any message (for example, CONNect ACKnowldge, HOLD ACKnowldge, KEY HOLD, or PROGress) sent by the network in the network-to-user direction.
- Its maximum length depends on the maximum length of the message and the existence of other information elements within that message.
- For additional information about the Display Text information element protocol and procedures, refer to “American National Standard T1.610A-1990 Display Procedures”.

Table 135 Display Text information element

Bits									Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**Meaning**	
0	Display Text								1
	0	1	0	1	0	1	0		
Length of Display Text IE									2
	Display type							**Display type**	3
1	0	0	0	0	0	0	0	Normal	
								All other values reserved	
Display Information (One or more groups of display information may be included, depending on specific service requirements.)									4 etc.

- Display information - formatted as described in “American National Standard T1.610A-1990 Display Procedures”.
- Display tags - there are three types of display tags:

1 Mandatory control tags (Blank and Skip),

2 Display Text tags, and

3 Optional control tags.

- Terminals using this information element for display purposes must at least comprehend the blank and skip tags.
- The display tags and corresponding codings are listed in Table 136, “Coding of Display Text and Control Tags”.
- The definitive encodings for the display tags are contained in the ANS T1.610A document, which is contained in T1S1/91-288R.
- If there are any discrepancies between the codings of display text tags shown in this document, and those contained in ANS T1.610A, those in ANS T1.610 A take precedence.

Table 136 Coding of Display Text and Control Tags

Bits								Meaning
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
1	0	0	0	0	0	0	0	***** Blank tag
1	0	0	0	0	0	0	1	Skip tag
1	0	0	0	0	0	1	0	Continuation tag
1	0	0	0	0	0	1	1	***** Called Address
1	0	0	0	0	1	0	0	Cause
1	0	0	0	0	1	0	1	Progress Indicator
1	0	0	0	0	1	1	0	Notification Indicator
1	0	0	0	0	1	1	1	Prompt
1	0	0	0	1	0	0	0	***** Accumulated Digit
1	0	0	0	1	0	0	1	Status
1	0	0	0	1	0	1	0	Inband
1	0	0	0	1	0	1	1	***** Calling address
1	0	0	0	1	1	0	0	***** Reason
1	0	0	0	1	1	0	1	***** Calling Party Name
1	0	0	0	1	1	1	0	***** Called Party Name
1	0	0	0	1	1	1	1	Original Called Name
1	0	0	1	0	0	0	0	***** Redirecting Name
1	0	0	1	0	0	0	1	***** Connected Name
1	0	0	1	0	0	1	0	Originating Restrictions
1	0	0	1	0	0	1	1	Date and Time of Day
1	0	0	1	0	1	0	0	Call Appearance ID
1	0	0	1	0	1	0	1	Feature Address
1	0	0	1	0	1	1	0	***** Redirection Name
1	0	0	1	0	1	1	1	***** Redirection Number
1	0	0	1	1	0	0	0	***** Redirecting Number
1	0	0	1	1	0	0	1	Original called party
1	0	0	1	1	0	1	0	Connected number
1	0	0	1	1	1	1	0	Text (for example, ASCII)
All other values are reserved								

Note 1: * Implemented for the current Calling Name and Reason feature.

Note 2: All tags are encoded using the basic ASN.1 encoding rules specified in CCITT X.209. The contents of each tagged parameter will be encoded as ASCII characters.

Display Tag Definitions

The full list of display tags, codings, and definitions is described in ANSI T1.610A.

- Skip - always 1 octet long, with a value between 1-255, that tells the terminal how many ASCII characters to skip over before operating on the next display tag. This value is interpreted as an unsigned integer.
- Blank - always 1 octet long, with a value between 1-255, that tells the terminal how many successive blank characters to append to any previous text. This value is interpreted as an unsigned integer.

When processing the Display Text information element, the terminal formats the ASCII characters beginning at the upper left-hand corner of the display unit.

The network sends the tagged display text as appropriate for the basic call progress and supplementary services. Stimulus terminals should display the ASCII text for successive fields by simply concatenating the fields without necessarily comprehending the display tag (except the Stimulus terminals must process the Blank and Skip tags).

Terminals must clear the display associated with a call when it is released.

5.5.7 Network-Specific information elements (Codeset 6)

The information elements defined in this section are network-specific; code them using the Locking Shift to codeset 6.

Table 137 Network-Specific information elements

Bits								Meaning (Information element identifier Codeset 6)
8	7	6	5	4	3	2	1	
0	-	-	-	-	-	-	-	Variable Length IE
	0	1	1	1	1	1	0	Protocol Version Control (PVC)
	1	1	1	1	0	1	1	Call Appearance (CA)
	1	0	0	0	0	0	1	Closed User Group (not presently supported)
	1	0	0	0	0	1	0	Reverse Charging Indication (not presently supported)
	1	1	1	0	1	0	1	Redirecting Subaddress (not presently supported)

5.5.7.1 Call Appearance information element

The Call Appearance information element identifies the selected intercom group for an intercom call, or call appearance for a particular directory number. Its coding is shown in Table 138, “Call Appearance information element”.

Table 138 Call Appearance information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Call Appearance information element Identifier							1
	1	1	1	1	0	1	1	
Length of Call Appearance contents								2
0/1Ext	Call Appearance identifier							3
1 Ext	Call appearance identifier continuation, if needed							3a*

Note: * This octet may be omitted.

- Call Appearance Identifier (octets 3 and 3a) - a unique number assigned to an intercom appearance, or Call Appearance of a DN.
- Use bit 8, in octet 3, to extend the Call Appearance identifier field.
- The identifier numbers for a 1 octet field range from 1-127.
- For a multi-octet field, the order of bit values progressively decreases as the octet number increases.

5.5.7.2 Closed User Group information element

Note: This information element is not currently supported.

The Closed User Group information element indicates a closed user group. It is used for packet-mode calls when either an X.25 CUG selection facility, or a CUG with outgoing access selection facility is received in the incoming X.25 Call Request packet, and unconditional notification applies (see Table 139, “Closed User Group information element”).

Table 139 Closed User Group information element

Bits								Meaning	Octet
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		**#**
0	1	0	0	0	0	0	1	Closed User Group information element Identifier	**1**
								Length of closed user group information	**2**
0/1 ext	SPARE				CUG indicator				**3**
					0	0	1	closed user group selection	
					0	1	0	closed user group with outgoing access selection and indication	
								All other values reserved	
0	CUG Index Code							CUG index Code (IA5 characters)	**4 etc.**
	0	1	1	0	0	0	0	0	
	0	1	1	0	0	0	1	1	
	0	1	1	0	0	1	0	2	
	0	1	1	0	0	1	1	3	
	0	1	1	0	1	0	0	4	
	0	1	1	0	1	0	1	5	
	0	1	1	0	1	1	0	6	
	0	1	1	0	1	1	1	7	
	0	1	1	1	0	0	0	8	
	0	1	1	1	0	0	1	9	
								All other values reserved	

Note 1: Do not use CUG IE at the originating party interface.

Note 2: For the terminating party interface when a user subscribes to unconditional notification and the X.25 CUG facility is included in the X.25 Call Request packet, the SETUP for a packet-mode call shall include the CUG IE.

5.5.7.3 Protocol Version Control information element

Protocol version control (PVC) allows for different ISDN protocols to be identified and stored in the network. Using the Q.931 message exchange described in Section 5.3, “Protocol Version Control (PVC)” terminals can query this stored PVC information and effect communication by tailoring their respective protocols to the version and issue in effect in the network.

Nortel BellCore TR-compliant Functional (NTTRF), Nortel Stimulus, and Nortel Meridian Feature Transparency (NTMFT) call control signaling methods, are each identified with a distinct protocol version. Within a particular version, different issue numbers are used to identify variations of the same protocol version over time.

Table 140 Version Operation codes (Octet 3)

Bits					Version Operation codes (Octet 3)
5	**4**	**3**	**2**	**1**	
0	0	0	0	0	Version query (user-to-network), query current version - issue
0	0	0	0	1	Version request (user-to-network), version - Issue negotiation
0	0	0	1	0	Version response (network-to-user), version to version query
0	0	0	1	1	Version prompt (network-to-user), prompt terminal to send in version query or request (not currently supported)

Table 141 Version Operation Codes (Octet 4a)

Bits							Version Codes (Octet 4a)
7	**6**	**5**	**4**	**3**	**2**	**1**	
0	0	0	0	0	0	0	NT Stimulus
0	0	0	0	0	0	1	NT Meridian Feature Transparency (MFT)
0	0	0	0	0	1	0	NT BellCore TR-compliant Functional(TRF)
All other values are reserved							

Table 142 Version Operation Codes (Octet 4b)

Bits							Issue Codes (Octet 4b)
7	**6**	**5**	**4**	**3**	**2**	**1**	(only values used 0 to 2)
0	0	0	0	0	0	0	issue number 0
0	0	0	0	0	0	1	issue number 1
0	0	0	0	0	1	0	issue number 2

The current versions, supported code values, and relevant Nortel Networks specifications that apply to each version and issue code are shown in Table 143, “Protocol Version Control”.

Table 143 Protocol Version Control

Version meaning	Issue Code value	Specification
NT BellCore TR-compliant Functional	0	NIS S208-4
NT BellCore TR-compliant Functional	1	NIS S208-5, Issue 1.0, except Section I
NT Bellcore TR-compliant National ISDN	2	NIS S208-6, Issue 06.01

Table 144 Protocol Version Control information element

Bits								Octet #
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
0	Protocol Version Control							1
	0	1	1	1	1	1	0	
Length of protocol version control information								2
1	Spare		Version OP code					3
	0	0						
0/1 Ext	Version Code							4
0/1 Ext	Version Code							4* etc.
0/1 Ext	Issue Code							5
0/1 Ext	Issue Code							5* etc.

Note 1: **Octet 4 and 5** can be extended and octets 3, 4 and 5 can also be repeated as a whole. Provide octets 4 and 5 at the same time. These octets are currently provided for the “version query”, “version request”, and “version response” version op-codes.

Note 2: **Octet 3** - the spare bit may be used as Coding Standard field, at a later date.

Note 3: **Octet 3** - the MSB is bit 5 of octet 3. The LSB is bit 1 of octet 3.

Note 4: **Octet 4** - the MSB is bit 7 of octet 4. The LSB is bit 1 of the last occurrence of octet 4a.

Note 5: **Octet 5** - the MSB is bit 7 of octet 5. The LSB is bit 1 of the last occurrence of octet 5a.

5.5.7.4 Redirecting Subaddress Information Element

Note: This information element is not currently supported.

The Redirecting Subaddress information element identifies a subaddress associated with the redirecting party of a call. It is coded as shown in Table 145, “Redirecting Subaddress information element”.

Table 145 Redirecting Subaddress information element

Bits								**Meaning**	**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Redirecting Subaddress information element Identifier								1
	1	1	1	0	1	0	1		
Length of Redirecting Subaddress									2
1/ Ext	Type of sub-address			**Odd / Even**	Spare				3
	7	**6**	**5**					**Type of subaddress**	
	0	0	0					NSAP (X.213/ ISO 8348 AD2)	
	0	1	0					User specified	
								All other values reserved	
				4				**Number of digits in subaddress is:**	
				0				Even	
				1				Odd	
					3	**2**	**1**	**Spare**	
					0	0	0		
Redirecting Subaddress Information									4, etc. *

Note: * This octet may be omitted.

5.5.7.5 Reverse Charging Indication information element

Note: This information element is not currently supported.

This information element indicates that an incoming packet call is reverse charged. It is used for packet-mode calls when an X.25 reverse charging facility is received in the X.25 incoming call packet and unconditional notification applies. Code the Reverse Charging indication as shown in Table 146, “Reverse Charging Indication information element”.

Table 146 Reverse Charging Indication information element

Bits									**Octet #**
8	**7**	**6**	**5**	**4**	**3**	**2**	**1**		
0	Reverse Charging Indication information element Identifier								1
	1	0	0	0	0	1	0		
Length of reverse charging indication information									2
1 EXT.	Spare				Rev. Charging Indication			Indication values	3
1	0	0	0	0	0	0	1	reverse charging requested	
								All other values reserved	

- Codings at Originating Interface - do not use this information element at the originating party interface.
- Codings at Terminating Party Interface - The network includes the reverse charging indication information element in a SETUP for a packet-mode call, when the user subscribes to Unconditional Notification and an X.25 reverse charging facility is included in the X.25 incoming call packet.

5.6 NI-2 Uniform Call Display

This feature provides all National ISDN 2 terminals, TR compliant display text. Display text is provided by the DMS to inform the user of various call states and to prompt the user for subsequent feature information and states. BellCore Technical Reference TR-NWT-000865 Generic Requirements for ISDN Display for Call Control and Selected Services and GR-NWT-001326 Generic Requirements for ISDN Calling Name Identification Services outlines these requirements for various features. Display text for features implemented by this activity include:

- ACB
- Basic Call Control
- Calling Name and Number (CNIS)
- Additional Call Offering
- Call Forwarding
- Call Hold
- Flexible Call

- EKTS

Also interactions between the features will be handled per TR requirements. It should be noted that in some areas the basic DMS feature functionality differs from the TR defined feature. In these few cases some TR display text requirements will not be met, and those are identified in the limitations/restrictions.

Below are defined all the TR display tags that will be supported by this feature. These tags explicitly define what is to be provided to the ISDN CPE. The format of the display text as shown in this document is to support display units of two lines of 40 characters each. It remains up to the CPE whether or not to actually display the information as provided or to make changes. Additionally some ISDN CPE's will provide only the first 40 characters of display text which generally contains the most crucial display information. In that case, the display text is formatted to support display units of two lines of 20 characters each.

The new displays will apply to all ISDN BRI terminals provisioned as NI2 except for IPLL terminals. This will supersede currently existing tags on terminals provisioned as NI2 but will not affect NI1 terminals and IPLL terminals.

NOTE: If non-EKTS tag is displayed for EKTS CACH, the call appearance ID is added to the display tag.

5.6.1 ACB

The ACB tags will be supplied to the CPE if the ACB feature is activated on that particular DN.

ACB-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#	#	#		#	#	#	-	#	#	#	#									P	l	a	c	e		c	a	l	l		n	o	w						
2																																								

Message: ACB-1 will appear in the NOTIFY message.

Situation: ACB-1 will be displayed to the terminal if the user is assigned with Automatic CallBack feature.

5.6.2 Additional Call Offering

The additional call offering tags will be supplied to the CPE in situations where a call or calls are already present on the set but a new call is offered to the set beyond the interfaces B channel limit.

It's main purpose is to provide a "Call is waiting" message in these situations and remind the user that the limit for their NI2 phone is 2 B channels. By it's nature of being in the SETUP message ACO greatly interacts with calling number and name delivery features.

ACO-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	a	l	l		i	s		w	a	i	t	i	n	g																									
2																																								

Message: ACO-1 will appear in the SETUP message

Situation: ACO-1 will be displayed when a incoming call terminates to a B channel busy set with ACO and the user does not have any number or name display features.

ACO Interactions

ACO-1a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	a	l	l		i	s		w	a	i	t	i	n	g					
2																																								

Message: ACO-1a will appear in the SETUP message

Situation: ACO-1a will be displayed when a incoming call terminates to a B channel busy set with ACO and the user has CND only.

ACO-1b	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																C	a	l	l		i	s		w	a	i	t	i	n	g			c	f	x
2	R	e	a	s	o	n																																		

Message: ACO-1b will appear in the SETUP message

Situation: ACO-1b will be displayed when a incoming call terminates to a B channel busy set with ACO and the user has only RND and the call was redirected.

ACO-1c	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	a	l	l		i	s		w	a	i	t	i	n	g			c	f	x
2	F	o	r		#																R	e	a	s	o	n														

Message: ACO-1c will appear in the SETUP message

Situation: ACO-1c will be displayed when a incoming call terminates to a B channel busy set with ACO and the user has both CND and RND and the call was redirected.

5.6.3 Call Control

The main purpose of the basic call control display tags are to notify the user as their call progress through various states and inform the user if they have encountered interworking with non ISDN agent types.

In addition to providing call state information such as “Dial”, “Ringing”, and “Connected” the CPE will be provided with the called DN that they have dialed, formatted in readable customer group/national/international form.

CC-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																																							
2																																								

Message: CC-1 will appear in the CALL PROCeding message

Situation: CC-1 will be displayed when a circuit mode *calling* party originates.

CC-2	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	D	i	a	l	:																																			
2																																								

Message: CC-2 will appear in the SETUP ACK message

Situation: CC-2 will be displayed when a circuit mode *calling* party uses overlap dialing.

CC-3	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N																					
2																																								

Message: CC-3 will appear in the SETUP message

Situation: CC-3 will be displayed to the **called** party if a #1 progress indicator was generated by the call and it is does not have provisioned either CND or any name delivery features.

CC-4	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	o	n	-	I	S	D	N		c	a	l	l	i	n	g																								
2																																								

Message: CC-4 will appear in the SETUP message

Situation: CC-4 will be displayed to the **called** party if a #8 progress indicator was generated by the call and it is does not have provisioned either CND or any name delivery features.

CC-5	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	n	e	c	t	e	d																															
2																																								

Message: CC-5 will appear in the CONN ACK or RET ACK message

Situation: CC-5 will be displayed to the **called** party in the CONN ACK message if that party does not have any number or name display features and the call was not redirected.

Message: CC-5 will appear in the RET ACK message.

Situation: CC-5 will be send in RET ACK message to the controller (for Held Call) if the Held Call is retrieved and CONN ACK was the last message associated with this call.

CC-5 will be displayed to an EKTS user in RETrieve ACKnowledge message when he successfully bridges onto the call that terminated to the EKTS group and is in the end-to-end communication mode.

CC-6	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				R	i	n	g	i	n	g													
2																																								

Message: CC-6 will appear in the ALERT message.

Situation: CC-6 will be displayed to the *calling* party anytime an ALERTing message is sent or it was in last message before a RET ACK.

CC-6 will be sent in the ALERTing message while establishing a courtesy call.

Message: CC-6 will appear in the RET ACK message.

Situation: CC-6 will be displayed to the controller (for Held Call) if the ALERTing message was the last message associated with call.

CC-7	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				D	e	l	a	y		i	n		r	e	s	p	o	n	s	e			
2																																								

Message: CC-7 will appear in the PROGress message.

Situation: CC-7 will be displayed to the *calling party* in the PROGress message if a #11 progress indicator was generated by the call.

CC-9	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N	
2	P	l	e	a	s	e		l	i	s	t	e	n																											

Message: CC-9 will appear in the PROG or RET ACK messages

Situation: CC-9 will be displayed in the PROG message to the *calling* party if a #1 progress indicator was generated by the call.

CC-10	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	n	e	c	t	e	d											
2																																								

Message: CC-10 will appear in the CONN or RET ACK message.

Situation: CC-10 will be displayed to the *calling* party in normal CONNect message.

Message: CC-10 will appear in the RET ACK message.

Situation: CC-10 will be included in the RET ACK message if CONN ACK message sent to the controller did not include the progress indicator IE or if the CONN message was sent before the call was held.

CC-10 will be displayed to an EKTS user who bridges onto a call that originated from the EKTS group in the RETrieve ACKnowledge misaligned the call is in the end-to-end communication mode.

CC-11	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	n	e	c	t	e	d	:		N	o	n	-	I	S	D	N	
2																																								

Message: CC-11 will appear in the CONN or RET ACK message.

Situation: CC-11 will be displayed to the *calling* party in the CONN message if a #2 progress indicator was generated by the call.

Message: CC-11 will appear in the RET ACK message.

Situation: CC-11 will be displayed to the retrieving party in an interworked state RET ACK message.

CC-11 will be displayed to the EKTS user that successfully bridges onto the outgoing call, in the RETrieve ACKnowledge message and progress indicator#2 was returned in the CONNect message sent to the EKTS group for the call.

CC-12	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	n	e	c	t	e	d	:		N	o	n	-	I	S	D	N	
2	N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N																					

Message: CC-12 will appear in the CONN or RET ACK message.

Situation: CC-12 will be displayed to the *calling* party in the CONN message if a #1 progress indicator was generated by the call.

Message: CC-12 will appear in the RET ACK message.

Situation: CC-12 will be displayed to the retrieving party in an interworked state RET ACK message.

CC-12 will be displayed to the EKTS user that successfully bridges onto the outgoing call, in the RETrieve ACKnowledge message and progress indicator #1 was returned in the CONNect message sent to the EKTS group for the cal

CC-13	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	P	r	o	c	e	e	d		w	i	t	h		d	a	t	a				c	a	l	l																
2																																								

Message: CC-13 will appear in the CONNect message.

Situation: CC-13 will be displayed to the *calling party* in the CONN message if packet mode call is being done.

CC-17	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1																																								
2																																								

Message: CC-17 will appear in call clearing messages

Situation: CC-17 will be displayed to both the *calling* and called parties upon call termination.

For a Flex Call, if there is only one call on the conference when a disconnect indication from the remote user or network is received and if display information associated with the conference was the last display information sent to the controller, the switch shall send Display #CC-17 to the controller.

CC-17 will be displayed when a call appearance is being released, to the EKTS users, who are not connected to the call, but had received call display information for this call appearance and no additional display has been sent to the user.

CC-17 will be displayed to the EKTS users who are connected to the call, when the remote user sends a release request.

5.6.4 Call Forwarding

The call forwarding display tags are meant to prompt the user for additional information and to give the user feedback on feature state and activation. The display tags are meant to compliment inband tones and feature lamps. This is especially useful in situations where call forwarding is assigned to a DN key and no inband tones are available.

CF-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r	w	a	r	d		t	o	:																													
2																																								

Message: CF-1 will appear in the INFO or SETUP ACKnowledge message

Situation: CF-1 will be displayed when the user is about to program the forward to DN in call forwarding programming scenarios.

When call forwarding feature is tried to be activated by modifying the SETUP message, then the Display #CF-1 is included in the SETUP ACK message. For cases in which call forwarding is tried to be activated by feature key or dial access code, then Display #CF-1 is included in the INFO message.

CF-2	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#	#	#		#	#	#	-	#	#	#	#									A	l	w	a	y	s		f	o	r	w	a	r	d		-		o	n	
2																																								

Message: CF-2 will appear in the CALL PROC, INFO or PROGress messages

Situation: Display #CF-2 will be displayed as confirmation of activation of call forwarding feature.

When call associated call forwarding feature is activated for which no courtesy call is to established, Display #CF-2 is included in the PROGress message to the controlling terminal.

When the courtesy call is answered, an I-CF subfeature activation display (Display #CF-2) shall be included in the INFOrmation message sent to the controlling terminal.

The I-CF subfeature activation display (Display #CF-2) shall be sent to the controlling terminal in the PROGress message if the courtesy call is not answered and the subfeature is activated on a second request.

While establishing a courtesy call for which no answer is required, an I-CF subfeature activation display (Display #CF-2) shall be included in the CALL PROCeeding message sent to the controlling terminal if the remote DN is valid and goes on ringing and Display #CF-2 is included in the INFOrmation message to the controlling terminal if the remote user is busy.

When the user activates an I-CF subfeature outside the context of a call using feature key management control and the remote DN is valid, an I-CF subfeature activation display (Display #CF-2) shall be sent to the controlling terminal. This display shall be included in the INFOrmation message that contains the feature indication information element coded “CF subfeature (status = active).”

CF-5	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#	#	#		#	#	#	-	#	#	#	#									R	e	d	o		c	a	l	l		f	o	r	w	a	r	d	i	n	g
2	C	a	l	l		f	o	r	w	a	r	d	i	n	g		o	f	f																					

Message: CF-5 will appear in call clearing message

Situation: CF-5 will be displayed when the user was required to establish a coutesy call (for which answer is required for activation) and the coutesy call was not answered. (i.e. Display #CF-5 shall be included in the first clearing message sent to the controlling terminal)

CF-6	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	A	l	w	a	y	s		f	o	r	w	a	r	d		-		o	f	f																				
2																																								

Message: CF-6 will appear in the PROGress or INFOrmation messages

Situation: CF-6 will be displayed when the user has deactivated call forward universal. (i.e. Display #CF-6 shall be sent in the PROGress message used for confirmation of the deactivation.)

When the user deactivates an I-CF subfeature outside the context of a call using feature key management control, Display #CF-6 shall be sent to the controlling terminal. This display shall be included in the INFOrmation message that contains the feature indication information element coded “CF subfeature (status = idle).”

CF-10	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				A	l	w	a	y	s		f	o	r	w	a	r	d		-		o	n	
2	N	u	m	b	e	r		n	o	t		c	h	e	c	k	e	d																						

Message:

Situation: When no courtesy call is to be established and the base switch considers the interswitch remote DN as unchecked, the base switch shall send Display #CF-10 for I-CFV, I-CFPF and I-CFIG.

5.6.5 Calling Number Identification Services

The calling number tags along with the calling name tags are arguably the most important displays to be provided to the user. Some display text is given to NI2 terminals prior to this feature incorporating number and name but is not TR compliant. TR compliancy will provide a more uniform display to the user and offer a host of interactions with Basic Call, ACOU, Call Forwarding, etc.

The interactions between CNIS and EKTS are discussed in separate section under EKTS.These uniform displays provide the called user with a consistent form of calling party information.

CN-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#																																		
2																																								

Message: CN-1 will appear in the SETUP message

Situation: CN-1 will be displayed to the called user if they have CND provisioned but they do not have any other number or name delivery features, the call was not redirected, and the call is end-to-end ISDN.

CN-2	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	o	n	n	e	c	t	e	d											
2																																								

Message: CN-2 will appear in the CONN ACK message

Situation: CN-2 will be displayed to the called user if they have CND provisioned when they connect but they do not have any other number or name delivery features, the call was not redirected, and the call is end-to-end ISDN.

CN-3 CN-18 **NA-5**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				N	a	m	e	&		N	u	m	b	e	r		P	r	i	v	a	t	e
2																																								

* Note: CN-3 & CN-18 have been replaced by NA-5 which is shown

Message: NA-5 will appear in the CALL PROC, ALERT, or PROGress message

Situation: NA-5 will be displayed to the calling party when they have activated the number/name blocking feature in conjunction with providing called digits enbloc. This is only allowed on the DMS by way of the PCACIDS per call feature or if the users status is permanently private.

CN-4 CN-20 **NA-6**	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				N	a	m	e	&		N	u	m	b	e	r		P	u	b	l	i	c	
2																																								

* Note: CN-4 & CN-20 have been replaced by NA-6 which is shown

Message: NA-6 will appear in the CALL PROC, ALERT, or PROGress message

Situation: NA-6 will be displayed to the calling party (users)) when they have activated the number/name delivery feature (CIDSDLV) in conjunction with providing called digits enbloc. This is only allowed on the DMS by way of the PCACIDS per call feature or if the users status is permanently public.

CN-5	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				N	u	m	b	e	r		P	r	i	v	a	t	e						
	R	e	q	u	e	s	t		d	e	n	i	e	d																										

Message: CN-5 will appear in the CALL PROC, ALERT, or PROGress message

Situation: CN-5 will be displayed to the calling party when they have tried to activate the number/name delivery feature (CIDSDLV) in conjunction with providing called digits enbloc and the Privacy Change Allowed Parameter (ALLOWPI field in PCACIDS provisioning) is set to ‘N’ by way of the PCACIDS feature activated corresponding to the particular call and the request was denied by the DMS. Only the PCACIDS per call feature can be used to generate this scenario.

CN-6	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				N	u	m	b	e	r		p	u	b	l	i	c							
2	R	e	q	u	e	s	t		d	e	n	i	e	d																										

Message: CN-6 will appear in the CALL PROC, ALERT, or PROGress message

Situation: CN-6 will be displayed to the calling party when they have tried to activate the number/name block feature (CIDSSUP) in conjunction with providing called digits enbloc and the Privacy Change Allowed Parameter (ALLOWPI field in PCACIDS provisioning) is set to ‘N’ by way of the PCACIDS feature activated corresponding to the particular call and the request was denied by the DMS. Only the PCACIDS per call feature can be used to generate this scenario.

CN-7 CN-17 **NA-3**	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	a	m	e	&		N	u	m	b	e	r		P	r	i	v	a	t	e	D	i	a	l	:															
2																																								

* Note: CN-7 & CN-17 have been replaced by NA-3 which is shown

Message: NA-3 will appear in the SETUP ACK or INFOrmation message

Situation: NA-3 will be displayed to the calling party (originator) when they have activated their number/name blocking feature (CIDSSUP) and have not provided the calling digits. In DMS, Caller ID delivery can be blocked by CIDS feature in which CIDSSUP access code or feature activator can be invoked to block the Caller ID delivery. Also the cases in which the user has activated their number/name blocking feature by means of the CIDS feature in DMS and the switch already has permanent blocking provisioned by means of PCACIDS, NA-3 will be displayed.

CN-8 CN-19 **NA-4**	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	a	m	e		&		N	u	m	b	e	r		P	u	b	l	i	c	D	i	a	l	:															
2																																								

* Note: CN-8 & CN-19 have been replaced by NA-4 which is shown

Message: NA-4 will appear in the SETUP ACK or INFOrmation message

Situation: NA-4 will be displayed to the calling party (originator) when they have activated their number/name delivery feature (CIDSDLV) and have not provided the calling digits. In DMS, Caller ID delivery can be unblocked by CIDS feature in which CIDSDLV access code or feature activator can be invoked to unblock the Caller ID delivery. Also the cases in which the user has activated their number/name unblocking feature by means of the CIDS feature in DMS and the switch already has permanent unblocking provisioned by means of PCACIDS, NA-4 will be displayed.

CN-9	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	u	m	b	e	r		r	e	c	e	i	v	i	n	g		o	f	f																				
2																																								

Message: CN-9 will appear in the SETUP ACK, PROG, INFO or call clearing message

Situation: CN-9 will be displayed as confirmation of CND deactivation to the party that has deactivated their CND feature.

CN-10	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	u	m	b	e	r		r	e	c	e	i	v	i	n	g		o	n																					
2																																								

Message: CN-10 will appear in the SETUP ACK, PROG, INFO or call clearing message

Situation: CN-10 will be displayed as confirmation of CND reactivation to the party that has activated their CND feature.

CN-15	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N	
2																																								

Message: CN-15 will appear in the SETUP message

Situation: CN-15 will be displayed to the called user (terminator) if they have CND provisioned but they do not have any other number or name delivery features, the call was not redirected but the call is not end-to-end ISDN with a #1 progress indicator in the SETUP message.

As per DMS implementation, instead of name OUTSIDE CALL will be displayed.

CN-16	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															N	o	n	-	I	S	D	N		c	a	l	l	i	n	g				
2																																								

Message: CN-16 will appear in the SETUP message

Situation: CN-16 will be displayed to the called user (terminator) if they have CND provisioned but they do not have any other number or name delivery features, the call was not redirected but the call is non ISDN (calling equipment is non-ISDN) with a #3 progress indicator.

Calling Number Interactions

CN-2a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																C	o	n	n	e	c	t	e	d									c	f	x
2	R	e	a	s	o	n																																		

Message: CN-2a will appear in the CONN ACK message

Situation: CN-2a will be displayed to the called user (terminator) in CONN ACK message if they have RND provisioned but they do not have any other number or name delivery features, the call was redirected, and the call is end-to-end ISDN.

Note : Since the 'cfx 'reason is not sent in the setup (CN-21) for terminator provisioned only with RND , we cannot get 'cfx' reason in CN-2a, in the CONN ACK msg.

CN-2b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	o	n	n	e	c	t	e	d									c	f	x
2	F	o	r		#																R	e	a	s	o	n														

Message: CN-2b will appear in the CONN ACK message

Situation: CN-2b will be displayed to the called user (terminator) if they have both CND and RND provisioned but they do not have any other name delivery features, and the call was redirected, and the call is end-to-end ISDN.

CN-15a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																R	e	a	s	o	n														
2	N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N																					

Message: CN-15a will appear in the SETUP message

Situation: CN-15a will be displayed to the called user (terminator) if they have RND provisioned but they do not have any other number or name delivery features, and the call was redirected, and the forwarded interswitch call is over a non-ISDN incoming facility (not end-to-end ISDN).

CN-15b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															F	o	r		#													c	f	x

CN-15b	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2	R	e	a	s	o	n															N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N	

Message: CN-15b will appear in the SETUP message

Situation: CN-15b will be displayed to the called user (terminator) if they have both CND and RND provisioned but they do not have any name delivery features, and the call was redirected, and the forwarded interswitch call is over a non-ISDN incoming facility (not end-to-end ISDN).

As per the DMS implementation, when a call is made over Non-ISDN trunk DMS doesn’t provide CND details. Due to this CN-15a will be displayed in place of CN-15b

CN-16a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																R	e	a	s	o	n														
2	N	o	n	-	I	S	D	N		c	a	l	l	i	n	g																								

Message: CN-16a will appear in the SETUP message

Situation: CN-16a will be displayed to the called user (terminator) if they have RND provisioned but they do not have any other number or name delivery features, and the call was redirected, and the call is from an intraswitch non-ISDN line.

CN-16b	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															F	o	r		#													c	f	x
2	R	e	a	s	o	n															N	o	n	-	I	S	D	N		c	a	l	l	i	n	g				

Message: CN-16b will appear in the SETUP message

Situation: CN-16b will be displayed to the called user (terminator) if they have both CND and RND provisioned but they do not have any name delivery features, and the call was redirected, and the call is from an intraswitch non-ISDN line.

CN-21	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																R	e	a	s	o	n														
2																																								

Message: CN-21 will appear in the SETUP message

Situation: CN-21 will be displayed to the called user (terminator) if they have RND provisioned but they do not have any other number or name delivery features, and the call was redirected, and the call is end-to-end ISDN.

CN-21a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															F	o	r		#													c	f	x
2	R	e	a	s	o	n																																		

Message: CN-21a will appear in the SETUP message

Situation: CN-21a will be displayed to the called user (terminator) if they have both CND and RND provisioned but they do not have any name delivery features, and the call was redirected, and the call is end-to-end ISDN.

5.6.6 Call Hold

The following call hold display tags show how ISDN Display would fit with ISDN Hold Capability. Call control displays #CC-5, #CC-6, #CC-10, #CC-11 and #CC-12, which will also be used for call hold, are not shown in this section, as they are already discussed in section 1.2.3 of this document. Calling Name Delivery displays #NA-29 and #NA-30 are also associated with Call Hold displays but they will be discussed in section 1.2.7 Calling Name Delivery.

Over a **warm swact** the display for held call 'Call Held' remains there but when it is retrieved, it still shows 'Call held' instead of previous display information.

HC-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	a	l	l		H	e	l	d																															
2																																								

Message: HC-1 will appear in the HOLD ACK message

Situation: HC-1 will be displayed to the holder upon successful holding of a call and the controller does not have any number or name display options.

HC-2	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	H	e	l	d		c	a	l	l		c	l	e	a	r	e	d																							
2																																								

Message: HC-2 will appear in the call clearing message

Situation: HC-2 will be displayed to the holder if a call already on hold is cleared by the holdee for multiple calls/keys.

HC-2 will be displayed to the holder if the remote user or switch initiates the clearing of the call on hold and it will appear in the RELease message.

HC-2 will be displayed to the EKTS user when a call is on hold against the EKTS group and a call clearing message is received from the user that placed the call on hold.

HC-2 will be displayed to an EKTS user not connected to the call, in the first call clearing message when he is on hold and the call appearance is being released.

Call Hold Interactions

HC-1a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	a	l	l		H	e	l	d											
2																																								

Message: HC-1a will appear in the HOLD ACK message

Situation: HC-1a will be displayed to the call holder who also has only CND provisioned.

HC-1b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	o	r		#																C	a	l	l		H	e	l	d									c	f	x
2	R	e	a	s	o	n																																		

Message: HC-1b will appear in the HOLD ACK message

Situation: HC-1b will be displayed to the call holder who also has only RND provisioned and the call to be held was originally redirected.

HC-1c	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		#															C	a	l	l		H	e	l	d									c	f	x
2	F	o	r		#																R	e	a	s	o	n														

Message: HC-1c will appear in the HOLD ACK message

Situation: HC-1c will be displayed to the call holder who also has both CND and RND provisioned and the call to be held was originally redirected.

5.6.7 Calling Name Delivery

The CNAMD feature provides the calling name from a centralized telco database. This is sometimes referred to TCAP name or Bellcore name. Since the name delivered to the ISDN CPE is not stored on the terminating switch it must be queried from the database. This may take up to a few seconds and is delivered to the set in an INFO message shortly after the initial SETUP message.

As with number, the name delivery is consistently formatted for easier use by the end user.

Note: The DMS is capable of providing proprietary calling name in which the name is retrieved from an on-board DMS database. In these cases the name and display text will be provided in the SETUP message.

Both NAMEDISP and CNAMD features are used for calling name delivery to the terminator. If only CNAMD feature is provisioned then TCAP name will be displayed. If only NAMEDISP feature is provisioned then proprietary name will be displayed. If both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

Redirecting TCAP (Bell core) name (RNAMD) is not currently supported on the DMS. DMS proprietary redirecting name controlled by the customer group option NAMEDISP is supported and will be used as the original called name if available.

NA-3, NA-4, NA-5, and NA-6 privacy name tags have replaced the number privacy tags as described in the CND section above.

NA-7	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	a	m	e		r	e	c	e	i	v	i	n	g		o	f	f																						
2																																								

Message: NA-7 will appear in the call clearing or INFO message

Situation: NA-7 will be displayed to a user that has de-activated only their CNAMD feature.

NA-8	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	N	a	m	e		r	e	c	e	i	v	i	n	g		o	n																							
2																																								

Message: NA-8 will appear in the call clearing or INFO message

Situation: NA-8 will be displayed to a user that has activated only their CNAMD feature.

NA-9	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	I	d	e	n	t	i	t	y	F	e	a	t	u	r	e	s		o	f	f																				
2																																								

Message: NA-9 will appear in the call clearing or INFO message

Situation: NA-9 will be displayed to a user that has de-activated multiple delivery features.

NA-10	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	I	d	e	n	t	i	t	y		F	e	a	t	u	r	e	s		o	n																				
2																																								

Message: NA-10 will appear in the call clearing or INFO message

Situation: NA-10 will be displayed to a user that has re-activated multiple delivery features.

NA-11a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e																															
2																																								

Message: NA-11a will appear in the SETUP or INFO message

Situation: NA-11a will be displayed to the called party which has only calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned. If only CNAMD feature is provisioned then TCAP name will be displayed. If only NAMEDISP feature is provisioned then proprietary name will be displayed. If both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-11b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N	
2																																								

Message: NA-11b will appear in the SETUP or INFO message

Situation: NA-11b will be displayed to the called party which has only calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned and progress indicator #1 is encountered. If only CNAMD feature is provisioned then TCAP name will be displayed. If only NAMEDISP feature is provisioned then proprietary name will be displayed. If both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

As per DMS implementation, instead of name OUTSIDE CALL will be displayed.

NA-11c	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												N	o	n	-	I	S	D	N		c	a	l	l	i	n	g				
2																																								

Message: NA-11c will appear in the SETUP or INFO message

Situation: NA-11c will be displayed to the called party which has only calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned and progress indicator #3 is encountered. If only CNAMD feature is provisioned then TCAP name will be displayed. If only NAMEDISP feature is provisioned then proprietary name will be displayed. If both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-12	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												C	o	n	n	e	c	t	e	d											
2																																								

Message: NA-12 will appear in the CONN ACK message

Situation: NA-12 will be displayed to the called party when they have answered the call and have only calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned. If only CNAMD feature is provisioned then TCAP name will be displayed. If only NAMEDISP feature is provisioned then proprietary name will be displayed. If both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-13a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												F	o	r		n	a	m	e												
2	F	o	r	w	a	r	d	e	d		C	a	l	l																										

Message: NA-13a will appear in the SETUP or INFO message

Situation: For a forwarded call NA-13a will be displayed to the called party that has both CNAMD (Bellcore calling name) and NAMEDISP (proprietary redirecting name) provisioned or only NAMEDISP (both proprietary calling and redirecting name) is provisioned and has no other delivery feature provisioned.

Note : Since the CM does'nt send the reason for redirection instead of reason we get Forwarded Call in the third quadrant.

NA-13b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												F	o	r		n	a	m	e												
2	F	o	r	w	a	r	d	e	d		C	a	l	l							N	o	n	-	I	S	D	N		c	a	l	l	i	n	g				

Message: NA-13b will appear in the SETUP or INFO message

Situation: For a forwarded call NA-13b will be displayed to the called party that has both CNAMD (Bellcore calling name) and NAMEDISP (proprietary redirecting name) provisioned or only NAMEDISP (both proprietary calling and redirecting name) is provisioned and has no other delivery feature provisioned and a #3 progress indicator was encountered.

Note : Since the CM does'nt send the reason for redirection instead of reason we get Forwarded Call in the third quadrant.

NA-14a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2																																								

Message: NA-14a will appear in the SETUP or INFO message

Situation: NA-14a will be displayed to the called party that has both CND and calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned. For calling name delivery, if only CNAMD feature is provisioned then TCAP name will be displayed; if only NAMEDISP feature is provisioned then proprietary name will be displayed; and if both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-14b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2	N	o	t		e	n	d	-	t	o	-	e	n	d		I	S	D	N																					

Message: NA-14b will appear in the SETUP or INFO message

Situation: NA-14b will be displayed to the called party that has both CND and calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned and a #1 progress indicator was encountered. For calling name delivery, if only CNAMD feature is provisioned then TCAP name will be displayed; if only NAMEDISP feature is provisioned then proprietary name will be displayed; and if both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

As per DMS implementation, instead of name and number OUTSIDE CALL will be displayed

NA-14c	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2	N	o	n	-	I	S	D	N		c	a	l	l	i	n	g																								

Message: NA-14c will appear in the SETUP or INFO message

Situation: NA-14c will be displayed to the called party that has both CND and calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned and a #3 progress indicator was encountered. For calling name delivery, if only CNAMD feature is provisioned then TCAP name will be displayed; if only NAMEDISP feature is provisioned then proprietary name will be displayed; and if both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-15	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2	C	o	n	n	e	c	t	e	d																															

Message: NA-15 will appear in the CONN ACK message

Situation: NA-15 will be displayed to the called party when the call is answered if both CND and calling name delivery feature [CNAMD (Bellcore) or/and NAMEDISP (proprietary)] provisioned. For calling name delivery, if only CNAMD feature is provisioned then TCAP name will be displayed; if only NAMEDISP feature is provisioned then proprietary name will be displayed; and if both CNAMD and NAMEDISP are provisioned then TCAP name is displayed.

NA-16	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																	c	f	x
2	f	o	r		n	a	m	e													R	e	a	s	o	n														

Message: NA-16 will appear in the SETUP or INFO message

Situation: NA-16 will be displayed to the called user if for a forwarded call CND, CNAMD (Bellcore calling name) and NAMEDISP (proprietary redirecting name) are provisioned or if CND and NAMEDISP (both proprietary calling and redirecting names) are provisioned and the call was redirected.

NA-17	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																	c	f	x
2	#																				R	e	a	s	o	n														

Message: NA-17 will appear in the SETUP or INFO message

Situation: NA-17 will be displayed to the called user if CND, CNAMD (Bellcore calling name), and RND are provisioned and the call was redirected.

NA-18	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																	c	f	x
2	f	o	r		n	a	m	e													#																			

Message: NA-18 will appear in the SETUP or INFO message

Situation: NA-18 will be displayed to the called user if for a forwarded call RND, CND, CNAMD (Bellcore calling name) and NAMEDISP (proprietary redirecting name) are provisioned or if RND, CND and NAMEDISP (both proprietary calling and redirecting names) are provisioned and the call was redirected.

NA-19	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												C	a	l	l		i	s		w	a	i	t	i	n	g					
2																																								

Message: NA-19 will appear in the SETUP or INFO message

Situation: NA-19 will be displayed to the called user if they only have CNAMD (Bellcore calling name) or NAMEDISP (proprietary calling/redirecting name) provisioned and the call terminates to a B channel busy set with ACO and the call was not redirected.

NA-20	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2	C	a	l	l		i	s		w	a	i	t	i	n	g																									

Message: NA-20 will appear in the SETUP or INFO message

Situation: NA-20 will be displayed to the called user if they only have CND, CNAMD (Bellcore calling name) or NAMEDISP (proprietary calling/redirecting name) provisioned and the call terminates to a B channel busy set with ACO and the call was not redirected.

Note: Tags NA-21, NA-22, NA-23 are not supported on the DMS as there is no delivery feature that can deliver display of just redirecting name and not calling name.

NA-24	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												C	a	l	l		i	s		w	a	i	t	i	n	g			c	f	x
2	f	o	r		n	a	m	e													R	e	a	s	o	n														

Message: NA-24 will appear in the SETUP or INFO message

Situation: NA-24 will be displayed to the called user if for a forwarded call only CNAMD (Bellcore calling name) and NAMEDISP (proprietary redirecting name) are provisioned or just NAMEDISP (proprietary calling/ redirecting name) and the call terminates to a B channel busy set with ACO and the call was redirected.

NA-29	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												C	a	l	l		h	e	l	d											
2																																								

Message: NA-29 will appear in the HOLD ACK message

Situation: NA-29 will be displayed to the holder of a call that has only either CNAMD (Bellcore calling name) or NAMEDISP (proprietary calling name) provisioned.

NA-30	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	F	r	o	m		n	a	m	e												#																			
2	C	a	l	l		h	e	l	d																															

Message: NA-30 will appear in the HOLD ACK message

Situation: NA-30 will be displayed to the holder of a call that has CND and either CNAMD (Bellcore calling name) or NAMEDISP (proprietary calling name) are provisioned.

NA-31	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		n	a	m	e										t	o		#																
2																																								

Message: NA-31 will appear in the SETUP or INFO message

Situation:NA-31 will be displayed when a call is offered to a CACH EKTS user and the terminating DN has CNAMD active.

NA-32	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		n	a	m	e										#																			
2	t	o		#																																				

Message: NA-32 will appear in the SETUP or INFO message

Situation: NA-32 will be displayed when a call is offered to a CACH EKTS user and the terminating DN has both CNAMD and CND active.

5.6.8 Flexible Calling

The FLEX display tags notify the controller after the conference is established about the number of parties connected to the call. If the call is placed on consultation hold to bridge another conferee to the call, the display tag informs the controller about the status of the held call. These tags also notify the controller whom to transfer the call or when the transfer is complete. In addition, the flex tags display call state information such as “Dial”, “Ringing” or “Connected” while bridging a conferee.

Note: As per requirement R267, Conference number shall not be included in Displays #FC-1, #FC-2, #FC-3 or #FC-4 during conference invocation.Hence display ‘Conference # of #’ is changed to ‘Conference’.

FC-1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	f	e	r	e	n	c	e										
2																																								

Message: FC-1 will appear in the CALL PROC or INFOrmation message

Situation: FC-1 will be sent to the controller in a CALL PROC message if a conference is being established and called address is in the SETUP message.

Also the FC-1 display information shall be sent in the INFOrmation message containing the call reference value of an established call if the Call proceeding message was the last message sent to the controller.

FC-2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e											D	i	a	l	:															
2																																								

Message: FC-2 will appear in the SETUP ACK or INFO message

Situation: FC-2 will be displayed to the controller if a conference is being established in the SETUP message without any called address information.

FC-3	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	f	e	r	e	n	c	e										
2	R	i	n	g	i	n	g																																	

Message: FC-3 will appear in the ALERT or INFOrmation message

Situation: FC-3 will be sent to the controller in an ALERT message if the controller is about to bridge in another person who is currently ALERTing.

Also the FC-3 display information shall be sent in the INFOrmation message containing the call reference value of an established call if the Alerting message was the last message sent to the controller.

FC-4	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	f	e	r	e	n	c	e										
2	D	e	l	a	y		i	n		r	e	s	p	o	n	s	e																							

Message: FC-4 will appear in the PROGress message with a progress indicator #10 or INFOrmation message.

Situation: FC-4 will be sent in the PROGress message to the controller if there is a delay in response from the called party.

Also the FC-4 display information shall be sent in the INFOrmation message containing the call reference value of an established call if the Progress message containing progress indicator #10 was the last message sent to the controller.

FC-5	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e		#		o	f		#				C	o	n	n	e	c	t	e	d											
2																																								

Message: FC-5 will appear in the CONN, CONN ACK, RET ACK, INFOrmation, NOTIFY message.

Situation: FC-5 will be sent in the CONN message or CONN ACk message to the controller whenever he tries to establish new call.

After conference has been established, after adding or removing conferees NOTIFY message is sent with the total number of conferees updated.

Also it will be displayed in a RETRIEVE ACK message sent to the controller in response to a RETRIEVE message of a held conference or a held call to be added to the conference.

FC-5 will be displayed in a RETRIEVE ACK message to the EKTS conference controller when he retrieves a held conference.

FC-5 display information shall be sent in the INFOrmation message containing the call reference value of an established call if the Connect or the Connect ACKnowledge message was the last message sent to the controller

FC-6	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	#																				C	o	n	f	e	r	e	n	c	e		h	e	l	d					
2																																								

Message: FC-6 will appear in the CALL PROCeeding message

Situation: FC-6 will be displayed to the controller if the controller is trying to add a call to the conference via consultation hold and the called address is in the SETUP message.

FC-6 will also be displayed to the EKTS user with DN-bridging capability, after the complete called party address information is received by switch.

FC-7	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e		h	e	l	d						D	i	a	l	:															

FC-7	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
2																																								

Message: FC-7 will appear in the SETUP ACK message

Situation: FC-7 will be displayed to the controller if the controller is trying to add a call to the conference via consultation hold and no called party address information is in the SETUP message.

FC-7 is also displayed to the EKTS user with DN-bridging capability, in the same scenario as described earlier.

FC-8	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e		h	e	l	d																									
2																																								

Message: FC-8 will appear in the SETUP ACK or HOLD ACK message

Situation: FC-8 will be sent to the controller in the SETUP ACK or INFOrmation message if the conference is trying to add a call to the conference via consultation hold and partial called party address information is in the SETUP message.

If the controller sends a request to hold a conference and the switch determines that hold can be provided, display FC-8 shall be included in the HOLD ACK message sent to the controller.

FC-8 will be displayed to the EKTS user with DN-bridging capability when partial called party address information is in the SETUP message.

FC-9	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e		c	l	e	a	r	e	d																						
2																																								

Message: FC-9 will appear in the DISC message.

Situation: FC-9 will be sent to the controller in the DISC message if there is only one call in the conference when the drop request is received and the switch clears the call in both directions.

If the switch clears the entire active (not held) conference, the display FC-9 shall be sent in the DISC message.

FC-10	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	C	o	n	f	e	r	e	n	c	e		d	r	o	p	p	e	d																						
2																																								

Message: FC-10 will appear in the call DISC message.

Situation: FC-10 will be displayed to the controller in the DISC message if the switch transfers the active (not held) conference.

FC-11	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	H	e	l	d		c	o	n	f	e	r	e	n	c	e						d	r	o	p	p	e	d													
2																																								

Message: FC-11 will appear in the call RELEASE message.

Situation: FC-11 will be displayed to the controller in the RELEASE message if the switch transfers the held conference.

FC-12	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	H	e	l	d		c	o	n	f	e	r	e	n	c	e						c	l	e	a	r	e	d													
2																																								

Message: FC-12 will appear in the RELEASE message

Situation: FC-12 will be sent to the controller in the RELEASE message if the switch clears the entire held conference.

FC-13	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	T	r	a	n	s	f	e	r		t	o	:																												
2																																								

Message: FC-13 will appear in the HOLD or INFOrmation message

Situation: FC-13 will be displayed to the controller in HOLD message if transferring a non conference related call(not on hold).

FC-13 will be displayed to the controller in INFOrmation message if transferring a non conference related call which is on hold.

FC-15	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	T	r	a	n	s	f	e	r		c	o	m	p	l	e	t	e																							
2																																								

Message: FC-15 will appear in the DISC or RELEASE message.

Situation: FC-15 will be displayed to the controller in RELEASE message if a second transfer request associated with a non conference call is received from the switch and first transfer is requested on a active call.

FC-15 will be displayed to the controller in DISC message if a second transfer request associated with a non conference call is received from the switch and first transfer is requested on a call which is in ringing stage.

5.6.9 Electronic Key Telephone System

EKTS provides the CPE with the functionality of multiple appearances of one directory number and hunt groups within those multiple appearances called call appearances.

Therefore, the user needs to know the call appearance in which the call is located. This is accomplished by including the call appearance indicator in most EKTS display tags.

Also of note is that EKTS users need to know if the call is considered private or public. Public calls can be bridged into by other EKTS members of that call appearance but private calls can not. EKTS users currently on a call also are informed of other users bridging into the call and likewise EKTS users who are getting alert are informed when a member has answered the incoming call.

Intercom calls within an EKTS group also have their own display tags informing the called party of an intercom call instead of a normal call.

These displays make a complicated feature like EKTS much easier to use and understand for the end user.

In the following EKTS requirements the call appearance id shown as “x” corresponds to the call appearance of the call:

- 1-26 (a-z)
- 27-52 (A-Z)
- 53-78 (AA-AZ)
- 79-104 (BA-BZ)
- etc.

The call appearance ID is displayed only for CACH EKTS users,not for basic EKTS users.

The call appearance ID is also displayed for CACH EKTS users even when basic call control display tags are displayed.

NOTE: The DMS does not support privacy release during call establishment and hence the requirements related to privacy release during call establishment will not be complied to.

If an international calling number is delivered to the EKTS terminal(s), the word ‘From’ shall not appear in the calling number display information.

EKTS-1	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=		t	o		#																																	
2																																								

Message: EKTS-1 will appear in the SETUP message or INFO message

Situation: EKTS-1 will be displayed to the called parties in the SET UP message if they do not have any number or name delivery features.

If the SETUP message is retransmitted, any display information that was included in the first SETUP message shall be retransmitted to those users that were previously sent this display information.

This shall also be displayed in the INFOrmation message sent to the called parties with the delayed ringing feature.

EKTS-2	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	C	a	l	l		a	n	s	w	e	r	e	d																									
2																																								

Message: EKTS-2 will appear in the KEY HOLD message

Situation: EKTS-2 will be displayed to the called parties once a shared call is answered by one of the users.

EKTS-3	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	O	t	h	e	r		u	s	e	r									c	o	n	n	e	c	t	e	d											
2																																								

Message: EKTS-3 will appear in the NOTIFY message

Situation: EKTS-3 will be displayed to all users connected to the call when another user bridges into that call.

EKTS-5	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		P	r	i	v	a	c	y		o	n										
2																																								

Message: EKTS-5 will appear in the CALL PROC message or RET ACK message

Situation: EKTS-5 will be displayed to the calling party with automatic privacy in the CALL PROC message when an ISDN-to-ISDN outgoing call is being established.

This shall also be displayed to the user with automatic privacy when he retrieves a held call and it was in the last message sent to the user before a RET ACK.

EKTS-6	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		P	r	i	v	a	c	y		o	n										
2	R	i	n	g	i	n	g																																	

Message: EKTS-6 will appear in the ALERT or RET ACK message

Situation: EKTS-6 will be displayed to the calling party with automatic privacy upon ALERTing.

This shall also be displayed to the user with automatic privacy when he retrieves a held call and it was in the last message sent to the user before a RET ACK.

EKTS-7	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		P	r	i	v	a	c	y		o	n										
2	D	e	l	a	y		i	n		r	e	s	p	o	n	s	e																							

Message: EKTS-7 will appear in the PROG or RET ACK message

Situation: EKTS-7 will be displayed to an EKTS user assigned automatic privacy in the PROG message with progress indicator #10.

This shall also be displayed to the user with automatic privacy when he retrieves a held call and it was in the last message sent to the user before a RET ACK.

EKTS-8	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		P	r	i	v	a	c	y		o	n										
2	C	o	n	n	e	c	t	e	d																															

Message: EKTS-8 will appear in the CONN, RET ACK, or NOTIFY message

Situation: EKTS-8 will be displayed to the calling party with automatic privacy in the CONNect message.

This shall be displayed to the user with automatic privacy when he retrieves a held call and the call is originated from the EKTS group and is already in the end-to-end communication mode.

This shall be displayed to the user when he bridges onto a call for which privacy is disabled and the call is originated from the EKTS group and is already in the end-to-end communication mode.

This shall be displayed to the user who enabled privacy retrieves a held call and the call is originated from the EKTS group and is already in the end-to-end communication mode.

This shall also be displayed to all the calling users connected to the call in the NOTIFY message when privacy is enabled.

EKTS-9	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	C	o	n	n	e	c	t	e	d										P	r	i	v	a	c	y		o	n										
2																																								

Message: EKTS-9 will appear in the CONN ACK or RET ACK message

Situation: EKTS-9 will be displayed to the called party with automatic privacy in the CONNect ACKnowledge message.

This shall be displayed to the user with automatic privacy when he retrieves a held call and the call is terminated to the EKTS group and is already in the end-to-end communication mode.

This shall be displayed to the user when he bridges onto a call for which privacy is disabled and the call is terminated to the EKTS group and is already in the end-to-end communication mode.

This shall be displayed to the user that enabled privacy retrieves a held call and the call is terminated to the EKTS group and is already in the end-to-end communication mode.

EKTS-10	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	C	a	l	l		a	n	s	w	e	r	e	d						P	r	i	v	a	c	y		o	n										
2																																								

Message: EKTS-10 will appear in the KEY HOLD or NOTIFY message

Situation: EKTS-10 will be displayed to the called parties that have not answered the call when the call was answered by another member and privacy is enabled.

If the switch has already sent an EKTS user a KEY HOLD message because a B channel could not be selected in response to a CONNect message, the switch shall include Display #EKTS-10 in the NOTIFY message sent to this user.

EKTS-11	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		P	r	i	v	a	c	y		o	f	f									
2																																								

Message: EKTS-11 will appear in the NOTIFY message

Situation: EKTS-11 will be displayed to all EKTS users connected to the call that originated from the EKTS group

- when a user disables privacy using an established call reference
- when the EKTS user that enabled privacy disconnects from the call
- when the EKTS user that enabled privacy sends a request to disable privacy

EKTS-12	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	P	r	i	v	a	c	y		o	f	f																											
2																																								

Message: EKTS-12 will appear in the NOTIFY message

Situation: EKTS-12 will be displayed to all EKTS users connected to the call that terminated to the EKTS group

- when a user disables privacy using an established call reference
- when the EKTS user that enabled privacy disconnects from the call
- when the EKTS user that enabled privacy sends a request to disable privacy

EKTS-13	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	P	r	i	v	a	c	y		o	n									O	t	h	e	r		u	s	e	r		c	o	n	n	e	c	t	e	d
2																																								

Message: EKTS-13 will appear in the NOTIFY message

Situation: EKTS-13 will be displayed to all EKTS members currently active in a call that terminated to an EKTS group and the privacy is enabled as a result of a user bridging onto the call.

When there is only one ekts user in the call and the second ekts associated user bridges onto the call , in that case the ekts user already in the call is going to get two back to back Q.931 NOTIFY messages .The first Q.931 NOTIFY message will contain the information ‘Other User Connected’ and the next Q.931 NOTIFY message will contain the display tag EKTS-15 .So as per the limitation of DMS-100 , ekts active user are not going to get the tag EKTS-13 as mentioned , but the same information in two different tags , with display tag EKTS-15 appearing on the terminal instead of display tag EKTS-13 .

The case which have been discussed is when there is just one ekts user in the call .The case when there are two or more ekts users in the call and other associated ekts user bridges onto the call , in that case all the active users are going to get just one Q.931 NOTIFY message giving the information that privacy is enabled with the display tag EKTS-15 .There won’t be any Q.931 NOTIFY message to give the information ‘Other User Connected’ , so ekts active users won’t be getting EKTS-13 , instead they will get display tag EKTS-15.

EKTS-14	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	#																		O	t	h	e	r		u	s	e	r		c	o	n	n	e	c	t	e	d
2	P	r	i	v	a	c	y		o	n																														

Message: EKTS-14 will appear in the NOTIFY message

Situation: EKTS-14 will be displayed to all EKTS members currently active in a call that originated from an EKTS group and the privacy is enabled as a result of another user bridging on the call.

When there is only one ekts user in the call and the second assocaited ekts user bridges onto the call , in that case the ekts user already in the call is going to get two back to back Q.931 NOTIFY messages .The first Q.931 NOTIFY message will contain the information ‘Other User Connected’ and the next Q.931 NOTIFY message will contain the display tag EKTS-8 .So as per the limitation of DMS-100 , ekts active user are not going to get the tag EKTS-14 as mentioned , but the same information in two different tags , with display tag EKTS-8 appearing on the terminal instead of display tag EKTS-14 .

The case which have been discussed is when there is just one ekts user in the call .The case when there are two or more ekts users in the call and other associated ekts user bridges onto the call , in that case all the active users are going to get just one Q.931 NOTIFY message giving the information that privacy is enabled with the display tag EKTS-8 .There won’t be any Q.931 NOTIFY message to give the information ‘Other User Connected’ , so ekts active users won’t be getting EKTS-14 , instead they will get display tag EKTS-8.

EKTS-15	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	P	r	i	v	a	c	y		o	n																												
2																																								

Message: EKTS-15 will appear in the NOTIFY message

Situation: EKTS-15 will be displayed to all EKTS members currently active in a call that terminated to an EKTS group when privacy is enabled

EKTS-16	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m		t	o		#	#																								
2																																								

NOTE:In this display ##’ represents number of the intercom group member.

Message: EKTS-16 will appear in the CALL PROC message

Situation: EKTS-16 will be displayed to the calling intercom party during call origination after digits are dialed.

EKTS-17	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m											D	i	a	l	:															
2																																								

Message: EKTS-17 will appear in the SETUP ACK message

Situation: EKTS-17 will be displayed to the calling intercom party using overlap dialing.

EKTS-18	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m		t	o		#	#					R	i	n	g	i	n	g													
2																																								

NOTE: In this display ‘##’ represents number of the intercom group member.

Message: EKTS-18 will appear in the ALERT message

Situation: EKTS-18 will be displayed to the calling intercom party when an ALERTing is received from the far end party.

EKTS-19	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m		t	o		#	#					C	o	n	n	e	c	t	e	d											
2																																								

NOTE: In this display ‘##’ represents number of the intercom group member.

Message: EKTS-19 will appear in the CONN message

Situation: EKTS-19 will be displayed to the calling intercom party when the call has been established.

EKTS-20	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m		f	r	o	m		#	#																						
2																																								

NOTE: In this display ‘##’ represents number of the intercom group member.

Message: EKTS-20 will appear in the SETUP message

Situation: EKTS-20 will be displayed to the called party for an intercom call.

EKTS-21	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	I	n	t	e	r	c	o	m		f	r	o	m		#	#			C	o	n	n	e	c	t	e	d											
2																																								

NOTE: In this display ‘##’ represents number of the intercom group member.

Message: EKTS-21 will appear in the CONN ACK message

Situation: EKTS-21 will be displayed to the called party when the call has been established.

EKTS-25	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1																					N	o		u	s	e	r	s		b	r	i	d	g	e	d				
2																																								

Message: EKTS-25 will appear in the INFO message

Situation: EKTS-25 is displayed to all EKTS users not connected to the call, when the call is no longer bridged and only one user in the EKTS group is connected to the far end user.

NOTE: EKTS-25 is changed in the DMS implementation of the feature such that quadrant 1 is not affected, in order to avoid undesirable interactions with other displays.It is since quadrant 1 is where the called address is stored, if it is cleared and the last bridged user drops, and then another user bridges, this information would be lost.

In case of termination condition, when CND or RND is not active then the display ‘No longer bridged’ is displayed in first quadrant.

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EKTS-1a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		#													t	o		#																
2																																								

Message: EKTS-1a will appear in the SETUP message

Situation: EKTS-1a will be displayed to the called user if they have CND provisioned but they do not have any other number or name delivery features.

EKTS-1b	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	o	r		#														t	o		#														c	f	x
2	R	e	a	s	o	n																																		

Message: EKTS-1b will appear in the SETUP message

Situation: EKTS-1b will be displayed to the called user if they have RND provisioned but they do not have any other number or name delivery features and the call was redirected.

EKTS-1c	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		#													t	o		#														c	f	x
2	F	o	r		#																R	e	a	s	o	n														

Message: EKTS-1c will appear in the SETUP message

Situation: EKTS-1c will be displayed to the called user if they have both CND and RND provisioned but they do not have any name delivery features and the call was redirected.

EKTS-8a	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		#													P	r	i	v	a	c	y		o	n										
2																																								

Message: EKTS-8a will appear in the CONN ACK, NOTIFY, or RET ACK message

Situation: EKTS-8a will be displayed to all EKTS users connected to the call (in place of #EKTS-9) if CND or both CND and RND are provisioned and privacy is active.

EKTS-8b	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	o	r		#														P	r	i	v	a	c	y		o	n										
2																																								

Message: EKTS-8b will appear in the CONN ACK, NOTIFY, or RET ACK message

Situation: EKTS-8b will be displayed to all EKTS users connected to the call (in place of #EKTS-9) if RND are provisioned, privacy is active and the call was redirected.

EKTS-10a	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	r	o	m		#													P	r	i	v	a	c	y		o	f	f									
2																																								

Message: EKTS-10a will appear in the NOTIFY message

Situation: EKTS-10a will be displayed to all EKTS user connected to the call (in place of #EKTS-12)if CND or both CND and RND are provisioned and privacy is not active.

EKTS-10b	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	x	=	F	o	r		#														P	r	i	v	a	c	y		o	f	f									
2																																								

Message: EKTS-10b will appear in the NOTIFY message

Situation: EKTS-10b will be displayed to all EKTS users connected to the call (in place of EKTS-12) if RND is provisioned, privacy is not active and the call was redirected.

5.6.10 Formatting of called, calling, redirecting number, reason, cfx and name

Table 147 Denoted in display tags as "#"

Called Number	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
Local N11	#	#	#																	
Local 7 digits	#	#	#	-	#	#	#	#												
National - No Transit Network	1	+	#	#	#		#	#	#	-	#	#	#	#						
National - Transit Selection	1	0	1	0	#	#	#	+	1	+	#	#	#	#	#	#	#	#	#	#
International - No Transit Network	0	1	1	+	C	C	+	N	N											
International - Transit Selection	0	1	1	+	C	C	+	N	N											
BBG Intercom	#	*																		
EKTS Intercom (2 members)																				
EKTS Intercom (2-9 members)	#																			
EKTS Intercom (10-99 members)	#	#																		

Note: CC: Country Code NN: National Number #*: Variable Length

Table 148 Denoted in display tags as "Reason"

Redirection Reason	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
Unknown	F	o	r	w	a	r	d	e	d		c	a	l	l						
Universal	F	o	r	w	a	r	d	e	d	-	a	l	w	a	y	s				
Busy	F	o	r	w	a	r	d	e	d	-	b	u	s	y						
No Answer	F	o	r	w	a	r	d	e	d	-	n	o		a	n	s	w	e	r	

Table 149 Denoted in display tags as "cfx"

Redirection CFX Acronym	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
Unknown																				
Universal	c	f	a																	
Busy	c	f	b																	
No Answer	c	f	n																	

Table 150 Denoted in display tags as "name"

Name	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
Name PI is Private	P	r	i	v	a	t	e		N	a	m	e								
Name is unavailable	U	n	a	v	a	i	l	a	b	l	e	N	a	m	e					
Name PI is Public	@	*																		

Note: @*: Variable length name up to 15 characters

Table 5 Display of [calling Number]

Display Number	1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20
CN-1A	P	r	i	v	a	t	e		N	u	m	b	e	r						
CN-1D	#	#	#		#	#	#	-	#	#	#	#								

5.6.11 Hardware requirement

This feature imparts no new hardware requirements in and of itself

5.6.12 Limitations and restrictions

Limitations and restrictions on the display text feature include the following non supported display tags, most of which are considered beyond NI2 functionality and DMS limitations.

Beyond NI2:

Calling Name & Number Delivery Display Tags - NA-7,Na-8,NA-16,NA-25a,NA-25b,NA-26,NA-27,NA-28(packet mode data tag),CN-11,CN-12,CN-13,CN-14.

ACO user activations - ACO-2,ACO-3, ACO-4,ACO-5

Business group tags - BG-1, BG-2

Call Control Display tags - CC-8,CC-14 thru. CC-16,CC-18 thru. CC-33.

Call Forward Display tags-CF-3,CF-4,CF-7,CF-8,CF-9.

Call Pickup Display tags - CP-1 thru. CP-10

EKTS Display tags -EKTS-4,EKTS-13 thru. EKTS-15,EKTS-22 thru. EKTS-25.

Flex Call Display tags - FC-13a,FC-13b,FC-14,FC-16 thru. FC-19,FC-21.

Held Call Display tags -HC-2a,HC-3, thru. HC-5,HC-5a,HC-5b,HC-5c,HC-6,HC-7.

Hunt Group Display tags -HG-1 thru. HG-4.

Message Signalling Diisplay tags -MS-1 thru. MS-4.

DMS Limitation:

NA-21,NA-22,NA-23 : Tags NA-21,NA-22,NA-23 are not supported on the DMS as there is no delivery feature that can deliver display of just redirecting name and not calling name.

Over a warm swact, the display for held call ‘Call Held’ is retained even after retrieving the call instead of showing the previous display(before the call was held).

Over a warm swact for nonconference related transfer, FC#13 appears instead of FC#15 for the second transfer request.

Consider a situation where the conference (with 3 members)is established with one of the conferees in ringing state and the other in connected state. Later when the conference call reverts to a two way call (with DCC active and the connected party being dropped from the call) the display at the controller will still show the call status as “Connected” instead of “Ringing” even though the call is now in ringing state .This is due to the absence of messaging to the originator.

When a conferee is joined into a 3-way conference,the display will show connected even if all parties are ringing.This is due to the DMS not updating the controller when a party answers after conference setup.

Sometimes it may happen that display sent by xpm is overwritten by display generated by CPE and this is out of scope of this feature.e.g.:- Even though ‘Dial:’ prompt is sent in Q931 SETUP ACKnowledge message for overlapsending, “ENTER NUMBER’ gets displayed instead of ‘Dial:’.This is CPE specific.

When an EKTS member bridges into a non_isdn (pots/ibn or over non-isdn trunks) call, it is unable to distinguish whether the active call is an isdn call or a non-isdn call. Hence the secondary member when bridged gets display cc-10 instead of cc-11 /cc-12(non-isdn displays).

Whenever a call is made over MF trunk , DMS does not provide the Calling party's name and number information . Instead the terminator gets the Display ' From OUTSIDE CALL ' .

Consider a case when an EKTS controller establishes a Flex conference and 3 members are active in the conference. Now if a secondary EKTS member bridges into the conference, the number information will not be displayed on the secondary member's display(in cc_10), since the CM is not sending any number information to the XPM in this scenario.

Consider a situation where an EKTS controller calls a non-isdn/isdn set over MF-trunk and the secondary member bridges into the call during ringing stage.Now, when the called party(non isdn/isdn) gets connected ,the displays on both the EKTS controller and EKTS secondary member still show the same displays which they had prior to connection. (i.e. both the sets are not receiving any messages regarding the called party being connected into the call)This is due to absence of messaging to the EKTS group.

5.6.13 Interactions:

5.6.14 Logs (LG)

No logs are modified by this activity.

5.6.15 New/modified logs

Table 151 New or modified logs

Log name	Log number	NEW/MOD/ DELETED	System (SOS/UNIX)
n/a	n/a	n/a	n/a

5.6.16 Data schema (DS)

5.6.17 New/modified tables

No tables are changed by this activity.

Table 152 New or modified tables

Table name	NEW, CHANGED or DELETED	Table Control (NEW/OLD/UNCHANGED)
n/a	n/a	n/a

5.6.18 Office parameters (OP)

5.6.18.1 New/modified office parameters

No office parameters are changed by this activity.

Table 153 New or modified commands

Parm table	Parameter name	NEW/CHANGED/ DELETED/RELOCATED
n/a	n/a	n/a

5.6.19 Service orders (SO)

The service order system is not changed by this activity.

5.6.20 Alarms (AL)

No alarms are charged by this activity.

5.6.21 New/modified directories

Table 154 New or modified directories

Directory name	NEW, CHANGED OR DELETED	New name (if renamed)	Target	RES/ NONRES
n/a	n/a	n/a	n/a	n/a

5.6.22 Command interface (CI)

No CI commands have been changed by this activity.

5.6.22.1 New/modified commands

Table 155 New or modified commands

Command name	NEW, CHANGED OR DELETED	New name (if renamed)	Directory/MAP level name	MENU/NON-MENU /HIDDEN
n/a	n/a	n/a	n/a	n/a

5.6.23 Operational measurements (OM)

No OMs’ have been changed by this activity.

5.6.23.1 New/modified OM groups

Table 156 New or modified OM groups

Group name (acronym)	Group name (expanded)	NEW, CHANGED or DELETED	Reason
n/a	n/a	n/a	n/a

5.6.23.2 AMA/Billing information (AM)

No billing has been changed by this activity.

5.6.23.3 New/changed AMA/billing information

Table 157 New or modified AMA/billing information

Billing format	NEW/CHANGED	Application	Standards

5.6.24 Software optionality control (SOC)

Table 158 SOC

SOC option name:	n/a
SOC option title:	n/a
SOC option control type:	n/a
New SOC option?	n/a
SOC option order code	n/a
Option defined in DRU:	n/a
Affected products:	n/a

5.6.25 Glossary

Term	Description
ACOU	Additional Call Offering Unrestricted
AFC	Additional Functional Call
BBG	Basic Business Group
BRI	Basic Rate Interface
CCM	100 CoMmon DRU
CFX	Call Forwarding
CGN	Calling Number
CIDS	Calling Identity Delivery & Suppression
CM	Computing Module
CNAMD	Calling Name Delivery (feature)
CND	Calling Number Delivery (feature)
CNIS	Calling Number Identification Service
CPE	Customer Premise Equipment
CRBL	Call Reference Busy Limit
DN	Directory Number
DTIE	Display Text Information Element

DRU	Development Release Unit
EKTS	Electronic Key Telephone System
FPE	Feature Processing Environment
FTRQ	Feature Queue
HLD	High Level Design
ISDN	Integrated Services Digital Network
MADN	Multiple Appearance Directory Number
NAMEDISP	Name Display (feature)
NI	National ISDN
NPI	Numbering Plan Indicator
PI	Presentation Indicator
PVC	Protocol Version Control
SCP	Signalling Control Protocol
SHR	SHaRed DRU
SME	Signalling Message Environment
TL	TeleCom DRU
TON	Type Of Number
TR	Technical Requirement
XPM	eXtended Peripheral Module

5.6.26 References

REF #	Description of Reference
GR-1326	Generic Requirements for ISDN Basic Rate Interface Calling Name Identification Services
TR-865	Generic Requirements for ISDN Display for Call Control and Selected Services

5.7 Call control procedures

This section describes the procedures for functional call setup. The following notes are provided as guidance to terminal manufacturers.

Note 1: To identify and associate with an appropriate service profile, all terminals using dynamic TEIs must undergo the terminal identification procedures described in Section 6.67, “Electronic Key Telephone Service”. For initializing terminals, service profile initialization occurs immediately after layer 2 data link establishment before any other layer 3 call/service requests are sent over the TEI by the terminal to the network. Service profile initialization is not required for non-initializing terminals.

Note 2: The data link connection should be kept up and running whenever layer 1 is up.

Note 3: Although optional, terminals should support Parameter Downloading. Refer to Section 9.1.1, “Functional overview” for further information.

Circuit-switched calls are controlled by a sequence of messages flowing across the user-network interface.

5.7.1 Procedures for Circuit-Switched Calls

The information elements contained in each message type are dependent on the direction of the message flow. The messages are as described in Section 5.4, “Message functional definitions”.

- Call Reference values are assigned by the origination side of the interface for a call.
- The CR flag can have the values “0” or “1”.
- The flag identifies which end of the layer 2 logical link allocated the CR.
- The side that allocated the CR value always sets the CR flag to ‘0’.
- The other side always sets the CR flag to ‘1’.
- An exception is the global CR flag, which currently has a value of ‘0’ in both directions.

5.7.1.1 Call establishment at the originating interface

Before invoking these procedures, establish a reliable data link connection between the user (TE/NT2) and the network. Send all layer 3 messages to the data link layer using a DL-DATA-REQ primitive. The data link services described in Chapter 4: "Data Link Layer Specification" of this interface specification are assumed.

Call originations from the 2 B-channel terminals are allowed, based on the interface having a free B-channel (up to the available limit of two), the calling DN having not reached its CRBL busy limit, and successful passage of the DN’s access privileges.

5.7.1.1.1 Call Request

A user initiates call establishment by transferring a SETUP across the user network interface. The message always contains the call reference selected, according to the procedures given in Section 5.5.3, “Call Reference information element”. The Bearer Capability information element is mandatory in the SETUP, even for overlap sending.

After sending the SETUP, the user optionally starts T303. If no response (CALL PROCeeding/SETUP ACKnowledge/RELease COMplete) is received from the network within time interval T303, the SETUP is re-transmitted and timer T303 re-started. If no response is received before timer T303 expires the second time, initiate clearing as described in Section 5.7.1.3, “Call clearing”.

If a subsequent SETUP, with identical call reference, is received after the network has responded with CALL PROCeeding or SETUP ACKnowledge to a SETUP, the network ignores the subsequent SETUP.

The SETUP may contain all or none of the call information (that is, called address, facility and supplementary service requests) necessary for call establishment, depending on whether en bloc or overlap procedures are being used respectively, as described in the “Call Information Sending” subsection, on page 292.

B-Channel Selection - Originating

- If the Channel Identifier (CID) information element is set to “preferred any channel”, or is not present in the SETUP from a user, the network interprets this as any available B-channel may be used.
  - — If a channel is available, the network sets the CID IE to be returned to the user, with that channel indicated as exclusive.
    - – If no channel is available, the call is rejected.
  - — If the CID IE indicates a preferred channel (that is, “prefer B1” or “prefer B2”) in the outgoing SETUP, and the requested channel is available, the network assigns that channel to the call, and sets the CID IE to be returned to the user with that channel indicated as exclusive.
    - – If the requested channel is unavailable, the network finds the first available B channel, assigns that channel to the call, and sets the CID IE to be returned to the user with that channel indicated as exclusive.
    - – If no channel is available, the call is rejected.
- If the CID IE is present and contains an exclusive channel (that is, “exclusive B1” or “exclusive B2”).
  - — If the requested channel is available, the network assigns that channel to the call, and the CID IE is returned to the user with that channel indicated as exclusive.
  - — If the requested channel is unavailable, the call is rejected.

In the above scenarios where a channel is successfully assigned, the network includes the CID IE in the first response to the SETUP (that is, a SETUP ACKnowledge or CALL PROCeeding).

In the above scenarios where the call is rejected due to the unsuccessful assignment of a channel, the network responds with a RELease COMplete, with an appropriate cause value.

- If channel selection failure is due to having no available channel in the network (that is, both channels are assigned), the network includes cause value #34, “no channel/circuit available”.
- If channel selection failure occurs because the requested channel is not available, the network includes a cause value #44, “requested circuit/channel not available”.
- In all of the above cases the clearing procedures in Section 5.7.1.3, “Call clearing” are used.

Bearer Capability Validation

- If the bearer capability indicated in the SETUP is not authorized for the calling user, or if the bearer service is authorized, but not presently available or implemented, the network rejects the SETUP by sending a message as described in Section 5.7.1.3, “Call clearing”.
- After an idle B-channel has been reserved and the bearer capability validation has successfully been completed, the network proceeds to process the call information.

Calling Party Number

- If the SETUP for a circuit-switched call contains Calling Party Number information, it is validated by the network (refer to Section 6.34, “Calling Number Identification Services (CNIS)” for more details on Calling Party Number validation.)
- If the user-provided Calling Party Number is valid, it is sent to the called party as part of calling number delivery.
- If it is invalid, the Default DN assigned to the calling party's service profile is used for calling number delivery.

Calling Party Subaddress

- If the SETUP for a circuit-switched call contains Calling Party Subaddress (CGS) information, it is transported transparently through the network unless either:
    - — a valid calling party number is not present in the SETUP
    - — the calling party does not subscribe to CGS Information Transfer
    - — the CGS IE either (1) exceeds the maximum allowable length or (2) is less than the minimum declared length.
- In the above cases, the network discards the CGS information by sending the calling user a STATus with:
    - — cause value #43, “user information discarded (location: public network serving local user)”
    - — diagnostic byte coded to “#6d’”(IE identifier value associated with the CGS IE)
    - — the Call State IE is coded as call state 1 “call initiated”.

  Regardless of whether the CGS information is discarded, call processing continues as normal.

Called Party Subaddress

- If the SETUP for a circuit-switched call contains Called Party Subaddress (CDS) information, it is transported transparently through the network unless either:
  - — the calling party does not subscribe to CDS Information Transfer
  - — the CDS IE either exceeds the maximum allowable length or is less than minimum declared length.
- In the above cases, the network discards the CDS information by sending the calling user a STATus with:
  - — cause value #43, "user information discarded (location: public network serving local user)"
  - — diagnostic byte = #71
  - — the call state IE coded as call state 1 "call initiated".

  Regardless of whether the CDS information is discarded, call processing continues as normal.

High/Low-Layer Compatibility

- If the SETUP for a circuit-switched call contains High/Low-Layer Compatibility information, it is transported transparently through the network unless either:
  - — the calling party does not subscribe to HLC/LLC Information Transfer
  - — the HLC/LLC IE either exceeds the maximum allowable length or is less than the minimum declared length.
- In the above cases, the network discards the HLC/LLC information by sending the calling user a STATus with:
  - — cause value #43, "user information discarded (location: public network serving local user)"
  - — diagnostic byte = IE identifier value associated with the HLC/LLC IE (as appropriate)
  - — the Call State IE coded as call state 1 "call initiated".

  Regardless of whether the HLC/LLC information is discarded, call processing continues as normal.

Call Information Sending

- The user/terminal may send call information to the network using either enbloc or overlap sending, or combinations of enbloc and/or overlap as specified by the generic procedures for supplementary service access in Section 6.18, "G7 - Dial Management (Call Initiation Phase)".
- Where combinations of en bloc and/or overlap are used to send information to the network, terminals must be able to accept the information request (IRQ) information element to prompt the user for supplemental information in either a SETUP ACKnowledge or INFOrmation.

- The network returns an IRQ IE on receipt of a complete access code (for example a routing code), or feature request during call establishment where supplemental address information is required.

  — en bloc sending - en bloc sending during call initiation refers to the case where the user has included all the information in the SETUP necessary to allow the network to establish a call or to provide access to a service. Depending on the call to be established or service to be accessed, encode the feature request/address information in any one or acceptable combination of Keypad information element, Called Party Number (CDN) information element, Transit Network Selection (TNS) information element, Feature Activator (FA) information element, and/or Operator System Access (OSA) information element.

  The combination of KP IE and any one of:

  – CDN

  – TNS

  – OSA

  in the SETUP is treated by the network as an error. The call is rejected by sending to the terminal a RELease COMPlete containing cause #28, “invalid number format (location: public network serving local user)”.

  – On receipt of the either the OSA or TNS information element in the SETUP, the network attempts to route the call, based on the call information received, and will not prompt for supplemental information.

  – If the user has requested enbloc access to a service, depending on the specific service, the network may require the user to send supplemental address information, in which case the network prompts for supplemental address information. Refer to Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)” for description of the generic procedures for supplementary service access supported by the network.

  — Overlap sending - Overlap sending during call initiation refers to the case where the user includes none or partial information in the SETUP necessary to establish a call or to access a supplementary service. Overlap access to supplementary service is described in Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”.

  When establishing a call using overlap sending, the user sends address digits in either the KP or CDN IE, with the associated Type of Number and Numbering Plan Identification each coded to “unknown”.

- On receipt of such a SETUP, the network starts T400 (the value is found in Section 5.8, “Protocol timer values”) and sends a SETUP ACKnowledge, containing the B-channel allocated to the call.

- If the SETUP does not contain any called party information and the bearer capability specifies speech or 3.1 kHz audio, the SETUP ACKnowledge contains signal #0, “dial tone on”, and progress indicator #8, “inband information or appropriate pattern now available.”

- After receiving the SETUP ACKnowledge, the user stops T303 (if started) and sends the call information (if any) in the KP IE contained in one or more INFOrmation(s). Upon receiving the first INFOrmation from the user, T400 is stopped, and T401 started. If dial tone was turned on as part of the SETUP ACKnowledge, the network also sends an INFOrmation, containing signal #63, “tones off” after receiving the first INFOrmation from the user.

Note: Besides the CDN information, the INFOrmation(s) may contain additional call information (that is, for supplementary services). The interpretation of the contents of KP IEs is network-specific and in accordance with the dialing plan provided to that user. T401 is used for interdigit timing and is started on receipt of each INFOrmation until end of dialing is determined.

- If T400 expires and the network has not received enough information to route the call, or T401 expires, the action taken by the network depends on the BC of the call. For end-to-end ISDN speech or 3.1 kHz audio calls, a PROGress with:

— cause #28

— progress indicator #8

— signal #3

are sent to the calling user by the network, while for end-to-end ISDN circuit-mode data calls, the user receives a call clearing with

— cause #28

— signal #3.

- Invalid Call Information - For a SETUP containing a BC value not implemented by the network, the network initiates call clearing and sends a RELease COMplete to the user, with cause value # 65, “Bearer capability not implemented”.

If, during overlap sending, the network determines either:

— that the call information received from the user is invalid (that is, invalid address or access to any services and facilities requested is not authorized for the user)

— if access to the requested services and facilities is authorized but not presently available

the networks’ action depends on the BC of the call.

— For ISDN speech or 3.1 kHz audio calls, a PROGress with the appropriate cause, progress indicator and signal numbers is sent to the calling user

— for ISDN circuit-mode data calls, the user receives a call clearing message with the appropriate cause and signal numbers.

If, during en bloc sending, the network determines that the call information received from the user is invalid, the network first returns a CALL PROCeeding specifying the B-channel to connect to, followed by a PROGress containing the appropriate cause, and progress indicator values.

5.7.1.1.2 Call Proceeding

When the network determines that:

- there is sufficient information to route a call
- access to the requested service and facilities is authorized and available,

the user receives a CALL PROCeeding indicating call establishment.

- If an IRQ IE was sent to prompt for supplemental information, the CALL PROCeeding contains the IRQ IE coded, indicating that the request for supplemental information is complete.
- When all the necessary information is received in the SETUP (that is, en-bloc case), the CALL PROCeeding contains the B-channel allocated to the call.

If during overlap sending, either:

- the network received a “sending complete” indication (for example, the # character) in an INFOrmation
- analysis by the network shows that all call information necessary to effect call establishment has been received,

the network stops T401 and, if access to the requested service and facilities is authorized and available, sends a CALL PROCeeding to the user.

If T401 expires during overlap sending, the network action depends on the bear capability of the call as described in Section 5.7.1.1.1, “Call Request”.

Call Proceeding Timer

If the user receives a CALL PROCeeding in response to a SETUP, T303 (if started) is cancelled, and T310 may optionally be initiated. If the user subsequently does not receive any response from the network prior to expiration of T310, the user initiates call clearing as described in Section 5.7.1.3, “Call clearing”.

Progress Indication at the Originating Interface

During call establishment, the network may send a PROGress to the user to indicate either:

- an interworking situation has occurred
- that a network announcement is provided in the information channel.

One of the following progress indicator values is included in the Progress indicator information element in the PROGress sent to the user:

- #1 - “call is not end-to-end ISDN, further call progress information may be available in-band”,
- #8 - “in-band information or pattern now available”, or
- #10 - “delay in response at called interface”.

The PROGress has no effect on the protocol state machine when sent or received at this time; however, any supervisory timers (T310, for example) are stopped. The user connects to the B-channel (if not already done so) and monitors the B-channel for further in-band information.

5.7.1.1.3 Termination to a non-ISDN Line: Calling Party Alerting

When an ISDN user originates a call terminating on a non-ISDN line, the network sends an ALERTing containing progress indicator #8 and signal #1, to the calling user indicating it has begun notifying the called line that a call is present.

5.7.1.1.4 Termination to an ISDN Line: Called Party Alerting

Upon receiving an indication that user alerting was initiated at the called address, the network sends an ALERTing across the user-network interface of the calling address. This message may cause initiation of a user equipment generated alerting indication.

For end-to-end ISDN speech or 3.1 kHz audio calls:

- the network sends an ALERTing, with progress indicator #8 and signal #1;
- end-to-end ISDN circuit-mode data calls are sent an ALERTing containing signal #1.

5.7.1.1.5 Call Connected

Upon receiving call acceptance indication:

- The network sends a CONNect across the user-network interface to the calling user, and enters the Active state.
- The CONNect may contain Signal #63 (if Signal #1 had previously been sent in an ALERTing), and Progress Indicator #2 (if the called party is non-ISDN).
- It indicates to the calling user that a connection is established through the network, and stops a possible local indication of alerting.
- On receipt of the CONNect, the calling user:
  - stops T301, T303, and T310 (if running)
  - optionally sends a CONNect ACKnowledge
  - enters the Active state.

  The network takes no action on receipt of a CONNect ACKnowledge when it perceives the call to be in the Active state.

5.7.1.1.6 Call rejection

Upon receiving an indication that the remote user (or network) is unable to accept the call, the network initiates clearing as described in Section 5.7.1.3, “Call clearing”.

5.7.1.2 Call establishment at the Destination Interface

- This procedure assumes that a data link connection providing services described in the layer 2 procedures (described in Chapter 4: "Data Link Layer Specification") may not exist before the first layer 3 message (SETUP) is transferred across the interface.
- However, reliable data link connections must be established by each user before they respond to the SETUP.
- The CR contained in all messages relating to this call exchanged across the user-network interface contain the CR value specified in the SETUP delivered by the network.
- For incoming calls, the SETUP contains Signal #64 for circuit-mode calls.

5.7.1.2.1 Incoming Call

- The network indicates the arrival of a call at the user-network interface by transferring a SETUP across the interface.
- The message is sent if the network can select an idle B-channel.
- The CID IE is mandatory in the SETUP and indicates the B-channel to be used for the call, with no acceptable alternative.
- In some circumstances (for example, ACO), the SETUP may also be sent when no B-channel is available.
- Since a multipoint terminal configuration may exist at the user-network interface, this message must be sent using a broadcast capability at the data link layer.
- The SETUP must contain the CDN IE, if the interface supports multiple DNs.
- After sending the SETUP, the network starts T303 and T312.
- T312 supervises the retention of the CR when the SETUP was transmitted by a broadcast data link.
- Its value is such that, if a network disconnect indication is received during the call establishment phase, it maximizes the probability that all responding users will be released prior to release of the CR. Refer to Section 5.7.1.3, “Call clearing” for procedures to be followed on expiry of T312.

The SETUP is the only message sent on the broadcast data link for an incoming call.

The SETUP for any call contains the following information elements, as appropriate:

- Protocol Discriminator - always present
- Call Reference - always present
- Message Type - always present
- Bearer Capability - always present
- Channel Identifier - always present

- Progress Indicator - included if an interworking situation has occurred
- Signal - always present
- Calling Party Number - included if:
  - — the called user has subscribed to delivery of calling party address information for circuit- switched calls
  - — the network has access to the information and presentation of the number is allowed.
- Calling Party Subaddress - included if:
  - — the called user has subscribed to delivery of calling party address information for circuit-switched calls
  - — the calling party subaddress information was included in the SETUP received from the calling user equipment
  - — the network accepted it for transfer to the called party.
- Called Party Number - always present for basic calls and is coded as a “local (directory) number in ISDN Numbering Plan”. When a user invokes a EKTS Intercom (ICM) feature, the Call Appearance information element is included in the SETUP rather than the Called Party Number information element
- Called Party Subaddress - included if the SETUP received from the calling user equipment included it, and the network accepted it for transfer to the called party
- First and last Redirecting Party Number - included if:
  - — the called user has subscribed to delivery of redirecting party address information for circuit- switched calls
  - — the network has access to the information and presentation of the number(s) is allowed.
- Low-Layer Compatibility - included if the SETUP from the calling user equipment contained low-layer compatibility and the network accepted it for transfer to the called party (not applicable for packet-mode calls)
- High-Layer Compatibility - included if the SETUP from the calling user equipment contained high-layer compatibility and the network accepted it for transfer to the called party (not applicable for packet-mode calls)
- Endpoint Identifier - included to identify the terminals to which a call is directed, and always present for incoming EKTS calls
- Call Appearance - included for the EKTS Intercom feature.

If T303 expires before the called party sends a CALL PROCeeding, ALERTing, CONNect, or RELease COMplete in response to the initial SETUP:

- the network re-transmits the SETUP
- restarts T303 and T312
- sends a PROGress to report a delay at the called interface.

Send a PROGress if a CALL PROC is received after the first expiry of T303. The contents of this PROGress vary according to the BC of the call.

For end-to-end ISDN speech or 3.1 kHz audio calls:

- the network sends the calling user equipment a PROGress containing progress indicators # 10 and # 8, and also includes signal # 1
- for circuit-mode data calls, it sends progress indicator # 10 and signal # 1.

When the incoming SETUP contains the low-layer compatibility information element, if the information in that information element conflicts with the information in the Bearer Capability information element, the terminal ignores the low-layer compatibility information element.

5.7.1.2.2 B-Channel Selection - Destination

Except with certain supplemental service (that is, ACO and EKTS), the network always uses the Channel Identifier information element in the SETUP to indicate the only acceptable B-channel for the call. If the indicated channel is not acceptable, the user equipment sends a RELease COMplete, with cause value #44 “requested circuit/channel not available”, to the network.

For ACO or EKTS, the network sends a SETUP with the Channel Identifier information element coded as “no channel indicated”. Channel negotiation takes place according to the channel identifier specified by the called user in response to the incoming SETUP.

5.7.1.2.3 B-channel allocation for 2B-channel terminals

Bellcore GR-268 uses ITU Q.931 call control procedures to offer basic calling capabilities.

- Calls offered to the user equipment under these procedures must have a free B-channel available at call offering time, or the incoming call receives busy treatment (under the Interface Busy condition).
- When a B-channel is available for the incoming call, assuming no other busy condition was encountered, the network specifies the B-channel for the call in the incoming SETUP.
- If the user subscribed to ACO, incoming calls are offered by the network to the user equipment even when all available B-channels are busy.
- In this case, the incoming SETUP may be provided with no B-channel specified.
- The user must first free up a B-channel, either through the HOLD Service (TR-856), or by clearing one or more of the active calls.
- The user equipment, in its response to the SETUP may optionally specify the B-channel on which the network should offer the call.

Hence, the B-channel allocation procedures for incoming calls are different depending on whether a free B-channel is available, and if the customer subscribes to ACO. To ensure NI-2 CPE equipment interpretability on our interface, calls are offered per the above protocol. For example, when a second call comes into a terminal subscribing to two B-channel access, and one of the

B-channels is busy, it is offered per GR-268 procedures. If a third call comes into the terminal, while both B-channels are active, it is offered as an ACO call.

The first additional VI call (a second VI call being offered when a VI or CMD call is currently active on one B-channel and the other B-channel is free) is offered per GR-268 procedures, using the available B-channel rather than as an ACO call. Table 159, “B-channel availability conditions” covers all the possible conditions of B-channel availability and incoming calls to the 2 B-channel terminal.

Table 159 B-channel availability conditions

Available channels	Incoming CMD call	Incoming VI call
2 free B-channels	GR-268	GR-268
1 free B-channel with CMD on the other B	GR-268	GR-268
1 free B-channel with VI on the other B	GR-268	GR-268
No free B-channels	TR-857	TR-857

5.7.1.2.4 Call Confirmation

Response to SETUP

When an idle user equipment determines that:

- sufficient call setup information was received
- compatibility requirements are satisfied
- the B-channel indicated in the SETUP message is acceptable

the user responds with either a CALL PROCeeding, ALERTing, or CONNect.

The user equipment that can not respond to a SETUP with an ALERTing, CONNect, or RELease COMplete should send the CALL PROCeeding before expiration of T303. (See Receipt of Call Proceeding on page 302 for more details.)

- When the network receives the first ALERTing from the called user after channel negotiation is successful, the network cancels T310 or T303 (if running) in conjunction with the start of T301.
- On receipt of a CONNect, T301 stops.
- User equipment receiving a SETUP performs compatibility checking before responding to it.
- At the minimum for basic calls, the user checks that:
  - the bearer service offered by the network in the Bearer Capability information element
  - the called number specified in the number digits subfield of the Called Party Number information element match with the BCs and DNs supported by the user equipment.

Basic call terminals supporting terminal initialization procedures (as defined in Section 6.7.4, “Initializing Terminal Procedures”) and, for example, the supplementary service Electronic Key Telephone Service, check for a match of the Endpoint Identifer information element contents with the endpoint identifier stored in the terminal.

If a mismatch is detected, the user is defined as “incompatible”. After the SETUP is delivered through the broadcast data link, an incompatible user shall either:

- Ignore the incoming call
- Respond by sending a RELease COMplete with cause value #88 “incompatible destination” and enters the Null state.

The network currently ignores this RELease COMplete.

If an incompatible user responds to the SETUP with either an ALERTing or CONNect:

- The network initiates clearing for this specific user by sending a RELease COMplete, with cause value #88 “incompatible destination”.
- The user, upon receiving the RELease COMplete, turns off alerting (if any), releases the CR, and returns to the Null state.
- Busy user’s equipment which satisfy the compatibility requirements indicated in the SETUP respond with a RELease COMplete, having cause value #17 “user busy”.
- If the user wishes to refuse the call, send a RELease COMplete, with cause value #21 “call rejected”.

After the user responded with CALL PROCeeding, ALERTing, CONNect to the first SETUP, if a subsequent SETUP with identical CR is received, the user ignores it.

- At the destination user to network interface, except in the case of ACO or EKTS, the Channel Identifier information element is mandatory in the first response from the user to the incoming SETUP (in these two instances, it may be included in the CONNect).
- In cases other than ACO or EKTS, channel negotiation is successful when there is a match between the channel specified in the incoming SETUP and the channel identified in the first message returned by the called user.
- When the Channel Identifier information element is included in the first response, and the channel specified is different from the one indicated in the incoming SETUP, the network initiates call clearing to the specific user by sending a RELease, with cause value #6 “channel unacceptable”.
- If the CID IE is not included in the response, the network takes action as specified for messages with missing mandatory information elements. (See the “Mandatory Information Element Missing” subsection in Section 5.7.1.4.6 on page 314).

Receipt of Call Proceeding

- Receipt of the CALL PROCeeding by the network stops T303 and starts T310.
- Receipt of an ALERTing or CONNect when a CALL PROCeeding has not been received, stops T303.
- Receipt of an ALERTing or CONNect subsequent to receipt of a CALL PROCeeding cancels T310.
- Receipt of an ALERTing causes a corresponding ALERTing to be sent to the calling user.
- Where multiple ALERTing messages are received in a multipoint access line, only the first occurrence triggers a message to the calling user.

Call Failure Procedures

- If, prior to the second expiration of T303, the network does not receive any response to the re-transmitted SETUP, it releases the CR and initiates clearing to the originating user, in accordance to the procedures specified in Section 5.7.1.3, “Call clearing”.
- If the network does not receive an ALERTing, CONNect or DISConnect prior to expiration of T310, it initiates clearing procedures to the calling user, as specified in Section 5.7.1.3, “Call clearing”. The clearing cause sent is cause #18, “no user responding”. The value of T303 and T310 are specified in Table 162, “Timers in the user side”.
- On a point-to-multipoint interface structure, if a RELease COMplete is received while T303 or T310 is running, the network retains the message cause. If T303 or T310 expires (that is, if no valid message such as ALERTing or CONNect is received), the cause previously retained when a RELease COMplete was received is sent back to the calling user in a RELease.

Note: The cause value to be returned to the calling user when multiple RELease COMplete(s) (and causes) from multiple terminals on the access loop have been received, is determined by the network. Normally the first cause received is returned to the user.

5.7.1.2.5 Call Accept

When an ISDN user answers the call:

- the terminal sends a CONNect to the network and starts T313
- the network establishes a connection between the calling and called user.

Note: When cut-through is completed, the network sends the called user a CONNect ACKnowledge containing signal #79.

- If the calling user has previously sent an ALERTing or PROgress containing signal information indicating ringback/audible ringing tone on, signal #63 is included in the returned CONNect.
- When the network receives a CONNect from the called user, T301, T303, and T310 are stopped, if running.

5.7.1.2.6 Active Indication

- On receipt of the first CONNect, the network completes the circuit-switched path to the selected B-channel and sends a CONNect ACKnowledge to the user that first accepted the call.
- It is presumed that the B-channel that was agreed upon earlier is being used for the call.
- The network also initiates procedures to send a CONNect towards the calling user.
- The CONNect ACKnowledge indicates completion of the circuit-switched connection.
- There may not be end-to-end communications until the CONNect indication is received at the calling user.
- Upon receipt of the CONNect ACKnowledge, the user stops T313.
- At this point, the call enters the Active state, where it remains until clearing is initiated.
- If T313 expires prior to receipt of a CONNect ACKnowledge from the network, the user initiates call clearing by sending a RELease, and starts T308.
- The user that received the SETUP through the broadcast data link, and was awarded the call, connects to the B-channel only after it receives the CONNect ACKnowledge.
- Only the user awarded the call receives the CONNect ACKnowledge.

5.7.1.2.7 Non-selected user clearing

DN Call Contention Not Supported

The network clears non-selected users with a RELease COMplete containing cause #81, “invalid call reference value”, or other appropriate cause. Any applicable timers associated with the non-selected user are also stopped.

DN Call Contention Supported

Note: This feature is currently supported only on non-initializing terminals.

- In addition to sending the CONNect ACKnowledge to the terminal selected for the call, the network sends a RELease, with cause value #26, “non-selected user clearing”, to all other terminals at the interface that sent a CALL PROCeeding, ALERTing, or CONNect in response to a SETUP.
- This RELease is used to notify the other terminals that the call is no longer offered to them.
- Any user that previously sent a CONNect, started T313, and subsequently received a RELease, stops T313.
- Each user receiving the RELease returns a RELease COMplete and releases the CR.

5.7.1.2.8 Additional functionality (non-ringing terminals)

A DN can be subscribed, in the network, not to ring. To support this capability, a terminal's decision to ring or not is based on the Signal information element included in a SETUP sent to the terminal.

Incoming SETUP messages sent for a non-ring DN have the Signal information element coded to # 79 "Alerting off". Upon receiving the signal value of # 79, the terminal does not ring.

5.7.1.3 Call clearing

5.7.1.3.1 Terminology

The following terms are used in the description of the clearing procedures:

- A channel is "connected" when it is part of a circuit-switched ISDN connection established according to this document.
- A channel is "disconnected" when it is no longer part of a circuit-switched ISDN connection but is not yet available for use in a new connection.
- A channel is "released" when it is not part of a circuit-switched ISDN connection and is available for use in a new connection.
- A call reference that is "released" is available for reuse.

5.7.1.3.2 Exception conditions

Under normal conditions, call clearing is initiated by the user or the network sending a DISConnect, and following the procedures defined in Section 5.7.1.3.3, "Clearing by the user", or Section 5.7.1.3.4, "Clearing by the network". Exceptions to this rule are as follows:

- Call clearing due to protocol violations - Protocol violations are:
  - — message type errors as defined in Section 5.7.1.4.4, "Message type errors"
  - — mandatory information element errors, as defined in Section 5.7.1.4.6, "Mandatory information element errors".
  - — call reference errors, as defined in the "Call Reference Procedure Errors" subsection of Section 5.7.1.4.3 on page 312.
  - — other protocol violations for which a cause value is not specified. In this case, use cause value #111 "protocol error, unspecified".

  With the exception of message type errors, handled as described in Section 5.7.1.4.4, "Message type errors", all of the above protocol violations are cleared as follows:

  - — If the network has either sent or received a message identifying a channel for the call (that is, any state except 0, 1, 6, and 19), it clears the call by sending a RELease.
  - — If no previous message was sent or received, identifying a channel to be connected for the call (that is, states 0, 1, and 6), a RELease COMplete is sent.
  - — If a RELease had previously been sent, the message is ignored.

Note: Follow this procedure regardless of whether the user has subscribed to in-band tone options.

Call rejection by Network during Cal Initiation

- In response to a SETUP, the network clears a call due to unavailability of B-channels by responding with a RELease COMplete, having cause value #34 “no channel/circuit available”.

  If the BC requested in the SETUP is not authorized or not presently available or implemented, the network rejects the SETUP by sending a RELease COMplete, with one of the following cause values:

  — #57 “bearer capability not authorized”

  — #58 “bearer capability not presently available”

  — #65 “bearer service not implemented”.

  If the network receives a SETUP with a transit network selection that it does not recognize, it rejects the origination.

  — Depending on the calling bearer capability, ISDN speech or 3.1 kHz audio, calls are rejected by the network and sent a CALL PROCeeding, with the Channel Identifier information element, followed by a PROGress, with cause #2, progress indicator #8, and signal #3.

  — For ISDN circuit-mode data calls, the network rejects the origination by sending the calling user a call clearing message with cause #2, and signal #3.

  If the network receives a SETUP with the transit network selection requesting a carrier not allowed to carry intraLATA calls, it rejects the origination.

  — Depending on the calling user’s bearer capability for ISDN speech or 3.1 kHz audio calls, the network sends the calling user a CALL PROCeeding with the Channel Identifier information element followed by a PROGress with cause #3, progress indicator #8, and signal #3.

  — For ISDN circuit-mode data calls, the network rejects the origination by sending the calling user a call clearing message with cause #3 and signal #3.

  After the requested bearer service is authorized and available, and an idle B-channel has been requested for the call, the network processes the call information provided by the user. If it is invalid, or the requested services and facilities are authorized but not presently available, the following procedures apply:

  — For en bloc sending, the network rejects the origination depending upon the bearer service requested.

    – For speech or 3.1 kHz audio calls, the network sends the calling user a CALL PROCeeding containing the Channel Identifier information element followed by a call PROGress with the appropriate cause value, progress indicator #8, and signal #3.

    – For ISDN circuit-mode data calls, the network sends the calling user a call clearing message having cause #28, and signal #3.

- For overlap sending, the network rejects the origination depending on the requested bearer service.
  - For speech or 3.1kHz audio calls, the network sends a PROGress, with the appropriate cause value, progress indicator #8, and signal #3, since the network has already returned a SETUP ACKnowledge specifying to which B-channel to connect (see Section 5.7.1.1.1, “Call Request”).
  - For circuit-mode data calls, the network sends the calling user a call clearing message having cause #28, and signal #3.
- Call clearing is initiated if T401 expires before all digits are received during overlap sending.
- Cause values returned by the network for call rejection by the network during call initiation are listed below. Each cause value indicates the reason for a particular call treatment.
  - #1 “unassigned number”
  - #22 “number changed”
  - #28 “invalid number format (incomplete number)”
  - #29 “facility rejected”
  - #50 “requested facility not subscribed”
  - #63 “service or option not available, unspecified”
  - #79 “service or option not implemented, unspecified”
  - network specific cause #1, “vacant code”
  - network specific cause #3, “prefix 1 dialed in error”
  - network specific cause #4, “prefix 1 not dialed”.
- After receiving the PROGress, the user may initiate call clearing by sending a DISConnect and following the procedures described in Section 5.7.1.3.3, “Clearing by the user”.
- If no DISConnect is received after a network-specified time period, the network clears the call by sending a RELease to the user and applying the procedures specified in Section 5.7.1.3.3, “Clearing by the user” (more than one PROGress may be sent if a call is routed to multiple tones and/or announcements).
- The PROGress has no effect on the protocol state machine when sent or received; however, any supervisory timers started (for example, T400) are stopped. The user connects to the B-channel (if not already done so) and monitors it for further in-band information.

Call rejection by Network or Destination User prior to Answer

Calls may be rejected by the network or the destination user prior to answer, due to:

- call progress failure in the network, that is, network congestion (cause value #42 “switch equipment congestion”)
- destination number unassigned (cause #1) or number changed (cause #22)

- destination number manually placed in trouble busy state (cause #27, “destination out of order” and progress indicator #8, “inband tone or appropriate pattern now available”)
- rejection of call by the called interface
- if the call clearing message contains cause #88 “incompatible destination”, clear calling interface with cause #18 “no user responding”, and signal #1 “ringback/audible ringing tone on”
- if the call clearing message contains cause #17 “user busy”, clear calling interface with cause #17, and signal #4 “busy tone on”
- if the call clearing message contains cause #21 “call rejected”, clear calling interface with cause #21, and signal #1 “ringback/audible ringing tone on”
- Network-Determined Busy status at called interface.
  - — For end-to-end ISDN speech or 3.1 kHz audio calls, the network sends the calling party a PROGress, with cause #17, progress indicator #8, and signal #4.
  - — For end-to-end ISDN circuit-mode data calls, it sends a call clearing message with cause #17 and signal #4.
- Receipt of call clearing (DISConnect, RELease, or RELease COMplete) from called user while T301 is running. Here, the network notifies the calling user that the call can not be completed as follows:
  - — For end-to-end ISDN speech or 3.1 kHz audio calls, the network sends the calling user a PROGress containing cause #21, progress indicator #8, and signal #1.
  - — For end-to-end ISDN circuit-mode data calls, a call clearing message containing cause #21, and signal #1 is sent to the calling user.
  - — If the destination user clears the call after first sending ALERT but prior to sending CONNect, and the network applied in-band audible ringing to the originating user, it completes call clearing to the destination user, but continues sending in-band audible ringing to the originating user.

Call Clearing by Network to Destination User prior to Answer

- If a network disconnect indication is received after a SETUP was sent to the called user, but prior to the expiry of T312, T303 or T310 is stopped (if running).
- Any user that responded, or subsequently responds before T312 expires, is cleared by a RELease, and the procedures of Section 5.7.1.3.4, “Clearing by the network”, are then followed for that user.
- Upon expiry of T312, the network enters the Null state.
- However, the network will not release the call reference for re-use until completion of the clearing procedures of Section 5.7.1.3.4, “Clearing by the network”, for all responding users.

Clearing of Non-Selected Terminals at the Destination Exchange

- For multipoint terminal configuration, the procedure described in Section 5.7.1.2.8, “Additional functionality (non-ringing terminals)”, above applies to clearing of non-selected terminal.

Clearing by Calling User during Call Establishment

- After retransmitting a second SETUP to the network, if no response is received before T303 expires the second time, the user sends a RELease COMplete, with cause value #31 “normal, unspecified” to the network.
- The user may optionally start T310 after receiving a CALL PROCeeding. If no response is received from the network prior to expiration of T310, the user initiates clearing by sending a RELease with cause value #31 “normal, unspecified” and starting T308.
- If the calling user goes on-hook during call establishment, that is, before the network sends a CONNect, it is considered normal clearing; follow the procedures specified in Section 5.7.1.3.4, “Clearing by the network”.

Clearing by Network Due to Destination Not Responding

- If the network does not receive a response to a re-transmitted SETUP (that is, on the second expiration of T303), the network initiates clearing to the originating user. When the SETUP is delivered by a broadcast data link, the network also initiates clearing procedures towards the called user in accordance with Section 5.7.1.3.2, “Exception conditions”. The treatment applied to the calling party depends on the calling bearer capabilities.
  - — For end-to-end ISDN speech or 3.1 kHz audio calls, the network sends the calling user a PROGress, with cause #18, progress indicator #8, and signal #1
  - — For circuit-mode data calls, the network sends a call clearing message with cause #18 and signal #1 to the calling user.
- If the network does not receive a valid CONNect from the called user before T301 expires, it clears the call at the called interface, sending a RELease with cause #102 to the called user equipment from which a CALL PROCeeding or ALERTing was the last message received by the network. The network sends a call clearing, with cause #19 and signal #63, to the calling user.
- The user may send a CALL PROCeeding to the network when it can not respond to the SETUP with an ALERTing, CONNect, or call clearing message before T303 expires. If the network receives a CALL PROceeding from the called user, it stops T303 and initiates T310. If T310 expires, the network sends the called party a RELease, with cause #102. The treatment applied to the calling party depends on the bearer capability.
  - — For an end-to-end ISDN speech or 3.1 kHz audio call the network sends a PROGress with cause #18, progress indicator #8, and signal #1.
  - — For end-to-end ISDN circuit-mode data calls, the calling user equipment is sent a call clearing message with cause #18 and signal #1.

Clearing by Network Due to Unavailable Equipment/Facilities

If a network condition of unavailable equipment/facilities or internal or other failure occurs, the network sends the calling user a CALL PROCeeding, identifying the channel, followed by a PROgress or DISConnect, based on the bearer capability of the calling user:

— For end-to-end ISDN speech or 3.1 kHz audio calls the network sends a PROGress containing cause #34 “circuit/channel congestion”, progress indicator #8, and signal #3.

— For end-to-end ISDN circuit-mode data calls, the network sends a call clearing message containing cause #34, and signal #3.

5.7.1.3.3 Clearing by the user

- Apart from the exceptions identified in Section 5.7.1.3.2, “Exception conditions”, and Section 5.9.1.5, “Handling of error conditions”, the user initiates normal clearing by sending a DISConnect, starting T305, and disconnecting the B-channel.
- On receipt of the DISConnect by the network:

  — the B-channel used in the call is disconnected

  — a RELease is sent to the user

  — T308 is started.

  The network also initiates procedures to clear both the network connection and the call to the remote user.
- On receipt of the RELease, the user:

  — cancels T305

  — releases the B-channel

  — sends a RELease COMplete

  — releases the call reference

  — returns to the Null state.

  Following the receipt of a RELease COMplete from the user, the network:

  — stops T308

  — releases both the B-channel and call reference

  — returns to the Null state.
- If the network does not receive a RELease COMplete before the first expiry of T308, it re-transmits the RELease, and re-starts T308. If no RELease COMplete is received from the user before T308 expires a second time, the network releases the call reference and the B-channel on the network side and returns to the Null state.
- If the user does not receive a RELease in response to the DISConnect before expiry of T305, it:

  — sends a RELease to the network with the cause value originally contained in the DISConnect

— starts T308.

On receipt of the RELease COMplete from the network, the user:

— stops T308

— releases both the B-channel and the call reference

— returns to the Null state.

If the user does not receive a RELease COMplete prior to the first expiry of T308, re-transmit the RELease and re-start T308. If no RELease COMplete is received from the network before T308 expires the second time, the user releases both the B-channel and call reference and enters the Null state.

- In some cases, a RELease may be received without having received a previous DISConnect. In these cases, the receiver of the RELease releases the B-channel and call reference and returns a RELease COMplete to the originator of the RELease.
- The Signal information element, set to “tones off”, is included in the appropriate network clearing message if tones were previously turned on and have not been previously turned off.

5.7.1.3.4 Clearing by the network

- Apart from the exceptions identified in Section 5.7.1.3.2, “Exception conditions”, and Section 5.9.1.5, “Handling of error conditions”, the network initiates normal clearing by sending a DISConnect, starting T305, and disconnecting the B-channel.
- On receipt of the DISConnect, the user disconnects the B-channel, sends a RELease, and starts T308.
- On receipt of this RELease, the network:

— stops T305

— releases the B-channel

— sends a RELease COMplete

— releases the call reference

— enters the Null state.

Following the receipt of a RELease COMplete from the network, the user:

— cancels T308

— releases both the B-channel and call reference

— returns to the Null state.

If the network does not receive a RELease in response to the DISConnect before expiry of T305, it:

— sends a RELease to the user with the cause value originally contained in the DISConnect

— starts T308.

On receipt of the RELease COMplete from the user, the network:

— stops T308

— releases both the B-channel and the call reference

— returns to the Null state.

If a RELease COMplete is not received before T308 expires, the RELease is re-transmitted and T308 re-started.

If no RELease COMplete is received from the user before T308 expires the second time, the network releases the call reference and B-channel on the network side.

If a RELease COMplete is not received by the user before the first expiry of T308, the user re-transmits the RELease and restarts T308.

If no RELease COMplete is received from the network before T308 expires a second time, the user releases the call reference and B-channel and returns to the Null state.

- In some cases, a RELease may be received without having received a previous DISConnect. If so, the receiver of the RELease releases the B-channel and call reference, and returns a RELease COMplete to the originator of the RELease.
- If channel negotiation fails at the called interface, the treatment applied to the calling party depends on the bearer capability for the call.

  — For end-to-end ISDN speech or 3.1 kHz audio calls, the network sends the calling user a PROGress, with cause #41, progress indicator #8, and signal #4.

  — For end-to-end ISDN circuit-mode data calls, the network sends a call clearing message with cause #41 and signal #4 to the calling user.
- The Signal information element, set to tones off, is included in the appropriate clearing message if tones were previously turned on and have not been previously turned off.

5.7.1.3.5 Clear collision

Clear collision occurs when the user and the network simultaneously transfer a DISConnect specifying the same call. Both the user and the network stop T305, send a RELease, start T308, and follow the procedures described in Section 5.7.1.3.3, “Clearing by the user”.

Clear collision can also occur when both sides simultaneously transfer a RELease related to the same call. The entity receiving such a RELease stops T308, releases the B-channel and call reference, and enters the Null state.

5.7.1.4 Handling of error conditions

Detailed error handling procedures are implementation dependent, and may vary from network to network. However, capabilities facilitating the orderly treatment of error conditions are provided for in this section.

The network may establish a threshold for the number of messages or information elements received that are either incorrect or not understood. Once the threshold is exceeded for call-related protocol errors, clear the call. Once the threshold is exceeded for non-call related protocol errors, disconnect the data link.

In this section, “ignore” means discard and do nothing, as if the message had never been received.

5.7.1.4.1 Protocol discriminator errors

If a message is received with a protocol discriminator not in accordance with Section 5.5.2, “Protocol discriminator”, ignore it.

5.7.1.4.2 Message too short

If a message is received with a truncated message header (e.g., less than 4 octets for a single-octet call reference value, and 5 octets for a 2-octet call reference value), ignore it.

5.7.1.4.3 Call reference errors

Invalid Call Reference Format

- If the Call Reference information element octet 1, bits 5-8, do not equal 0000, ignore the message.
- If the Call Reference information element octet 1, bits 1-4, indicate a length greater than two octets, the message will be ignored.

Call Reference Procedure Errors

The network handles call reference procedure errors as follows:

- When the network or user receives any message except SETUP or RELease COMplete, specifying a call reference it does not recognize as relating to an active call or a call in progress, it sends a RELease COMplete using the call reference in the received message, with cause value #81 “invalid call reference value”.
- If a RELease COMplete is received, specifying a call reference not recognized as relating to an active call or a call in progress, take no action.
- When a SETUP is received with the call reference flag value incorrectly set to 1, ignore it.
- When a SETUP is received specifying a call reference recognized as relating to an active call or to a call in progress, ignore it.
- Ignore any message specifying the global call reference.
- When any message, except INFOrmation, is received specifying the null call reference, ignore it.

5.7.1.4.4 Message type errors

Unrecognized Message Type

If a message is received containing a message type either not implemented or not understood, take no action on that message, and no state changes occur. A STATus may optionally be returned by the network, with cause value #97 “message type non-existent or not implemented”.

An exception to this rule occurs when the network receives an unrecognized message type before address sending is complete. In this case the network initiates call clearing to the calling user with cause #97 “message type non-existent or not implemented”.

Unexpected Message

When either side of the interface receives an implemented message, except RELease or RELease COMplete, that specifies:

- either a valid call reference relating to a call considered to be in either the ACTIVE state, or
- any of the states of call establishment
- but for which a response is not prescribed by the procedures in Section 5.7.1.1, “Call establishment at the originating interface”, Section 5.7.1.2, “Call establishment at the Destination Interface”, or Section 5.7.1.3, “Call clearing”,

the network typically ignores the unexpected message, and returns a STATus containing cause #101, “message not compatible with call state”. Such messages are also ignored if the call is perceived to be in a clearing state. However, if an unexpected message pushes the erroneous message count beyond the threshold, the call is cleared as described in Section 5.7.1.3, “Call clearing” with cause #101 “message not compatible with call state”.

- An exception to this rule exists if the network receives an unexpected message from the calling user before address sending is complete. In this case, the network clears the call with a DISConnect containing cause #101, “message not compatible with call state”.
- If a RELease COMplete is received:
  - — the receiver stops any supervisory timers
  - — releases the B-channel (if any) and call reference
  - — enters the Null state.
- If a RELease is received, the receiver:
  - — stops any supervisory timers
  - — releases the B-channel (if any)
  - — sends a RELease COMplete
  - — releases the call reference
  - — enters the Null state.
- The network ignores any RESTart and unsolicited STATus messages (that is, any STATus messages not in response to a STATus ENQuiry initiated by the network).

5.7.1.4.5 General Information Element errors

If an information element is received containing less information than is required to act on it, treat it as having “invalid information element contents”.

Duplicated Information Elements

When an information element is repeated in a message in which its repetition is not permitted, only the contents of the information element appearing first are processed. All subsequent repetitions of the information element are ignored.

When a message is received containing an information element repeated more times than the specified allowable maximum, it is acted upon, ignoring the contents of occurrences of the information element beyond the maximum.

Extension Errors

- If the extension bit is “0” when “1” is expected or vice versa, ignore the information element. An information element is also ignored when it is received with unrecognized extended octet(s).
  - If the ignored information element is mandatory, follow the error handling procedures for invalid mandatory information elements, described in Section 5.7.1.4.6, “Mandatory information element errors”.
  - If the ignored information element is non-mandatory, the receiver continues to process the message.

5.7.1.4.6 Mandatory information element errors

Out-of-Sequence Mandatory Information Elements

The network discards any out-of-sequence information element (an information element is considered out-of-sequence if the value of its identifier is less than that of the in-sequence information element preceding it).

If a discarded out-of-sequence element is a mandatory information element, the network considers it to be missing and takes action as described in Mandatory Information Element Missing, below.

Mandatory Information Element Missing

When a SETUP or RELease having one or more mandatory information elements missing is received, a RELease COMplete with cause value #96, “mandatory information element is missing”, is returned. After sending the RELease COMplete, the sender releases the call reference and B-channel (if any) and returns to the Null state.

When a DISConnect with the Cause information element missing is received, the actions taken are the same as if a DISConnect with cause value #31, “normal, unspecified”, were received. Follow the procedures in Section 5.7.1.3, “Call clearing”, for normal clearing. The RELease returned may optionally contain cause value #96, “mandatory information element missing”.

When a RELease COMplete with a Cause information element missing is received, it is assumed that a RELease COMplete was received with cause value #31, “normal, unspecified”.

If a message, other than SETUP, RELease, DISConnect, or RELease COMplete, is received having one or more mandatory information elements missing, a RELease is returned with both:

- the cause value #96, “mandatory information element missing”
- diagnostic field specifying the identifier of the first missing information element.

Mandatory Information Element Content Error

When a SETUP or RELease having one or more mandatory information elements with invalid contents is received, a RELease COMplete with cause value #100, “invalid information element contents”, is returned. After sending the RELease COMplete, the sender:

- releases the call reference and B-channel (if any)
- returns to the Null state.

When a DISConnect is received with the Cause information element having invalid contents, the actions taken are the same as if a DISConnect with cause value #31, “normal, unspecified”, were received. Follow the procedures in Section 5.7.1.3, “Call clearing” for normal clearing. The RELease returned may optionally contain cause value #100, “invalid information element contents”.

When a RELease COMplete, HOLD REJect, or RETRieve REJect, with the Cause information element having invalid contents, is received, it is assumed that the message was received with cause value #31, “normal, unspecified”.

If a message, other than SETUP, RELease, DISConnect, RELease COMplete, HOLD REJect, or RETRieve REJect, which has one or more mandatory information elements having invalid contents is received, return a RELease with cause value #100, “invalid information element contents”.

5.7.1.4.7 Non-mandatory information element errors

When the network or user receives a message containing optional information elements that either have invalid contents or the network or user does not know how to act upon them, the network or user processes the message and the recognizable elements having valid contents. Information not acted upon is discarded.

Optionally, a STATus, in some instances, is returned by the network with cause value #99, “information element non-existent or not implemented”, or cause value #100, “invalid information element contents” and diagnostics field specifying the IE identifier.

If the network receives a DISConnect or RELease containing an IE it cannot act upon, it:

- discards the unrecognizable element
- processes any remaining elements
- continues call clearing by returning cause #99, “information element non-existent or not implemented”, or other appropriate cause, in the next clearing message sent to the user (that is, the subsequent RELease or RELease COMplete, respectively).

If the network receives a RELease COMplete containing an unrecognizable IE, it discards the element and clears the call, as defined in Section 5.7.1.4.6, “Mandatory information element errors”.

When the network receives a message containing an out-of-sequence non-mandatory information element, it discards the out-of-sequence element and, if appropriate, continues processing with the next available information element in sequence (information element sequence is based on the value of the information element identifiers).

5.7.1.4.8 Data link reset

If the network-side layer 3 entity is notified by its data link layer entity, through the primitive DL-Establish-Indication, that the data link was reset, the following procedures apply:

- For all calls in the Active state, the network sends a STATus ENQuiry to the user. Timer T322 is started, and if any other timer is running, it is cancelled. The procedures in Section 5.7.1.4.10, “Status Enquiry procedure”, and Section 5.7.1.4.11, “Receiving a STATus message”, are then applied.
- For calls in the Call Initiated state (N1), the network initiates clearing by sending a RELease COMplete with cause value #41, “temporary failure”.
- For calls in the other establishment states, the network initiates clearing by sending a DISConnect with cause value #41, “temporary failure”, and follows the procedures in Section 5.7.1.3, “Call clearing”.
- For calls in the Call Present state (N6), and for which no response has been received from the user, the network continues call offering until events lead to answer of the call or call clearing.
- For calls in the Null state, take no action.
- For calls in the Clearing phase (N12 or N19), the network re-transmits the last call clearing message sent.
- If the user-side layer 3 entity is informed of a data link layer reset by means of the DL-Establish-Indication, take no action.

5.7.1.4.9 Data link failure

If the data link layer entity notifies the network side layer 3 through the primitive DL-Release-Indication that there is a data link layer malfunction (other than as a result of TEI removal), the following procedures apply:

- Start T309 for all calls. Stop all other timers except for the call clearing timers (T305 and T308), and then restart T316.

For calls in the establishment phase and for which a response has been received from a remote user, the network clears the call to the remote user with a RELease with cause value #41, “temporary failure”.

Note: If T309 is already running, do not restart it.

- Request layer 2 re-establishment by sending primitive DL-Establish-request. When informed, through the request, that the data link layer is re-established, the network stops T309 and follows the procedures defined in the case of Section 5.7.1.4.8, “Data link reset”. If the remote user clears while T309 is still running, upon receiving the DL-Establish-Confirmation before T309 expires, the network clears the call to the local user using the normal clearing procedures as described in Section 5.7.1.3, “Call clearing”.

  If T309 expires prior to data link re-establishment, the network:

  — clears both the network connection and calls to the remote user, using cause value #41, “temporary failure”.

  — clears the connection and calls to the local user by disconnecting and releasing both the B-channel and the CR, and entering the Null state.

  When informed through the primitive DL-Establish-Confirmation that the data link layer is re-established, the network initiates the Restart procedures as described in Section 5.7.1.4.10, “Status Enquiry procedure”.

- If the user-side layer 3 entity is notified by its data link entity through the DL-Release-Indication primitive that there is a data link layer malfunction, it clears all calls.
- If the user-side entity is able to distinguish calls in the Active state (that is, state 10), it may optionally maintain all active calls, and start T309.

  — If T309 expires before layer 2 is re-established and before the user-side entity receives a STATus ENQuiry from the network, the entity clears the CRs associated with the active calls and disconnects all B-channel connections.

  — If the user-side entity receives a STATus ENQuiry, it follows the procedures outlined in Section 5.7.1.3, “Call clearing”.

5.7.1.4.10 Status Enquiry procedure

When the network wants to check the correctness of a call state at the user side, a STATus ENQuiry is sent requesting the call state. T322 starts and if any other timer is running, it is cancelled.

- Upon receipt of a STATus ENQuiry from the network, if the call is in the Active state, the user responds with a STATus containing cause value #30, “responding to STATus ENQuiry”.
- If a STATus ENQuiry is received in the Null state, the user sends a RELease COMplete, using the message’s call reference, having cause #81, “invalid call reference value”.
- If a STATus ENQuiry is received in any state other than the Null or Active, the user either:

  — ignores the STATus ENQuiry

— responds with a STATus, reporting the current call state and cause #30, “responding to STATus ENQuiry”.

- Receipt of the STATus ENQuiry does not result in a state change.
- If clearing is initiated by either the user or network while T322 is running, the network cancels T322 and proceeds with call clearing as described in Section 5.7.1.3, “Call clearing”.
- While T322 is running, the network ignores all except clearing and STATus messages from the user, using cause #30 “response to STATus ENQuiry”. When one of these messages is received, T322 is cancelled.
- If T322 expires, and no response to the STATus ENQuiry is received, the network clears the call by sending a DISConnect, with cause #41 “temporary failure”, as outlined in Section 5.7.1.3, “Call clearing”. The call is cleared to the remote user having cause #41, “temporary failure”.

5.7.1.4.11 Receiving a STATus message

On receipt of a STATus from the local user containing cause #30, “response to STATus ENQuiry”, and a call state, the network cancels T322 and takes action on the local user as shown in Table 160, "Network action on reports”, based on the call state reported.

Table 160 Network action on reports

Report Call State	Network action
Active (10)	Maintain end-to-end connection and continue call processing
Null (0)	Release B-channel and call reference and move to null state
Disconnect Request (11) or Disconnect Indicator (12)	Clear call with RELease as described in Section 6.1.3
Release Request (19)	Release B-Channel and call reference. Clear call with RELease COMplete
Any Other State	Clear call with DISConnect containing cause #101, “message not compatible with call state (location: public network serving local user)” or other appropriate cause.

Note: The CPE requires the support of at least two all call states.

- Unless the reported call state is Active (that is,10), the network also clears the call to the remote user using cause #41, “temporary failure (location: user)”, or some other appropriate cause.
- If a STATus containing a cause other than #30, “response to STATus ENQuiry”, is received from the user, the message is ignored and T322 continues to run.
- The network ignores autonomous STATus messages (those not in response to a STATus ENQuiry) from the user.

5.7.1.5 Call collision

Call collision may occur when the user and network simultaneously send a SETUP, allocating the last available call reference associated with the service profile. In this case, priority is given to the incoming call over the user call request. The network clears the outgoing call by sending a RELease COMplete, with cause value #44, “requested circuit/channel not available”.

5.7.1.6 Interworking with existing networks

During call establishment, the call may leave an ISDN environment, due to interworking with either a non-ISDN network or non-ISDN equipment.

5.7.1.6.1 Outgoing call not end-to-end ISDN

If the network receives indication that the outgoing call left the ISDN after CALL PROCeeding was sent, but before reaching the exchange serving the destination user, the network sends a PROGress to the user, with Progress indicator IE specifying the value #1, “call not end-to-end ISDN”.

This indicates the user connects to the B-channel, if not connected already, and then monitors the B-channel for further in-band information. No state change occurs, but any supervisory timers are stopped.

5.7.1.6.2 Answer supervision

The network monitors the out-going non-ISDN trunking facilities for answer and disconnect supervision. These conditions, upon detection, are translated into CONNect or DISConnect messages, respectively, for the ISDN side of the call; and vice-versa.

5.8 Protocol timer values

Table 161 Timers in the network side

Timer number	Time-out value	Started	Normally terminated	Action to be taken when timer expires
T301	3-7 m, in 1 m steps (Note 1)	After receiving ALERTing from the called user	On receipt of CONNect from called user (Note 2)	Call cleared to the called and calling users
T303	2.5 s	On sending SETUP	On receiving CALL PROC, ALERT, CONN, REL COMplete (Note 3)	Resend SETUP, restart T303
Second T303	2.5 s	On resending SETUP	On receiving CALL PROC., ALERT, CONN, REL COMplete (Note 3)	Release call reference for incoming call and enter Null state
T305	30 s	On sending DISC	On receiving RELease or DIS.	Send RELease, start T308
T308	4 s	On sending RELease	On receiving RELease COMp or RELease	Resend RELease, restart T308
Second T308	4 s	On expiry of T308	On receiving RELease COMp, or RELease	Release CR and B-channel, and return to Null state
T309	30 s	DL Disc Calls in active state are not lost	On DL re-connect	Release network connection
T310	5 s	On receiving CALL PROC	On receiving ALERTing, CONNect, DISC, or REL	Send RELease
T312	T303 2 s	SETUP sent or re-sent	Time-out	If in Call Abort state, call reference is released; else, take no action
T316	120 s	On sending RESTart	On receiving RESTart ACK	Resend RESTart, restart T316
Second T316	120 s	On resending RESTart	On receiving RESTart ACK	Leave in RESTart pending state
T322	4 s	On sending STATus ENQuiry	On receipt of STATus	Initiate call clearing
T302	10-15 s	On sending INFO for terminal initialization	On receipt of INFO with SPID	Notify maintenance
T309	30 s	DL Disc active connection	On DL Reconnect	Release network connection
T322	4 s	On sending STATus ENQuiry	On receipt of STATus	Initiate connection clearing
T400	20 s (default)	Message received providing address information, but address information not yet complete	INFOrmation received from calling user (Note 4)	Network provides partial dial treatment
T401	4-10 s	Message received that potentially completes address information	INFOrmation received from calling user (Note 4)	Network provides partial dial treatment or routes call, as appropriate

Timer number	Time-out value	Started	Normally terminated	Action to be taken when timer expires
TI_T1	20 s	On sending last INFO for AutoSPID procedures	On receipt of INFO with SPID	Send INFO. Terminal is not initialized.
TI_T1	20 s	layer 2 is established	On receipt of INFO with SPID	Send INFO to request initialization.

Note 1: Timer is settable by the network in the range from 0-320 s.

Note 2: T301 is supported for both ISDN and non-ISDN calls.

Note 3: T303 terminates on receipt of RELease COMplete if the network knows there is only one user on the interface.

Note 4: T400 starts after the network sends the SETUP ACKnowledge to the user. It stops either when an INFOrmation is received from the user, or the timer period expires. If it expires, the call is given call treatment using an inband tone or announcement, at which time the user should disconnect the call. Use T401 for interdigit timing and start it on receipt of each INFOrmation until end of dialing is determined.

5.8.1 Timers in the user side

Table 162 Timers in the user side

Timer number	Time-out value	Started	Normally terminated	Action to be taken when timer expires
T303 (opt)	4 s	On sending SETUP	On receiving SETUP ACK, CALL PROC., REL COMP	Resend SETUP, restart T303
T303 2nd time	4 s	On resending SETUP	On receiving SETUP ACK, CALL PROC., REL COMP	Send RELease COMplete
T305	30 s	On sending DISC	On receiving RELease or DISC	Send RELease, start T308
T308	4 s	On sending RELease	On receiving REL COMp or RELease	Send RELease, restart T308
T308 2nd time	4 s	On expiry of T308	On receiving REL COMp or RELease	Release CR
T309	30 s	On DL- Release	On reestablishment of layer 2 to network	Clear all CRs of active calls and B-channel connections
T313	4 s	On sending CONNect	On receiving CONNect ACK, DISC or REL	Send RELease

5.9 Call-independent signaling procedures

This section specifies the procedures for the support of signaling not directly associated with calls or circuits, that is, signaling which does not control a bearer service between the network and user.

The procedures specified in this section are based on the procedures defined in CCITT Recommendation Q.932, Generic Procedures for the Control of ISDN Supplementary Services. Generic procedures specifically for the support of supplementary services related to calls (bearer services) can be found in Chapter 6: "Supplementary Services".

For terminals using these procedures, the data link connection should be kept up and running whenever layer 1 is up.

5.9.1 Call-independent connection using REGister

5.9.1.1 Connection establishment

The side initiating a call-independent connection must first establish a reliable data link connection between the network and user. Send all layer 3 messages to the data link layer using a DL-DATA-REQ primitive. The data link services described in Chapter 4: "Data Link Layer Specification" are assumed.

A call-independent connection using REGister is one established with a REGister. It establishes a CR for the connection, and includes a Facility IE. Depending on the service, the signaling connection may be established by the network or the user.

5.9.1.2 Service Procedures

A service within a call-independent connection is initiated with a Facility information element containing an Invoke component. The Facility information element can be placed in either the REGister message which initiated the connection or in a subsequent FACility message. The service discriminator in this Facility information element and the operation value within the Invoke component identify the service.

An exchange of FACility messages on the established call reference may follow, each of which contains a Facility information element with a Remote Operations component for the service. The RELease COMplete message which clears the connection may include a Facility information element containing the final component of the service operation.

The components contained in the Facility information elements are specific to each service.

5.9.1.3 Application association establishment

Note: These procedures are not supported in the initial release.

An application association is established on a call independent connection by the application association initiator sending either a REGister, with a new CR value, or a FACility, on an existing connection. The REGister or FACility contain a Facility IE, with an request component. The request component contains the application context, and optionally, user information specific to the service.

The application association responder acknowledges the request by sending a FACility with the same CR, and a Facility IE containing a response component, to the application association initiator. The response component contains the application context, associate result, result diagnostic, and optionally, user information specific to the service.

The application context parameter may contain the same application context as specified in the request component, or may be a new value determined by the responder. In either case, the application context for the application association is determined by the value returned in the response component.

The associate result parameter identifies whether the request component is accepted or rejected. If the request component is rejected by the application association responder, the result diagnostic parameter provides some information on the request rejection. If the association request is rejected, the response component is sent in a RELease COMplete.

A maximum of one application association is allowed to be simultaneously established for each call independent connection.

5.9.1.4 Connection clearing

A RELease COMplete clears the call-independent connection and releases the call reference. For normal clearing the RELease COMplete may contain a Cause information element with cause value #31, “normal, unspecified”.

Depending on the service, connection establishment and completion can be performed by either the network or the user.

Figure 27 Example call-independent connection using REGister

SIDE 1	MESSAGE	SIDE 2
	REG (CRn, FIE=a) ←	establish connection
FACility messages may be exchanged until the service is complete	FAC (CRn, FIE=b) →	
	. . .	
	REL COM (CRn) REL COM (CRn,CAUSE,FIE=c) ←	release release connection

5.9.1.5 Handling of error conditions

Note: CAUSE is not supported in the initial release.

This section contains the procedures for the handling of error conditions associated with call-independent connections. Procedures for the handling of Remote Operations errors are specific to the service using a call-independent connection and are covered in the specification of that service.

A RELease COMplete, which clears a call-independent connection, can optionally include a Cause information element. Service and Remote Operation errors are normally reported in a Reject or Return error component. CSE errors are reported in a CSE abort component.

5.9.1.5.1 Protocol discriminator errors

When a message is received with a protocol discriminator not in accordance with Section 5.5.2, “Protocol discriminator”, ignore it.

5.9.1.5.2 Message too short

When a message is received with a truncated message header (for example, less than 4 octets for a single-octet call reference value, and 5 octets for a 2-octet call reference value), ignore it.

5.9.1.5.3 Call reference errors

Invalid Call Reference Format

- If the Call Reference information element octet 1, bits 5-8, do not equal 0000, ignore the message.
- If the Call Reference information element octet 1, bits 1-4, indicate a length greater than that supported by the receiving equipment, ignore the message.

Call Reference Procedure Errors

- For an interface using only call independent signaling, when the network or user receives any message except REGister or RELease COMplete, specifying a call reference it does not recognize as relating to an active connection, the network or user sends a RELease COMplete, using the call reference in the received message, with cause value #81, “invalid call reference value”.
- If a RELease COMplete is received, specifying a call reference not recognized as relating to an active connection, take no action.
- When a REGister is received with the call reference flag value incorrectly set to 1, ignore it.
- If a REGister is received, indicating a call reference already in use, the user and network shall abort any services active on the connection.
  - — The receiver may send a FACility, containing a Facility information element, with a Return error component, for each active service.
  - — The application association is cleared using the abort procedures.
  - — The connection is cleared with a RELease COMplete, and the call reference is released.
- When any message except RESTart or RESTart ACKnowledge is received specifying the global call reference, ignore it.

5.9.1.5.4 Message type errors

Unrecognized Message Type

If a message is received having a message type either not implemented or not understood, take no action on it and make no state change.

Unexpected Message

If a message other than REGister, FACility, or RELease COMplete is received with a call reference of a call-independent connection, perform the abort procedures and the clear the connection by sending a RELease COMplete with cause value #101, "message not compatible with state", and release the call reference. The user and network will abort all services active on the connection.

If the user or network begins clearing the connection and there are active services using it, clearing can continue. If the call reference is released before a service can complete, the user and network will abort the service.

5.9.1.5.5 General information element errors

The following procedures only apply to Q.931 IEs and the Q.931 portion of the Facility information element, for call-independent connections. The error handling procedures for the Remote Operations (RO) component of the Facility information element are covered in the specifications of the services which use call-independent connections.

Duplicated Information Elements

If an information element is repeated in a message in which its repetition is not permitted, process only the contents of the information element appearing first. Ignore all subsequent repetitions of the information element.

When a message is received containing an information element repeated more times than the specified allowable maximum, act upon it, but ignore the contents of those beyond the maximum.

Extension Errors

Ignore the information element when:

- the extension bit is "0" when "1" is expected or vice versa
- it is received with unrecognized extended octet(s).

  If the ignored information element is mandatory, follow the error handling procedures for invalid mandatory information elements as described in Section 5.7.1.4.6, "Mandatory information element errors". If the ignored information element is non-mandatory, the receiver should continue to process the message.

5.9.1.5.6 Mandatory information element errors

Mandatory Information Element Missing

When a REGister is received having one or more mandatory information elements missing, return a RELease COMplete with cause value #96, “mandatory information element is missing”. After sending the RELease COMplete, the sender releases the Call Reference.

If a FACility is received, in which one or more mandatory information elements missing, perform the ACSE abort procedures, and return a RELease COMplete with the cause value #96, “mandatory information element missing”, and a diagnostic field specifying the identifier of the first missing information element.

Mandatory Information Element Content Error

Upon receipt of a REGister having one or more mandatory information elements with invalid contents, return a RELease COMplete with cause value #100, “invalid information element contents”. After sending the RELease COMplete, release the call reference.

When a RELease COMplete is received with the Cause information element having invalid contents, assume that a RELease COMplete was received with cause value #31, “normal, unspecified”.

If a FACility having one or more mandatory information elements having invalid contents is received, perform the ACSE abort procedures and return a RELease COMplete with cause value #100, “invalid information element contents”.

5.9.1.5.7 Non-mandatory information element errors

When the network or user receives a message containing optional information elements that either have invalid contents or the network or user does not know how to act upon them, the network or user processes the message and the recognizable elements having valid contents. Information not acted upon is discarded.

5.9.1.5.8 Data link reset or failure

If layer 3 is notified by its data link layer through the primitive DL-Establish-Indication that the data link has been reset or has malfunctioned, it should note the problem, but not take any additional action. Services active on the call-independent connection are responsible for deciding whether to abort.

5.10 Rapid Messaging

The Rapid Messaging feature provides for the monitoring and controlling of the rate of SAPI 0 D-Channel messaging for provisioned terminals on an ISDN interface. The BellCore name for this feature is “D-Channel Message Performance Monitoring and Control” (DCMPMC). The mechanisms are applied on a per-terminal basis by changing terminal status to “out of service” when control is applied and to “in service” when control is removed. Prior to the application of control, the warning message “out of service soon” is sent to give the offending terminal an opportunity to reduce its message traffic. Repeated violations of the message traffic limit result in the terminal being temporarily or, in extreme cases, permanently removed from service.

While a terminal is in the “out of service” condition, the network ignores any messages sent by the terminal that are not associated with the establishment or clearing of a call in progress at the terminal, or associated with the maintaining or clearing of an active call at the terminal.

5.10.1 Definitions

The following definitions are applicable to the Rapid Messaging feature:

- **D-Channel Message** - A layer 3 ISDN signaling message that is sent in a layer 2 information frame on the D-Channel using the layer 2 Service Access Point Identifier (SAPI) value of 0.

The term “D-Channel Message” as used in this section does NOT apply to the following terms:

- — Layer 3 X.25 packets that are sent in Layer 2 Information frames on the D-Channel using the layer 2 SAPI value of 16
- — Layer 2 Supervisory and Unnumbered frames that are sent on the D-Channel using the layer 2 SAPI value of 0
- — Layer 2 frames that are sent on the D-Channel using the layer 2 SAPI value of 16
- — Layer 2 frames that are sent on the D-Channel using the layer 2 SAPI value of 63.

- **Overload Messaging Limit** - the provisioned maximum number of D-Channel Messages receivable by the network per unit time without invoking Rapid Messaging control procedures.
- **No Overload** - a terminal condition in which the number of D-channel messages received per minute is below the Overload Messaging Limit. No Rapid Messaging controls are applied.
- **Near Overload** - a terminal condition entered from the “No Overload” condition when the rate of D-Channel messages exceeds the Overload Messaging Limit. The terminal remains “in service”, but the network sends a warning message to give the terminal an opportunity to reduce its volume of D-Channel messages.
- **Overload** - a terminal condition entered from the “Near Overload” condition when the rate of D-channel messages exceeds the Overload

Messaging Limit for a second consecutive time. The network places the terminal “out of service” and notifies it accordingly.

- **“In Service” condition** - Rapid Messaging controls are not in force on a terminal.
- **“Out of Service” condition** - Rapid Messaging controls are in force on a terminal.

  Impacted messages:

  — All D-Channel Messages that are not associated with call establishment or clearing (INFOmation messages associated with feature activation, for example) are ignored

  — All circuit-mode call origination attempts from the terminal are ignored

  — All circuit-mode call termination attempts to the terminal are treated as if the terminal is Network-Determined Busy

  — All packet-mode call origination attempts that involve D-Channel Messaging (i.e., establishment of On-Demand B-Channels using SETUP messages) are ignored

  — All packet-mode call termination attempts that involve D-Channel Messaging (i.e., establishment of incoming calls using Conditional Notification) are rejected.

  Non-impacted messages:

  — Packet-mode call origination attempts and packet-mode call termination attempts that do not involve D-Channel Messaging (i.e., establishment of X.25 Switched Virtual Circuits (SVCs) on existing B-Channel and D-Channel packet links, establishment of new D-Channel packet links) are still allowed

  — Existing circuit-mode and packet-mode calls from and to the terminal are unaffected by the overload condition. The network allows these existing calls to be cleared (by the terminal or by the network) even though the overload condition is in place

  — Packet-mode Permanent Virtual Circuits (PVCs) to and from the terminal are unaffected by the overload condition. The network allows these PVCs to be reset (by the terminal or by the network) even though the overload condition is in place

  — Existing circuit-mode and packet-mode call *attempts* from and to the terminal at the time the control is enacted are unaffected by the overload condition. The network allows these existing call attempts to progress to completion (if the call attempt is accepted) or to be cleared (if the call attempt is rejected) even though the overload condition is in place.

- **TMEAS** - the continuous time interval used by Rapid Messaging to monitor D-Channel message traffic from BRI terminals. It is also used to control the length of the “Out of Service” condition such that the when the “Out of Service” condition is applied, its duration is for the remainder of the current TMEAS interval and the full duration of the following interval.

It is set by the office and ranges from 0-900 seconds in 30 second increments.

The Nortel Networks recommended setting for the Overload Message Limit is 120 messages per TMEAS; the TMEAS recommended time is 90 seconds.

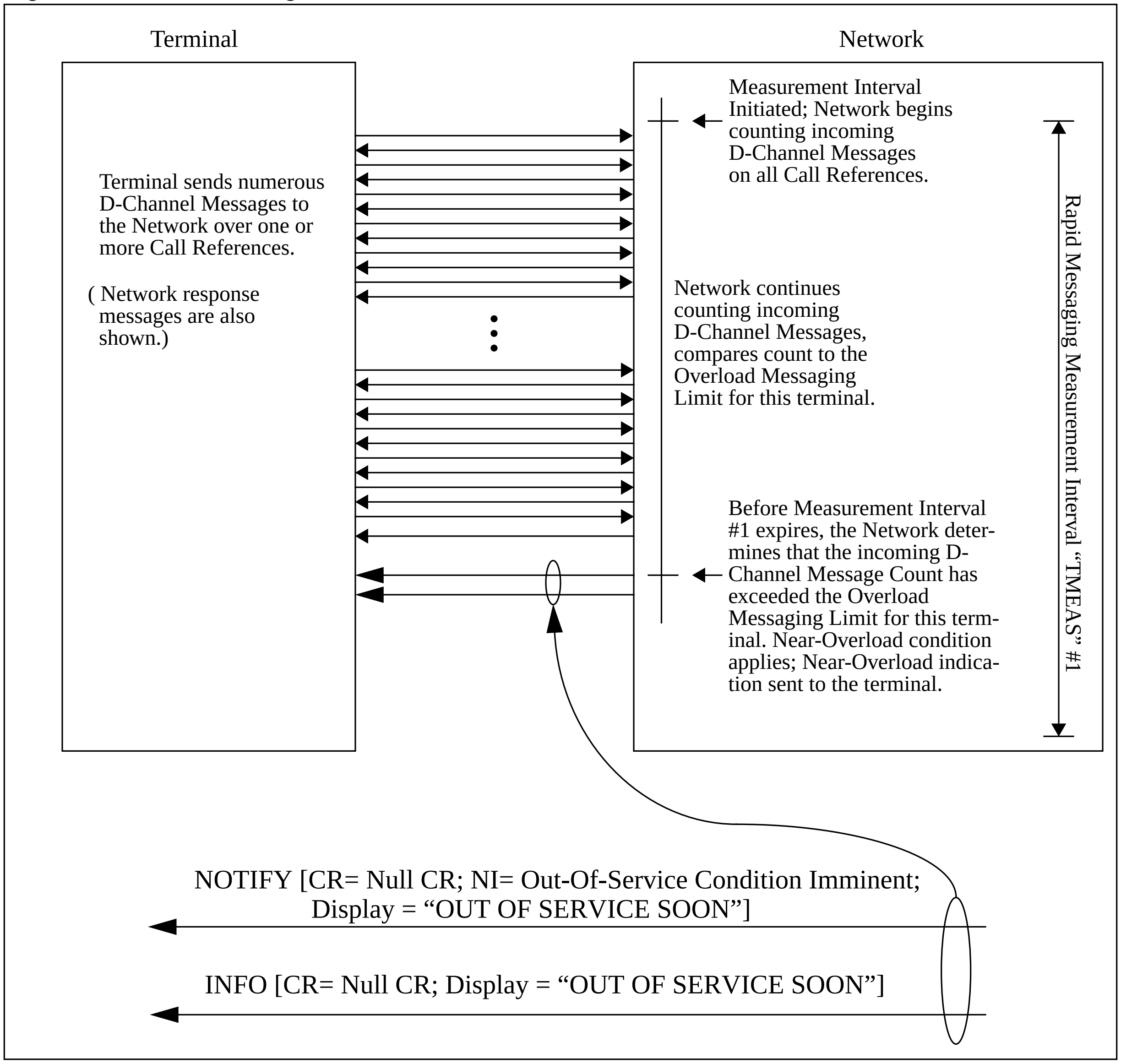
5.10.2 Procedures

The Rapid Messaging feature applies to all NI-2 terminals and NI-1 terminals using Protocol Version Control Issue 2 (PVC2) that are not provisioned or subscribed as exempt.

5.10.2.1 Near Overload

The sequence of events that cause a terminal to be placed in the “Near-Overload” condition is illustrated in Figure 28, “Events causing Near-Overload condition”.

Figure 28 Events causing Near-Overload condition



When the network detects that the terminal has entered the Near-Overload condition, it responds with:

- A NOTIFY message with a null call reference containing
  - — A Notification Indicator information element containing an ASN.1-encoded Notification Indicator value of “Out-Of-Service Condition Imminent”
  - — A Display Text information element containing a Display Tag value of “Notification Indicator” and a Display Text value of “OUT OF SERVICE SOON”.
- An INFOrmation message with a null call reference containing
  - — A Display Text information element containing a Display Tag value of “Status” and a Display Text value of “OUT OF SERVICE SOON”.

Note: The DMS-100 sends the INFOrmation message after the NOTIFY message because some NI-1 and NI-2 terminals do not respond as expected to the receipt of the Display Text information element in a NOTIFY message.

The terminal recognizes the Notification Indicator information element coded to “Out-Of-Service Condition Imminent” as an indication that

- — it has reached a Near-Overload condition
- — it may soon reach an Overload condition if it continues to send D-Channel Messages to the network at its current rate.

On receiving the “Out-of-Service Condition Imminent” NI IE, a terminal should reduce the rate of its D-Channel Messages to the network for at least ninety seconds, the length of the TMEAS interval.

5.10.2.2 Overload

5.10.2.2.1 Near-Overload and Overload in different measurement intervals

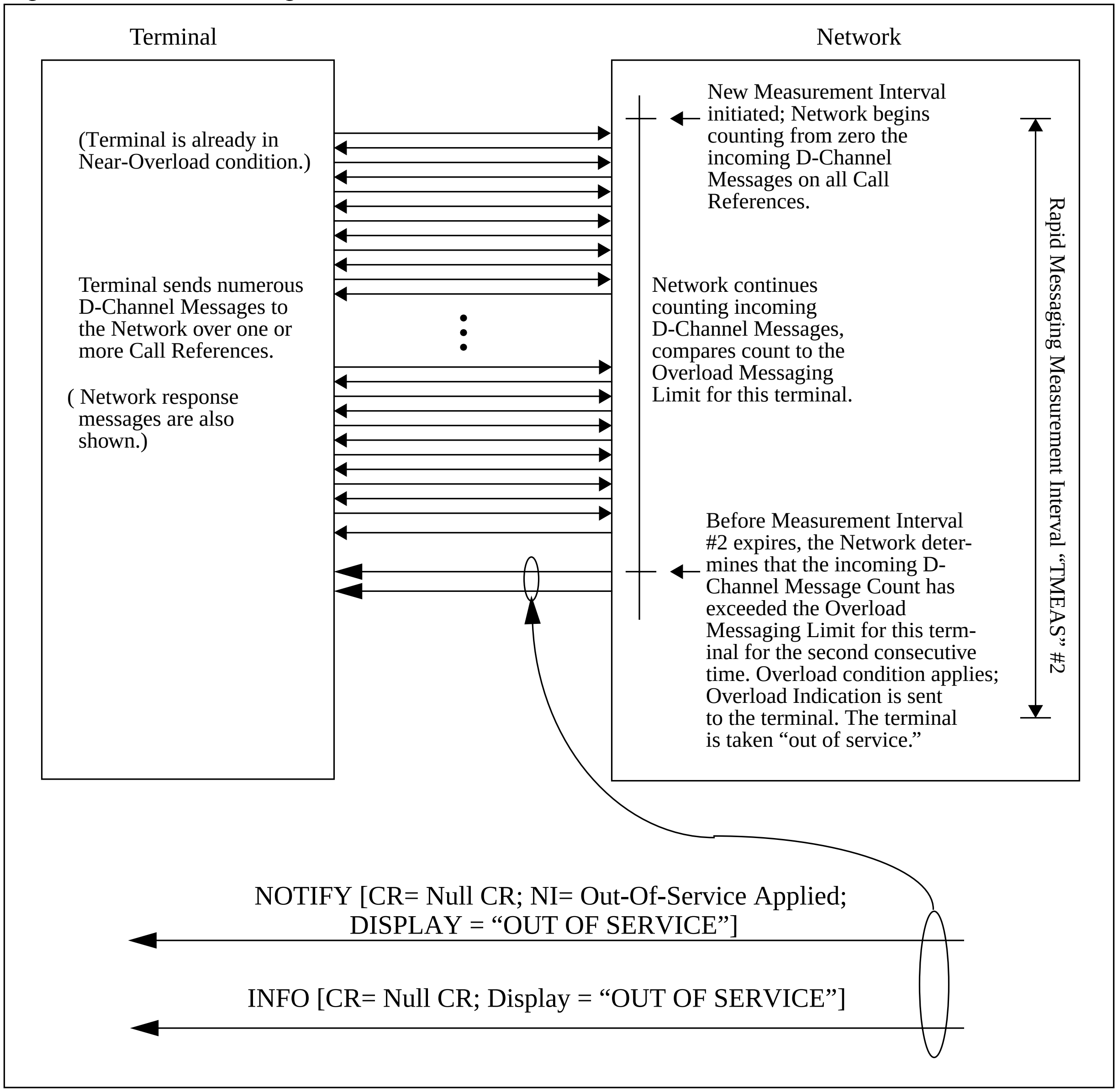
In most cases, the Overload condition will occur in the measurement interval immediately after the measurement interval when the Near-Overload condition occurred. This will happen under the following circumstances:

The terminal sends a high number of messages to the DMS during one measurement interval. This high number exceeds the Overload Messaging Limit value for that terminal and causes a Near-Overload condition in that first measurement interval.

The terminal then continues sending a high number of messages to the network during the next measurement interval. This high number again exceeds the Overload Messaging Limit for that terminal and causes an Overload condition in that second measurement interval.

This set of events is illustrated in Figure 29, "Events causing Overload condition". It immediately follows the set of events illustrated in Figure 28, "Events causing Near-Overload condition"; that is, the Rapid Messaging Measurement Intervals are consecutive.

Figure 29 Events causing Overload condition



When the network detects that the terminal has entered the Overload condition, it responds with:

- A NOTIFY message with a null call reference containing
  - — a Notification Indicator information element containing an ASN.1-encoded Notification Indicator value of "Out-Of-Service Condition Applied"
  - — a Display Text information element containing a Display Tag value of "Notification Indicator" and a Display Text value of "OUT OF SERVICE".
- An INFOrmation message with a null call reference containing
  - — A Display Text information element containing a Display Tag value of "Status" and a Display Text value of "OUT OF SERVICE".

the terminal recognizes the Notification Indicator information element coded to “Out-Of-Service Condition Applied” as an indication that

— it has reached an Overload condition
— it has been taken Out-of-Service by the Rapid Messaging feature.

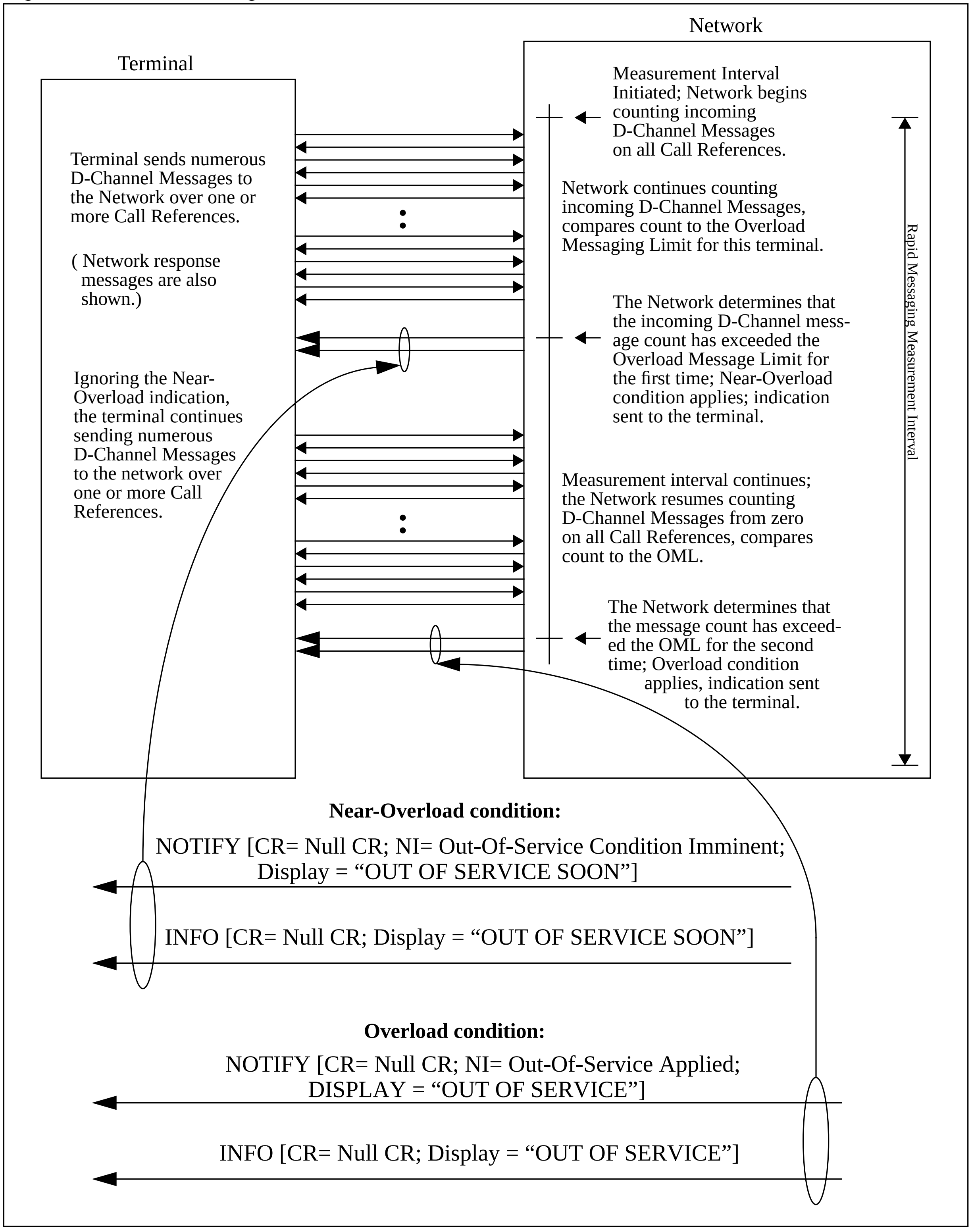
On receiving the “Out-of-Service Condition Applied” NI IE, a terminal should cease sending its D-Channel Messages to the network for at least ninety seconds.

5.10.2.2.2 Near-Overload and Overload conditions in the same measurement interval

It is also possible to have both the Near-Overload condition and the Overload condition occur in the same measurement interval. This will occur if the terminal continues sending messages to the DMS during the measurement interval when the Near Overload condition occurs (that is, after the Near-Overload NOTIFY message is sent) and then exceeds its Overload Messaging Limit again before that measurement interval ends.

The sequence of events causing the Rapid Message feature to place a terminal in a Near-Overload condition and an Overload condition in the same measurement interval is illustrated in Figure 30, "Events causing Near-Overload and Overload in the same measurement interval," on page 333.

Figure 30 Events causing Near-Overload and Overload in the same measurement interval



5.10.2.2.3 Overload/Out-of-Service messaging

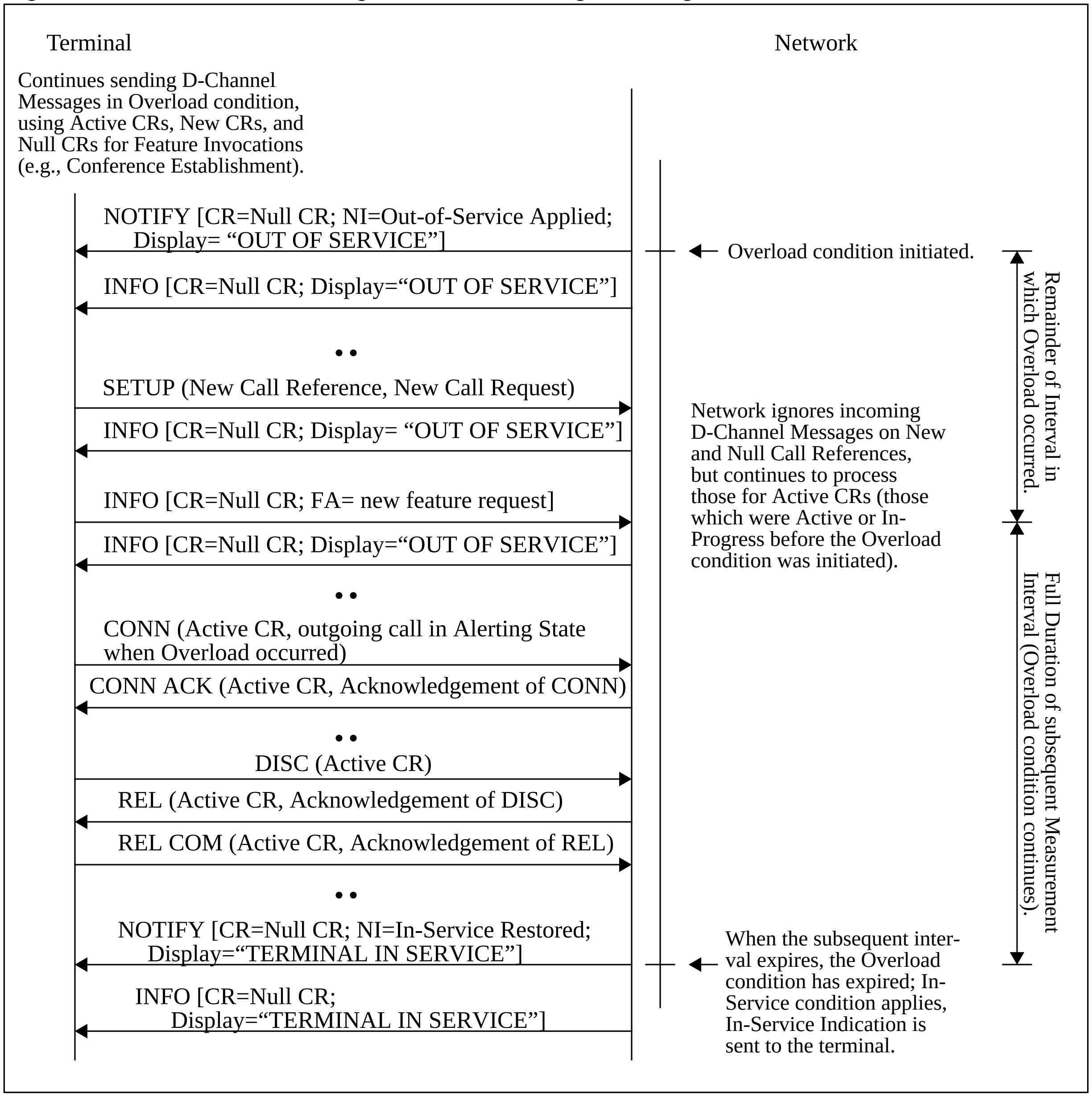
Rapid Messaging controls do not interfere with calls made prior to the imposition of the controls. Active circuit-mode and packet-mode calls in the Active state are not affected by the controls, neither are the normal call clearing messages for those calls.

However, if the terminal sends a user-to-network SETUP or null call reference INFOrmation message to the network while it is in an Overload/Out-Of-Service condition, the network will respond to the terminal with an INFOrmation message reminding the terminal that the Overload condition still applies. This INFOrmation message will contain the following

- A Call Reference information element containing a null call reference,
- A Display Text information element containing a Display Tag value of “Status” and a Display Text value of “OUT OF SERVICE”.

Treatment of incoming D-Channel messages on active, new, and null call references during an Overload/Out-of-Service condition is illustrated in Figure 31, "Treatment of incoming D-Channel Messages during Overload/Out-of-Service condition".

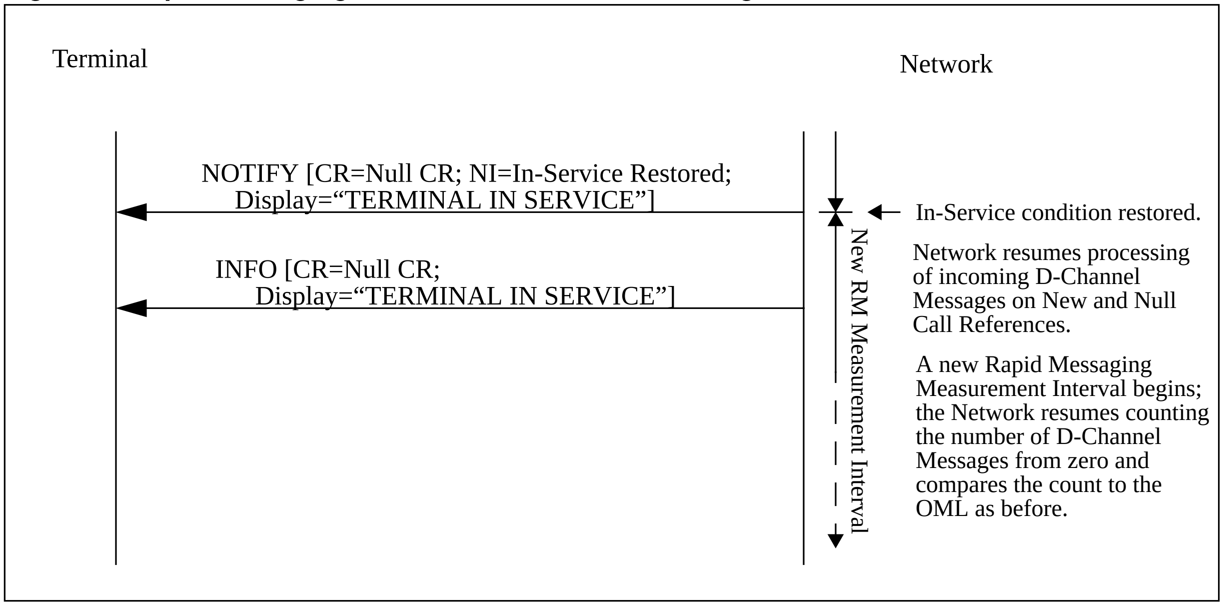
Figure 31 Treatment of incoming D-Channel Messages during Overload/Out-of-Service condition



5.10.2.3 In Service

Full processing of incoming D-Channel messages is resumed when the Rapid Messaging In-Service condition is restored. The message sequence for the return to the In Service condition is illustrated in Figure 32, "Rapid Messaging In-Service condition after being Out-of-Service".

Figure 32 Rapid Messaging In-Service condition after being Out-of-Service



When the network restores a terminal to In-Service condition, it sends the terminal:

- A NOTIFY message with a null call reference
  - — A Notification Indicator information element containing an ASN.1-encoded Notification Indicator value of "Terminal Restored to In-Service Condition"
  - — A Display Text information element containing a Display Tag value of "Notification Indicator" and a Display Text value of "TERMINAL IN SERVICE".
- An INFOrmation message with a null call reference containing
  - — A Display Text information element containing a Display Tag value of "Status" and a Display Text value of "TERMINAL IN SERVICE".

The terminal recognizes the Notification Indicator information element coded to "Terminal Restored to In-Service Condition" as an indication that

- — it has been removed from the Overload condition
- — it is being placed back In-Service by the Rapid Messaging feature.

The terminal may now resume sending D-Channel messages to the network (if it has any D-Channel messages to send).

5.10.2.3.1 Feature Key Updates for In-Service Conditions

The network also provides each terminal returned to service with an update on the status of individual feature keys associated with that terminal after the Rapid Messaging "In Service" condition has been restored.

For additional information about the feature indicator refresh, see Section 6.9, "Feature Indicator Lamp Refresh".

5.10.2.4 Permanent Out of Service

The network maintains a running count, reset at the start of each half hour, of the “out-of-service” conditions imposed on each terminal subject to Rapid Messaging. Usually a terminal is “out-of-service” for only a short period of time, typically spanning one to two minutes, before the network returns the terminal to service. However, if the number of these “temporary” out-of-service reaches ten per half hour period, the network will not return the terminal to “in-service”. The terminal will remain “out-of-service” indefinitely. This “permanent out-of-service” condition can only be reset manually by the ISDN service provider.

5.10.2.5 ASN.1-Encoded Notification Indicator Values

The previous procedures identified cases where Notification Indicators are sent to ISDN BRI terminals to indicate the following three Rapid Messaging conditions:

- Out-Of-Service Condition Imminent
- Out-Of-Service Condition Applied
- Terminal Restored to In-Service Condition

The DMS-100 encodes these three Notification Indicator values using the “Discriminator for extension to ASN.1-encoded component” value in the “Notification description” field in the Notification Indicator information element in the NOTIFY message. The “ASN.1 Encoded Data Structure” field in the Notification Indicator information element with the ASN.1 Encoded Data Structure is coded as shown in Figure 33, "ASN.1 Encoded Data Structure for Rapid Messaging". A single Object Identifier value is included in this “ASN.1 Encoded Data Structure” field, depending on which of the above three Rapid Messaging Notification Indicator values is to be delivered.

Figure 33 ASN.1 Encoded Data Structure for Rapid Messaging

```
-- begin Rapid Messaging Notification Indicators ASN.1 definition
Rapid Messaging Notification Indicators
DEFINITIONS::=
BEGIN
IMPORTS NOTIFICATION, FROM Notification-Indicator-IE-Data-Structure
{ccitt Recommendation q 932 notification-data-structure (6)}
Out-Of-ServiceConditionImminent::= NOTIFICATION
Out-Of-ServiceConditionApplied::= NOTIFICATION
TerminalRestoredtoIn-ServiceCondition::= NOTIFICATION
out-Of-ServiceConditionImminent Out-Of-ServiceConditionImminent::=
{1 3 17 102 4 1}
-- notification value is an object identifier in number form which represents: ISO (1),
-- identified organization (3), Bellcore (17), ISDN-supplementary-services (102),
-- Rapid Messaging (4), Out-of-Service Condition Imminent (1)
out-Of-ServiceConditionApplied Out-Of-ServiceConditionApplied::=
{1 3 17 102 4 2}
-- notification value is an object identifier in number form which represents: ISO (1),
-- identified organization (3), Bellcore (17), ISDN-supplementary-services (102),
-- Rapid Messaging (4), Out-of-Service Condition Applied (2)
terminalRestoredtoIn-ServiceCondition TerminalRestoredtoIn-ServiceCondition::=
{1 3 17 102 4 3}
-- notification value is an object identifier in number form which represents: ISO (1),
-- identified organization (3), Bellcore (17), ISDN-supplementary-services (102),
-- Rapid Messaging (4), Terminal Restored to In-Service Condition (3)
END
```

5.10.2.6 Applications to FITs and NITs

The Rapid Messaging feature applies to both Fully Initializing Terminals (FITs) and Non-Initializing Terminals (NITs). For interfaces with only FITs or a single NIT, Rapid Messaging operation for NITs is slightly different from Rapid Messaging operation for multiple NITs.

There is a single Overload Message Limit associated with the TSP of each terminal. Thus, for configurations with only FITs and/or a single NIT, an individual Overload Message Limit is associated with each terminal. Rapid Messaging controls are also applied and removed on a per-terminal basis as described in this section.

However, in the case where there are multiple NITs on an interface, there is still only one Overload Message Limit associated with the default TSP associated with the NITs. Thus, incoming D-Channel messages from all of the individual NITs are added together for comparison to the Overload Message Limit. The network then compares this cumulative counter value to the OML value for the TSP and applies Near-Overload and Overload treatments to all of the NITs on the interface when the cumulative counter exceeds the OML value.

This means that all of the NITs on a default TSP will be jointly taken “Rapid Messaging Out-Of-Service” during an Overload condition. It also means that all of the NITs on an interface are jointly restored to “Rapid Messaging In-Service” at the end of the Overload condition, and that all of them are jointly warned about the potential of an Overload during a Near-Overload condition.

5.10.3 Feature Interactions and Limitations

The Rapid Messaging feature applies to all NI-2 terminals and NI-1 terminals using Protocol Version Control Issue 2 (PVC2) that are not provisioned or subscribed as exempt.

5.11 Remote operations service

This section provides background on Remote Operations, based on the following CCITT Blue Book (1988) Recommendations:

- Q.932 Generic Procedures for the Control of ISDN Supplementary Services
- X.208 Specification of Abstract Syntax Notation One (ASN.1)
- X.209 Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)
- X.219 Remote Operations: Model, Notation and Service Definition
- X.229 Remote Operations: Protocol Specification

While this ISDN specification (primarily Chapters 4, 5, and 8) contains all the information needed to implement services provided with Remote Operations, refer to the above CCITT recommendations for further background information on this topic.

5.12 Remote Operations Service Element (ROSE)

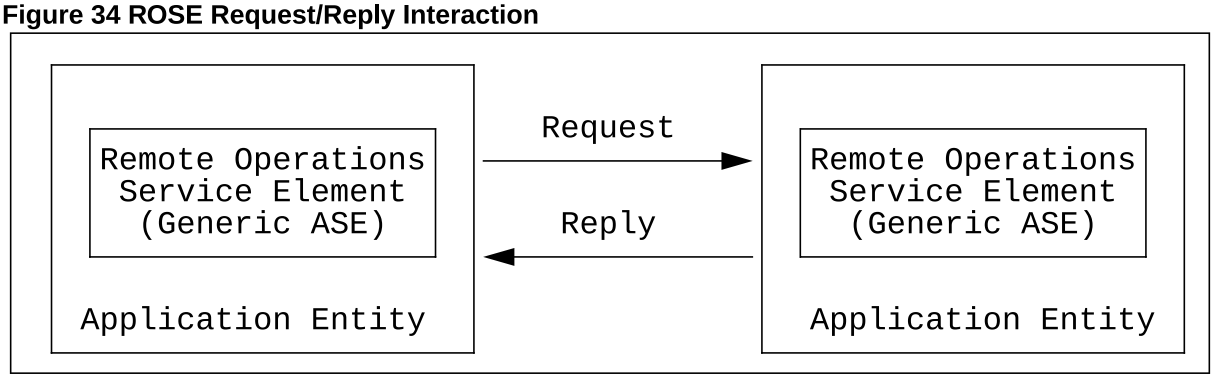
5.12.1 General

This section provides an overview of the Remote Operations service, notation, and protocol defined in X.219/X.229 that is supported by this specification.

5.12.1.1 The Remote Operation model

The Remote Operation service supports an interactive communication between two Application Processes, and can be modeled as a request/reply interaction between the two Application Entities (AE). The Application Entities represent the functionality responsible for providing open communication between Application Processes. The Remote Operations Service Element represents that part of the functionality which provides the open communication for a request/reply interaction (see Figure 34, “ROSE Request/Reply Interaction”).

Figure 34 ROSE Request/Reply Interaction



Operations invoked by one AE, the invoker, are performed by the other AE, the performer. Operations may be classified according to whether the performer of an operation is expected to report its outcome:

- in case of success or failure (a result reply is returned if the operation is successful, and error reply if the operation is unsuccessful);

- in case of failure only (no reply is returned if the operation is successful, and error reply if the operation is unsuccessful);
- in case of success only (a result reply is returned if the operation is successful, and no reply if the operation is unsuccessful)
- not at all (neither a result nor an error reply is returned, whether the operation was successful or not).

Operations may also be classified according to two possible operation modes:

1 synchronous, in which the invoker requires a reply from the performer before invoking another operation

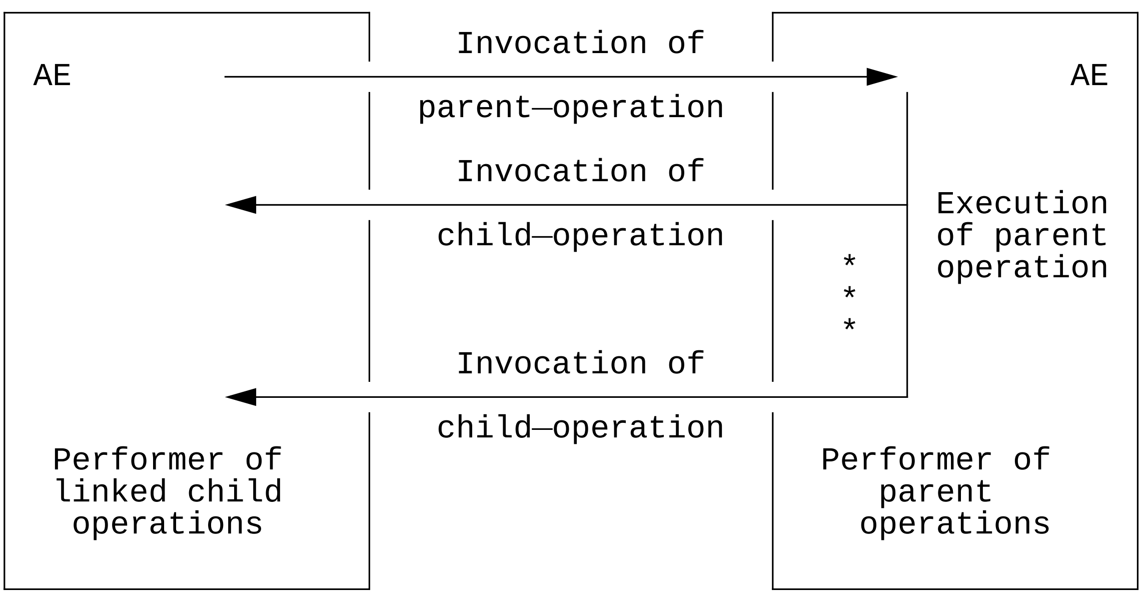
2 asynchronous, in which the invoker may continue to invoke further operations without waiting for a reply.

The Operation Classes are:

- Operation Class 1: Synchronous, reporting success or failure (result or error)
- Operation Class 2: Asynchronous, reporting success or failure (result or error)
- Operation Class 3: Asynchronous, reporting failure (error) only, if any
- Operation Class 4: Asynchronous, reporting success (result) only
- Operation Class 5: Asynchronous, outcome not reported.

In some cases it is useful to group operations into a set of linked-operations performed by a parent-operation and one or more child-operations, as in Figure 35, "ROSE linked operation".

Figure 35 ROSE linked operation



- The performer of the parent-operation may invoke none, one, or more child-operations during the execution of the parent-operation.
- The invoker of the parent-operation is the performer of the child-operations.
- A child-operation may be a parent-operation of another set of linked-operations in a recursive manner.

Remote Operations service defines a set of components used to communicate between entities. They are:

- Invoke - used to start both parent-operations and child-operations
- Return result - used to report successful outcomes
- Return error - used to report failures
- Reject - used to report errors not operation specific, such as unknown operation.

5.13 Remote Operations macros

This specification uses the macro format, as described in X.219, to define service operations which use Remote Operation procedures. The remainder of this section provides the notation (ASN.1) and encoding rules (transfer syntax) for each data type, relating the macro descriptions to actual component encodings. Section 5.5.5.13, “Facility information element”, describes the structure of each tpe of RO component.

5.13.1 Macro notation

The five classes of Remote Operations (see Section 5.12.1.1, “The Remote Operation model”) are defined using the following operation and error macro notations. These are based on the definitions found in X.219.

ARGUMENT, RESULT, and PARAMETER types in operation and error macros can be mandatory or optional. An optional type is indicated by OPTIONAL. A mandatory type having a default value is indicated by DEFAULT followed by a value.

5.13.1.1 Operation macro notation

Figure 36 Operation macro notation

```
operationname OPERATION
               ARGUMENT   ArgumentType | empty
               RESULT     ResultType | empty
               ERRORS     {ErrorList} | empty
               LINKED     {LinkedOpList} | empty
               ::= operationvalue
```

OPERATION, ARGUMENT, RESULT, ERRORS, and LINKED are keywords used to structure operation macros.

- operationname - the label of the operation macro, to be identified in the Invoke component using the operationvalue

- ArgumentType - the label of the argument data type, is operation specific and used in the Invoke component. It is defined, when required, on a per operation basis using ASN.1.
- ResultType - the label of the result data type, is operation specific, and used in the Return result component. It is defined, when required, on a per operation basis using ASN.1.
- ErrorList - a list of errorname labels, each of which is defined using the error macro notation and labeled with an errorname, as discussed in Section 5.13.1.2, "Error macro notation".
- LinkedOpList - a list of operationname labels, each of which is defined using this operation macro notation.

5.13.1.2 Error macro notation

Figure 37 Error macro notation

```
errorname       ERROR
                PARAMETER ParameterType  | empty
                ::= errorvalue
```

ERROR and PARAMETER are keywords used to structure error macros.

- errorname - the label of the error macro, identified in the error component using the 'errorvalue'
- ParameterType - the label of the parameter data type, used in the Return error component and is error specific. It is defined, when required, on a per error basis using ASN.1.

5.13.2 Class 1 and 2 operations

Class 1 and 2 operations are those always requiring a response, whether the operation succeeded or failed. Class 1 operations are synchronous and Class 2 operations are asynchronous. Note that there may be an argument included in the operation.

Figure 38 Class 1 and 2 operation

```
operationExample 12 OPERATION
                   ARGUMENT   ArgType12
                   RESULT     ResultType12
                   ERRORS     {error1,error2}
                   ::= 9

error1              ERROR
                   PARAMETER ParameterType1
                   ::= 1

error2              ERROR
                   ::= 2
```

In the above example:

- the operation name is "operationExample12"

- the operation value, coded as an integer in an Invoke component, is 9
- the argument is defined by the type “ArgType12”.

If the operation is successful, success is reported in a Return result component. The Return result component has a mandatory parameter, defined in this example by the type “ResultType12”.

In this example, if the operation fails, there are two possible error responses:

- “error1”, has value 1 and has one parameter, “ParameterType1”
- “error2”, has value 2 and has no parameter.

  The error result is returned in a Return error component.

5.13.3 Class 3 operation

Class 3 operations are those requiring a response only when the operation fails. They are not currently used in this specification, so the following example is presented here for informational purposes only.

Figure 39 Class 3 operation example

```
operationExample3  OPERATION
                  ARGUMENT   ArgType3
                  ERRORS     {error1,error2}
                  ::= 10
```

5.13.4 Class 4 operation

Class 4 operations are those requiring a response only when the operation succeeds. They are not currently used in this specification, so the following example is presented here for informational purposes only.

Figure 40 Class 4 operation example

```
operationExample4  OPERATION
                  ARGUMENT   ArgType4
                  RESULT     ResultType4
                  ::= 11
```

5.13.5 Class 5 operation

Class 5 operations are those requiring no response. There is a mandatory argument, ArgumentType5.

Figure 41 Class 5 operation example

```
operationExample51  OPERATION
                   ARGUMENT   ArgumentType5
                   ::= 17
```

In the above example, the operation name is “operationExample51” and the operation value, coded as an integer in an Invoke component, is 17. There is an argument associated with this operation, further defined by the type “ArgumentType5”.

5.13.6 Linked operation

Figure 42, “Linked operation”, shows how linked operations are defined in the macro notation. The parent-operation, “parentop12”, has one child-operation, “operationExample51”.

Figure 42 Linked operation

```
parentop12   OPERATION
            ARGUMENT   ArgumentType12
            RESULT     ResultType12
            ERRORS     {error1,error2}
            LINKED     {operationExample51}
            ::= 12
```

5.14 Abstract Syntax Notation One (ASN.1)

ASN.1 is a formal notation for specifying the data types and values used in an application layer protocol, such as Remote Operations. ASN.1 can be used to describe the data types and values associated with the generic components (see X.229 Section 9), and those associated with a specific service through the use of macros. The entire ASN.1 specification is not repeated, only those relevant to understanding the service definitions given here, described with ASN.1.

5.14.1 Data types

Data Types defined in the operation macros (for example, ArgumentType5, and ResultType12 in the operation examples) are defined following the main operation definition, using the general format shown in Figure 43, “Data types”.

Figure 43 Data types

```
DataTypeLabel::= PredefinedValue    | TaggedValue
```

- The left side of the definition symbol “::=” is the label of the Data Type being defined.
- The right side is the Data Type definition, either a pre-defined or a tagged value.
- Pre-defined values belong to the Universal class, and use the tags defined in X.208.
- Table 163, “Universal Tagged Types”, lists the pre-defined values currently used in this specification.
- Tagged values belong to the Application, Context, and Private classes and are defined in this specification. The tag is not used for pre-defined values (for example, INTEGER).

The tag is composed of a class and an integer, enclosed in brackets “[]” (for example, [PRIVATE 1]). The classes that can be specified are UNIVERSAL, APPLICATION, and PRIVATE. If the class is omitted it defaults to Context (for example [5]). In this specification, pre-defined values are specified using keywords, shown in the left column of Table 163, “Universal Tagged Types”.

Table 163 Universal Tagged Types

Pre-defined Value	Tag (ASN.1)	Tag (binary)							
		8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
Integer	Universal 2	0	0	0	0	0	0	1	0
Octet string	Universal 4	0	0	0	0	0	1	0	0
Enumerated	Universal 10	0	0	0	0	1	0	1	0
Sequence	Universal 16	0	0	1	1	0	0	0	0
Sequence of	Universal 16	0	0	1	1	0	0	0	0
Set	Universal 17	0	0	1	1	0	0	0	1
Set of	Universal 17	0	0	1	1	0	0	0	1
IA5 string	Universal 22	0	0	0	1	0	1	1	0

Note: All the tag types are in the universal class (bits 8, 7 = 00). The sequence and set tags are constructors (bit 6 = 0); the rest are primitives.

- If the term IMPLICIT is used between the tag and the value in the type definition, the type tag is a constructor, or a primitive, depending on the base encoding of the value.
- The base encoding of a constructor is tag, length, contents.
- The base encoding of a primitive is contents (no tag or length).
- If IMPLICIT is not used, the tag is a constructor, and the full base encoding of the value is used (that is, tag, length, and contents).

To illustrate the coding rules for translating between ASN.1 and data element octets, examples for coding the IA5String “Jones” are shown for each type in Table 164, "Coding of Example ASN.1 Types”.

Table 164 Coding of Example ASN.1 Types

Type1 ::= IA5String
Type2 ::= [APPLICATION 3] IMPLICIT Type1
Type3 ::= [2] Type2
Type4 ::= [APPLICATION 7] IMPLICIT Type3
Type5 ::= [2] IMPLICIT Type2

	Tag	Length	Contents
Type1	16	05	4A6F6E6573
Type2	43	05	4A6F6E6573
Type3	A2	07	TAG=43 LEN=05 C=4A6F6E6573
Type4	67	07	TAG=43 LEN=05 C=4A6F6E6573
Type5	82	05	4A6F6E6573

Note: The ultimate contents of eachtype is the string “Jones”, but the structure of te data elements differs, as shown. The octet contents are displayed in hexadecimal.

An explanation of how each type is coded follows.

1 Type1 is a Universal class primitive for the IA5String “Jones”.

2 The tag for Type2 is Application class, code 3. The tag and length for Type1 are not used since the value is implicit. Only the assigned tag distinguishes Type2 from Type1.

3 The tag for Type3 is Context class, code 2. Since te value of Type3 is explicit, its contents are the entirety of Type2 (tag, length, contents). The explicit value results in Type3 being a constructor.

4 The tag for Type4 is Application class, code 7. The tag and length of Type3 are not used since the value is implicit. The contents of Type3, and now the contents of Type4, is Type2. Since Type3 is therefore explicit in Type2, Type4 is a constructor.

5 The tag for Type5 is Context class, code2. The tag and length for Type2 are not used since the value is implicit. The contents of Type2 is the IA5String “Jones”, which is now the contents of Type5. Type5 is a primitive.

5.14.1.1 Integer

- An INTEGER type is a primitive having as its contents, one or more octets, representing a twos-complement binary number.
- If the contents are longer than one octet, the number is interpreted, with descending bit significance, from bits 8 through 1 of octet 1, bits 8 through 1 of octet 2, and so on, up to and including the last octet.
- The bits in the first octet and bit 8 of the second octet are not to be either all 1’s or 0’s; the integer is to be encoded in the smallest possible number of octets.

5.14.1.2 Octet String

An OCTET STRING type is a primitive which has as its contents a string of zero or more octets. The interpretation of the octets is at the discretion of the application.

5.14.1.3 Enumerated

An ENUMERATED type is a primitive which has as its contents an integer value associated with one of the defined range of allowed values. Figure 44, “Enumerated primitive” is an example of an ENUMERATED type in ASN.1.

Figure 44 Enumerated primitive

```
WeekDays::= {monday (0), tuesday (1), wednesday (2),
                thursday (3), friday (4)}
```

- When the defined type, WeekDays, is present in a component, it contains the integer associated with the selected weekday for that transaction.
- An integer value other than one associated with a name is not valid.
- The list within the braces “{ }” contains one or more items separated by commas.
- Each item consists of a name followed by an integer value within parentheses “( )”.

5.14.1.4 Sequence

A SEQUENCE type is a constructor having as its contents one of each of a sequence of types. The order of the types in the sequence must follow the order defined in the structure. Figure 45, “Sequence constructor” is an example of a SEQUENCE type in ASN.1.

Figure 45 Sequence constructor

```
Stype1::= SEQUENCE {name IA5String,
                      age  INTEGER     OPTIONAL}
```

The SEQUENCE structure consists of one more types, separated by commas, and enclosed within braces “{}”. Each type in the structure can be defined either where it is or elsewhere. In the above example, the type “age” is optional. Figure 46, “Stype 1 coding”, shows the coding of an Stype1 with the name “Jones” and age 30.

Figure 46 Stype 1 coding

	Tag	Length	Contents
Stype1	16	0A	
Name	22	05	4A6F6E6573
Age	02	01	1E

Note: All values are in base-16 (hexadecimal).

5.14.1.5 Sequence of

A SEQUENCE OF type is a constructor which has as its contents a sequence of zero or more instances of a single type. The order of the instances of the type has significance to the application. Figure 47, “Sequence of type”, is an example of a SEQUENCE OF type in ASN.1:

Figure 47 Sequence of type

```
ReadingList::= SEQUENCE OF books
```

The SEQUENCE OF structure is similar to that for SEQUENCE, but it must have exactly one type. The coding for the type “ReadingList” is similar to that for Stype1, but would have zero, one, or more instances of “Books” in the sequence.

5.14.1.6 Set

A SET type is a constructor having as its contents one of each of a set of types, in any order. A SET type is identical to a SEQUENCE, type except for the lack of a rigid order for the types within the structure. Figure 48, “Set constructor”, is an example of a SET type in ASN.1

Figure 48 Set constructor

```
Stype3::= SET {name IA5String,
                 age INTEGER     OPTIONAL}
```

Figure 49, “Hexadecimal example”, is the coding of an Stype3 with the name “Jones” and age 30. All values are in base-16 (hexadecimal). Note that the order of the name and age are not the same as shown in the ASN.1 notation.

Figure 49 Hexadecimal example

	Tag	Length	Contents
SType1	17	0A	
Age	02	01	1E
Name	22	05	4A6F6E6573

5.14.1.7 Set of

A SET OF structure is a constructor having as its contents a set of zero or more instances of a single type. The order of the instances of the type is of no significance to the application. Figure 50, “Example of SET OF type”, is an example of a SET OF type in ASN.1.

Figure 50 Example of SET OF type

```
ToyBox::= SET OF toys
```

The SET OF structure is similar to that for SET, but it must have exactly one type. The coding for the type “ToyBox” is similar to that for Stype1, but would have zero, one, or more instances of “Toys” in the set.

5.14.1.8 IA5String

An IA5String type is a primitive having as its contents a string of zero or more IA5 characters. Each octet of the contents contains one binary-coded IA5 character. IA5String types are coded in a similar fashion to OCTET STRING types.

5.14.2 Choice

A CHOICE type is used when one of a set of types must be selected. The types in the CHOICE list must be made distinguishable (usually by the tag value) to allow the receiver of the type to determine which one was selected. In Figure 51, “Examples of Choice”, car and bicycle types are distinguished by their different tags.

Figure 51 Examples of Choice

```
Vehicle  ::= CHOICE {car, bicycle}

car    ::= [5] IMPLICIT IA5String

bicycle::= [8] IMPLICIT IA5String
```

The CHOICE list consists of one or more types, separated by commas, and enclosed within braces “{}”. Each type can be defined where it is in the list or elsewhere.

5.15 Transfer syntax

5.15.1 General description of component encoding rules

This section provides description of general component encoding rules, based on Q.932, Appendix III.

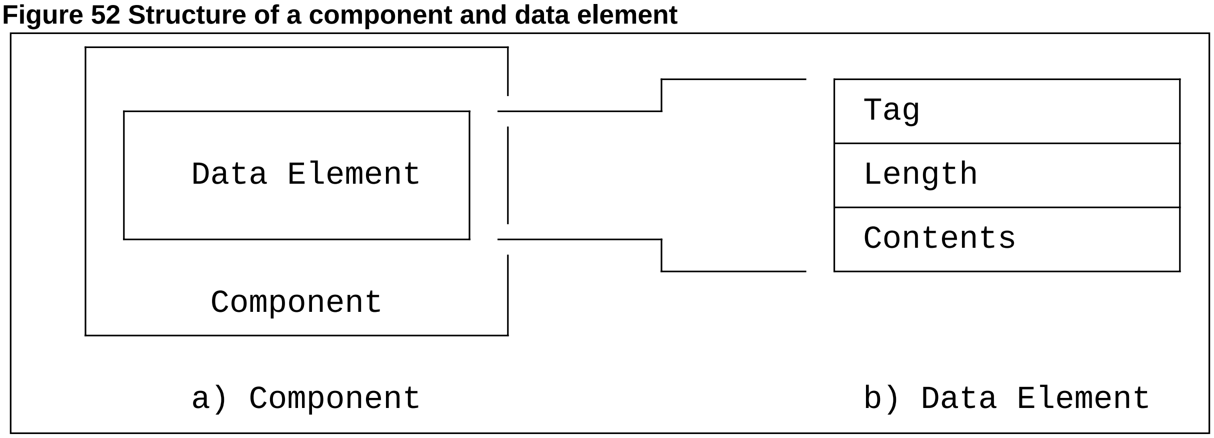
5.15.1.1 General component structure

A component consists of data elements, each of which has the same structure. A data element consists of three fields, always appearing in the following order.

- The tag distinguishes one type from another and governs the interpretation of the contents.
- The length specifies the length of the contents.
- The contents is the substance of the data element, containing the primary information the data element is intended to convey.

  Figure 52, “Structure of a component and data element”, shows an overview of a component and a data element.

Figure 52 Structure of a component and data element



Each field is coded using one or more octets. Octets are labelled as shown in Figure 53, “Octet Labeling scheme”. The first octet is the first transmitted. Bits in an octet are labelled as shown in Figure 54, “Bit Labeling scheme”, with bit 1 the least significant and the first transmitted.

Figure 53 Octet Labeling scheme

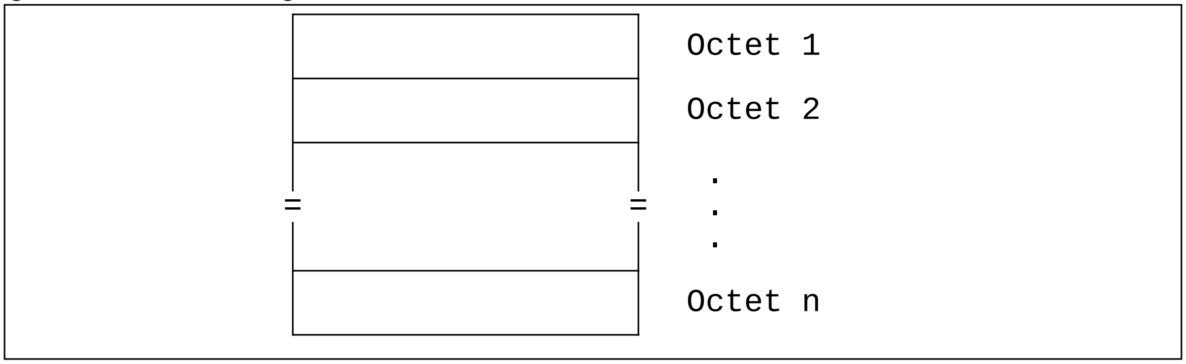
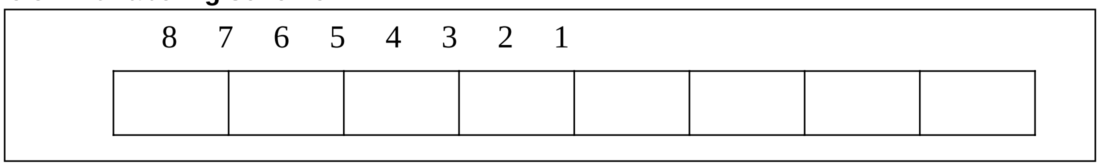
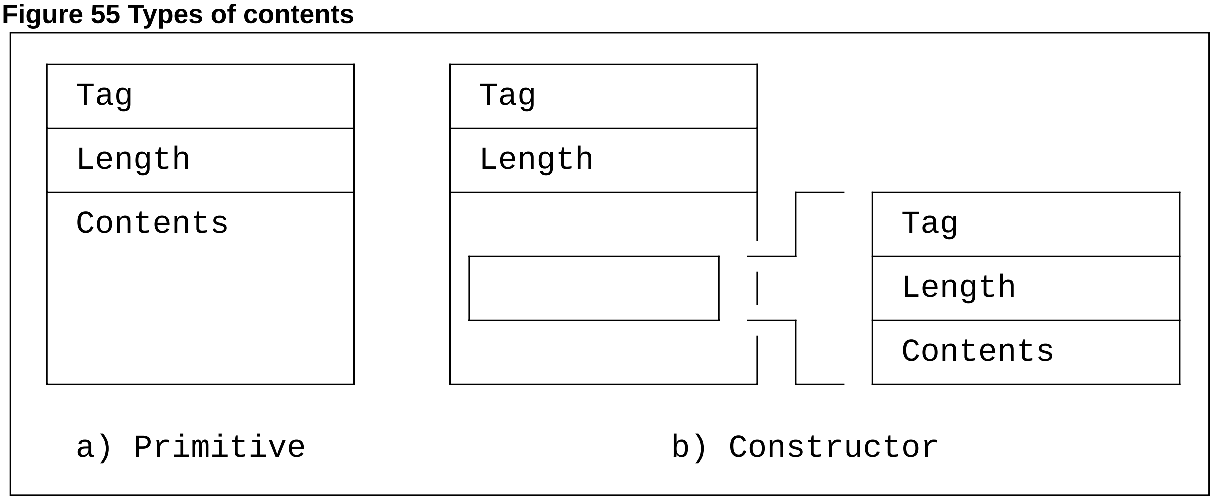


Figure 54 Bit Labeling scheme



The contents of each data element is either one value (primitive) or one or more data elements (constructor), as shown in Figure 55, “Types of contents”.

Figure 55 Types of contents



5.15.1.2 Tag

A data element is first interpreted according to its position within the syntax of the messages. The tag, one or more octets long, distinguishes one data element from another and governs the interpretation of the contents. The tag is composed of “class”, “form”, and “tag code”, as shown in Figure 56, “Format of tag”.

Figure 56 Format of tag

8	7	6	5	4	3	2	1
Class		Form	Tag Code (*)				

(*): The tag code may be extended to the following octets

5.15.1.2.1 Tag class

All tags use the two most significant bits (8 and 7) to indicate the tag class. These bits are coded as shown in Table 165, “Coding of tag class”.

Table 165 Coding of tag class

Bits		**Class**
8	**7**	
0	0	Universal
0	1	Application wide
1	0	Context specific
1	1	Private

- The Universal class is used for tags exclusively standardized in Recommendation X.209 and are application independent types. Universal tags may be used anywhere a Universal data element type is used. The Universal class applies across all CCITT Recommendations, that is, across Recommendation Q.932 Facility IEs, CCITT Signaling System No 7 ASEs (Application Service Elements), X.400 MHS (Message Handling System), X.500 Directory Services, and so forth
- The Application-wide class is used for data elements that are standardized across all applications (ASEs) using CCITT Q.932 Facility information element procedures
- The Context-specific class is used for data elements specified within the context of the next higher construction, and take into account the sequence of other data elements within the same construction. This class may be used for tags in a construction, and the tags may be re-used in any other construction
- The Private class is reserved for data elements specific to a nation, network, or private user, and apply across all applications.

5.15.1.2.2 Form of the data element

Bit 6 is used to indicate whether the data element is “primitive” or a “constructor”, as shown in Table 166, "Coding of element form”.

- A primitive element’s structure is atomic, that is, one value only
- A constructor element’s content is one or more data elements which may themselves be constructor elements.

Both forms of elements are shown in Figure 55, “Types of contents”.

Table 166 Coding of element form

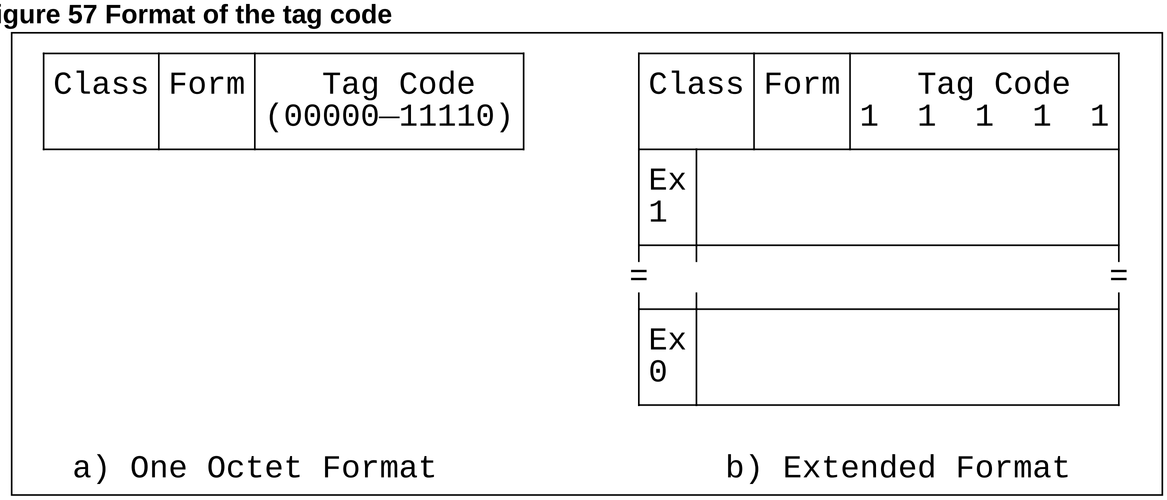
Coding (bit 6)	Element form
0	Primitive
1	Constructor

5.15.1.2.3 Tag code

Bits 1 to 5 of the first octet of the tag, plus any extension octets, represent a tag code that distinguishes one element type from another of the same class. Tag codes in the range 00000 to 11110 (0 to 30 decimal) are provided in one octet.

The extension mechanism is to code bits 1-5 of the first octet as 11111. Bit 8 of the following octet serves as an extension indication. If bit 8 of the extension octet is set to 0, no further octets for this tag are used. If it is set to 1, the following octet is also used for extension of the tag code. The resultant tag consists of bits 1-7 of each extension octet with bit 7 of the first extension octet being most significant, and bit 1 of the last extension octet being least significant. Tag code 31 (decimal) is encoded as 001 1111 in bits 7 to 1 of a single extension octet. Higher tag codes continue from this point using the minimum possible number of extension octets.

Figure 57 Format of the tag code



5.15.1.3 Length of the contents

- The length of the contents is coded to indicate the number of octets in the contents.
- The length does not include the tag nor the length of the length octets.
- The length of the contents uses the short or long form.
- If the length is less than 128 octets, the short form is used.
  - In the short form, bit 8 is coded 0, and the length is encoded as a binary number using bits 1 to 7.
- If the length of the contents is greater than 127 octets, use the long form of the length of the contents.
  - The long form length is 2-127 octets long.
  - Bit 8 of the first octet is coded 1, and bits 1 to 7 of the first octet encode a number one less than the size of the length in octets as an unsigned binary number whose MSB is bit 8 of the second octet, and whose LSB is bit 1 of the last octet. This binary number should be encoded in the fewest possible octets, with no leading octets having the value 0.

Table 86, "Format of the length field (short form)”, and Table 88, "Component Type tags,” on page 204, show the formats of the length field described above. The maximum value that may be encoded is constrained by Q.931 message size limitations.

Chapter 6: Supplementary Services

6.1 Introduction to Supplementary Services

This chapter describes an extensive range of supplementary services including services described for National ISDN. Services not described by National ISDN follow the National ISDN Generic procedures as described by TR-847 and CCITT Recommendation Q.932. This philosophy of using generic procedures allows terminal equipment to access additional services using the common procedures.

The information is provided primarily to assist terminal designers. Since not all terminals are expected to implement all of the features described in this chapter, terminals are required to comply only with the procedures for the features they support.

This chapter contains the service definition and signaling procedures (where applicable) required to support access to network based supplementary services provided by DMS-100. These procedures apply in a functional call control environment and define the required exchange of messages across the user-network interface. The messages and information elements are specified in Chapter 5: "Functional Call Control Signaling".

- All descriptions of feature activation/deactivation and procedures are based on the Abstract Terminal defined in Section 6.3, “Abstract Terminal”.
- The notation “FI = x, y” represents a Feature Indication information element, with feature identification number x, and status indicator pattern y, where x = 1 - 64 and y is as described in Section 5.5.5.15, “Feature Indication information element”. The status indicator codepoints and associated meaning are summarized in Section 6.3.4.1.3, “Indicator states”.
- The notation “FA = z” represents a Feature Activation (FA) information element, with feature identification number z, where z = 1 - 64, as described in Section 5.5.5.14, “Feature Activation information element”
- The notation “SIG = alert patn x” represents a Signal information element with alerting pattern x, as described in Section 5.5.5.30, “Signal information element”.

6.2 Call reference rules

The phrase “call associated services” is defined as services that act upon, or relate to, an existing call (as defined by the existence of an active call reference in the case of a functional call).

When the Feature activation information element is sent in the INFOrmation, the following rules apply:

- If the service is call associated, the active call reference must be used if the service is associated with a functional call.
- If no active call reference exists, (for example, when programming the Call Forward number), use the null call reference.

If an INFOrmation with a Feature Indication information element is received, specifying a non-null call reference not related to any existing functional call, the terminal discards the INFOrmation received from the network.

6.3 Abstract Terminal

The concept of an Abstract Terminal is introduced in order to support differing levels of functionality found in various implementations of ISDN terminals.

The user's terminal communicates with the network through the Abstract Terminal interface. Since the network has only one view of the terminal, and in reality there can be different types of physical terminals, the concept of an Abstract Terminal is useful in bridging the capabilities of the terminal and the network. The Abstract Terminal is the network's view of the real terminal. The network interacts only with the Abstract Terminal and not with the real terminal. The network and Abstract Terminal communicate using the messaging defined in this document. The functionality of the real terminal must be able to map onto that of the Abstract Terminal.

The Abstract Terminal is a collection of logical components. Conceptually, it is part of the user-network interface. It is the primary vehicle through which a terminal and the DMS-100 interact.

6.3.1 Components of basic Abstract Terminal

There are four logical components to the basic Abstract Terminal:

- Functional Call Management (FCM)
- Functional Feature Management (FFM)
- Feature Key Management (FKM)
- Functional Terminal Management (FTM)

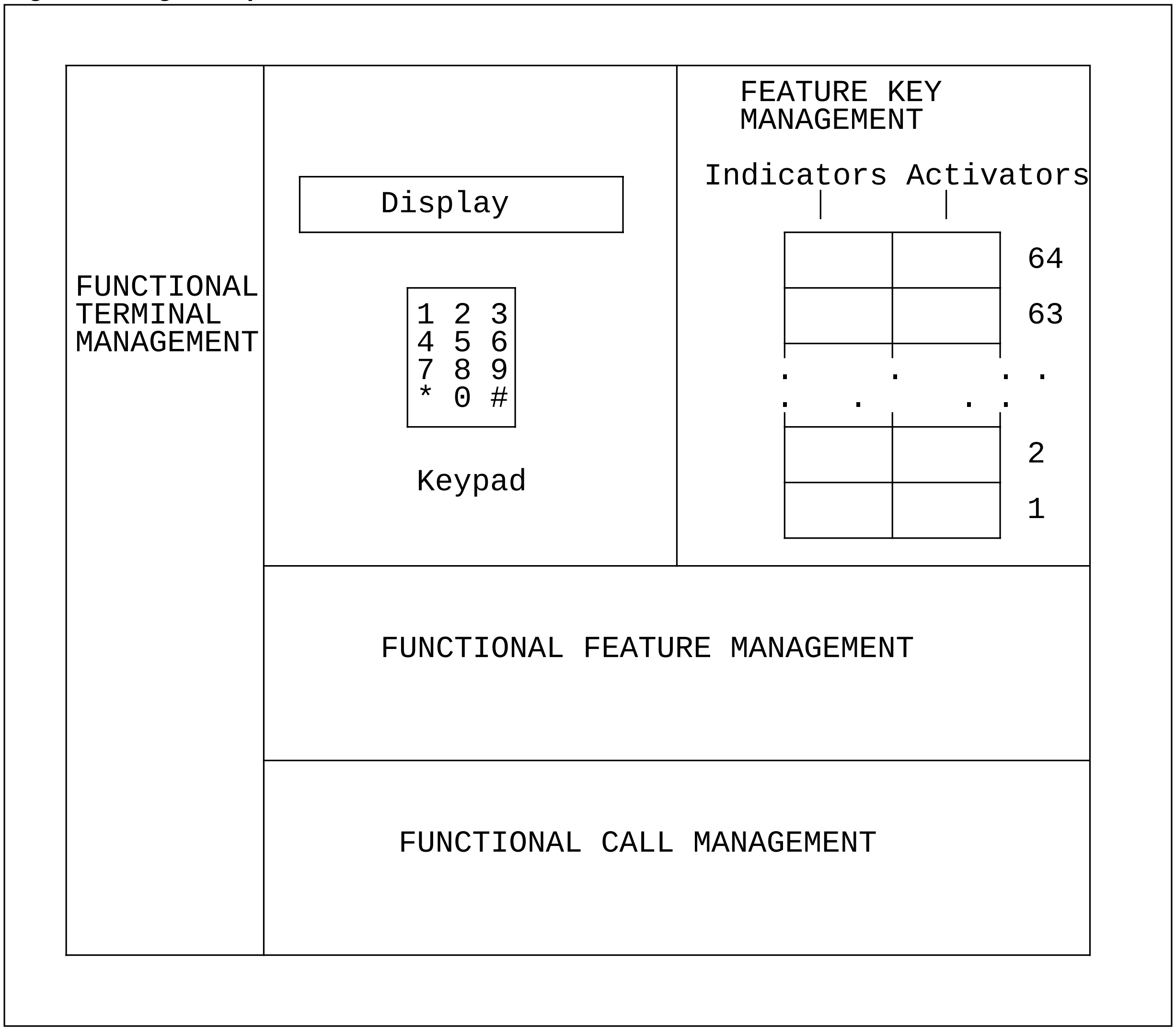
Terminals must implement at least FCM to support basic calling.

- Functional Call Management - the FCM handles all basic functional signaling call control requirements. It includes Abstract Terminal logical resources such as DNs, B-channels, call references, and bearer capabilities, and uses both the display and keypad on the Abstract Terminal. FCM is CCITT, T1, and GR-268 compatible, and is a crucial component of Nortel's ISDN BRI implementation to facilitate terminal portability among switch interfaces built to these standards.

- Functional Feature Management - the FFM handles supplementary service signaling features, such as Hold/Retrieve, ACO, and EKTS, that modify the basic call control process.
- Feature Key Management - the FKM handles all supplementary services using activators and indicators that transfer information between the switch and terminal, but do not directly change the basic call control process, such as Speed Calling, Call Pickup and so forth.
- Functional Terminal Management - the FTM interacts with the network to maintain the service data of the other three logical components of the Abstract Terminal, such as the assignment of a specific feature to a particular FA key of the FKM component.

The following subsections define the logical components in the Abstract Terminal. Refer to Figure 58, “Logical representation of the Abstract Terminal”, for a pictorial view of the Abstract Terminal concept.

Figure 58 Logical representation of the Abstract Terminal



6.3.2 Functional Call Management component

The following logical components are required for basic functional signaling control:

- Directory Number (DN)
- Call Reference (CR)
- Bearer Capabilities (BCs)
- Address information elements

6.3.2.1 Directory Numbers

The Abstract Terminal has DNs it uses when terminating or originating a call. A terminal is only associated with a DN when it originates an outgoing call or when it is awarded an incoming call by answering it.

6.3.2.2 Call References

The Abstract Terminal has a number of call references it may use when establishing a call or activating a feature. A terminal is associated with a call reference either when it originates an outgoing call or responds to an incoming call. A null call reference is used for invocation of supplementary services only. Refer to Section 5.5.3, “Call Reference information element”, for more information.

6.3.2.3 Bearer Capabilities

The Abstract Terminal can support a number of bearer capabilities. For a particular call instance, a terminal is associated with only one of these bearer capabilities. Refer to Section 5.5.5.2, “Bearer Capability information element”, for more information.

6.3.2.3.1 Call Type Provisioning on a DN basis

On one B-channel terminals, provisioning of call types on a DN basis is not supported; call type provisioning is only allowed on a terminal basis. For 2B-channel terminals, call type provisioning is provided on a DN basis.

Two B-channel terminals continue to support the assignment of multiple DNs. Each of these DNs may subscribe to the Voiceband Information (VI) call type, the Circuit-Mode Data (CMD) call type, the Packet-Mode Data (PMD) call type (using D-channel packet only), or any combination of the three.

The introduction of call type provisioning does not effect the provisioning of any current features.

6.3.2.4 Address information elements

The Abstract Terminal supports address information elements that may be delivered in call control messages. Chapter 5 defines the procedures and coding of these information elements.

There are six address related information elements of interest:

- Called Party Number (CDN) - identifies the destination of the call to the calling party. Examples of encoding of called party number are shown in Section 5.5.5.4, “Called Party Number information element”.

- Calling Party Number (CGN) - identifies the origin of a call to the called party. The terminal user normally uses this information to recognize the caller.
- Connected Number (CN) - indicates the number to which the call is connected. It is sent from the network to both the calling and called terminals, to indicate the address of the actual connected party. It may be different from the calling or called party number(s) because of changes (for example, call re-direction) during the lifetime of the call.
- Redirecting Number (RGN) - identifies the number from which call redirection/ diversion was invoked. An example of this is Call Forward, where the re-directing number is the terminal that activated the feature.
- Redirection Number (RNN) - identifies the number to which call redirection/ diversion will be or has been invoked. For Call Forwarding, the re-direction number is the terminal address to which the calls were forwarded.

6.3.2.5 B-channels

The Abstract Terminal knows nothing about physical input/output devices such as the headset, handset, speaker or hands-free unit. Instead, it has entities known as B-channels that represent bi-directional communication channels between the terminal and the network. The Abstract Terminal makes no restriction on what input/output devices the physical terminal implements.

B-channels are dynamically assigned to terminals on an interface. A terminal is only allocated a B-channel when it originates an outgoing call, or when it is awarded an incoming call by answering it. When a terminal is idle, it is not associated with any B-channel.

6.3.2.6 Keypad

The keypad consists of 12 keys, as on the existing push button telephone: 0-9, # and *. There are three primary functions for the keypad.

1 Send terminating address information in Overlap or En bloc sending mode during call origination.

2 Send feature access code to access supplementary services.

3 Send additional information pertaining to feature activation.

The keypad on the Abstract Terminal can also be used to generate (locally) DTMF end-to-end signaling through the B-channel.

6.3.2.6.1 Digit sending

The procedures for digit sending are described in Section 6.10, “Generic procedures for supplementary service access”.

6.3.3 Functional Feature Management (FFM) component

FFM handles supplementary service signaling features, that modify the basic call control process, such as Hold/Retrieve, ACO and EKTS.

The Additional Functional Calls (AFCs) feature is the DMS-100 feature which allows provisioning of a Call Reference Busy Limit (CRBL) greater than one for a DN. To set a CRBL of 5, provision the AFC feature against a DN.

For NI-2 terminals, CRBL is provisioned explicitly using the CRBL parameter and is done on a DN/CT basis.

ISDN calls terminating to an AFC appearance use the bearer capabilities subscribed against the DN for screening purposes. These calls are offered, provided the bearer capability of the terminating call is compatible with the DN.

6.3.4 Feature Key Management component (FKM)

FKM handles all supplementary services using activators and indicators that transfer information between the switch and terminal, but do not directly change the basic call control process.

6.3.4.1 Activators and indicators

6.3.4.1.1 Activators

FKM features are activated using feature activators (FA). An FA is mapped into a Feature activation information element, containing a feature identification number (that is, feature key number). The Feature activation information element may be carried in an INFOrmation or an appropriate Q.931 message sent by the user to the network.

The following limitations apply:

- The Abstract Terminal supports a maximum of 64 activators.
- Activator number 1 is reserved, and as such may not be defined as a feature activator.
- Activators are defined at subscription time.
- A Release activator is recommended for programming purposes.

6.3.4.1.2 Indicators

Indicators are abstract equivalents of lamps, LCDs or other display devices used on key system terminals. They are sent by the network to the user to update features.

The following limitations apply:

- For every activator, there is a corresponding indicator.
- Only one feature may be assigned to a particular activator/indicator pair, even if the feature does not require both an activator and indicator (that is, no mixed usage of activator/indicator by features).
- The Abstract Terminal supports a maximum of 64 indicators to correspond to the 64 activators.

Indicator status information is conveyed using the Feature indication information element carried in INFOrmation, or appropriate Q.931 messages sent by the network to the user. These information elements contain a feature identification number, and a status indicator, as described in Section 5.5.5.15, “Feature Indication information element”. Additional information concerning indicator refresh is presented in Section 6.9, “Feature Indicator Lamp Refresh”.

6.3.4.1.3 Indicator states

There are four feature indicator states defined for the Abstract Terminal. They are shown in the following table:

Table 167 Abstract Terminal indicator states

States	Feature Indicator corresponding to a Feature Appearance
0	Deactive or idle
1	Active
2	Prompt
3	Pending

Note: This document's information is not intended to constrain the terminal vendors to a specified human-machine interface. The CPE may choose to indicate the states in whatever manner is most consistent with other human-machine considerations on the terminal.

The meanings of the feature indicator states vary depending on the particular feature.

6.3.4.1.4 Fixed feature keys on Non-Initializing terminals

The DMS-100 supports NITs that support FKM (as per the requirements in SR-4288). The feature identifiers are assignable to the default TSP. The DMS-100 supports the following features, and feature identifier values:

- 63 = Message Waiting Indicator
- 62 = Drop
- 61 = Transfer
- 60 = Conference Size of 3
- 57 = Call Forwarding Variable (main DN/voice)

6.3.4.1.5 Directory Number (DN) appearances

For each DN assigned to a particular logical terminal, a number of feature activators/indicators are reserved (that is, they cannot be used for FKM-based access to supplementary services). In cases where "n" simultaneous calls (identified by "n" call references) are allowed, a corresponding set of "n" feature activators/indicator pairs are reserved.

Terminal vendors may wish to represent the appearance of calls using real feature keys and lamps, corresponding to the reserved activator/indicator pairs. As an example, a terminal may subscribe to two DNs with five simultaneous calls allowed on each DN. In this case the switch reserves ten activators, (for example, FA = 1 - 10). The terminal in this case could represent the appearance of calls using key/lamp pairs 1 - 10, while pairs 11 - 64 (corresponding to activator/indicator pairs 11 - 64) can be used for supplementary services.

While this is a convenient approach, terminals are by no means constrained to this human-machine interface.

6.3.4.2 Display

The Abstract Terminal provides a means to display the following information elements received from the network:

- Calling party number
- Called party number
- Connected number
- Redirecting number
- Redirection number

The information is delivered as information elements in the call control messages. The Abstract Terminal also provides display of Name/Reason, using the Display Text information element, as described in Section 6.56, “Display procedures”. Name/Reason display follows the generic procedure described in Section 6.22, “G11 - Call-Related notification of feature information”.

6.3.4.2.1 Usage of Display and Address elements

While it is desirable to support basic terminals with the widest possible variety of features, CPE vendors may want to build more sophisticated terminals. One of the most visible ways of increasing the visible sophistication (in the user's eyes) is through the use of displays and/or graphics to show information about the call(s). This information could include the Called party number, CPN, Connected number, Redirecting number, Redirection number, and NAME/Reason, as well as other locally provided services such as Call Timing and Call by Name (Directory Dialing).

6.3.4.3 Keypad

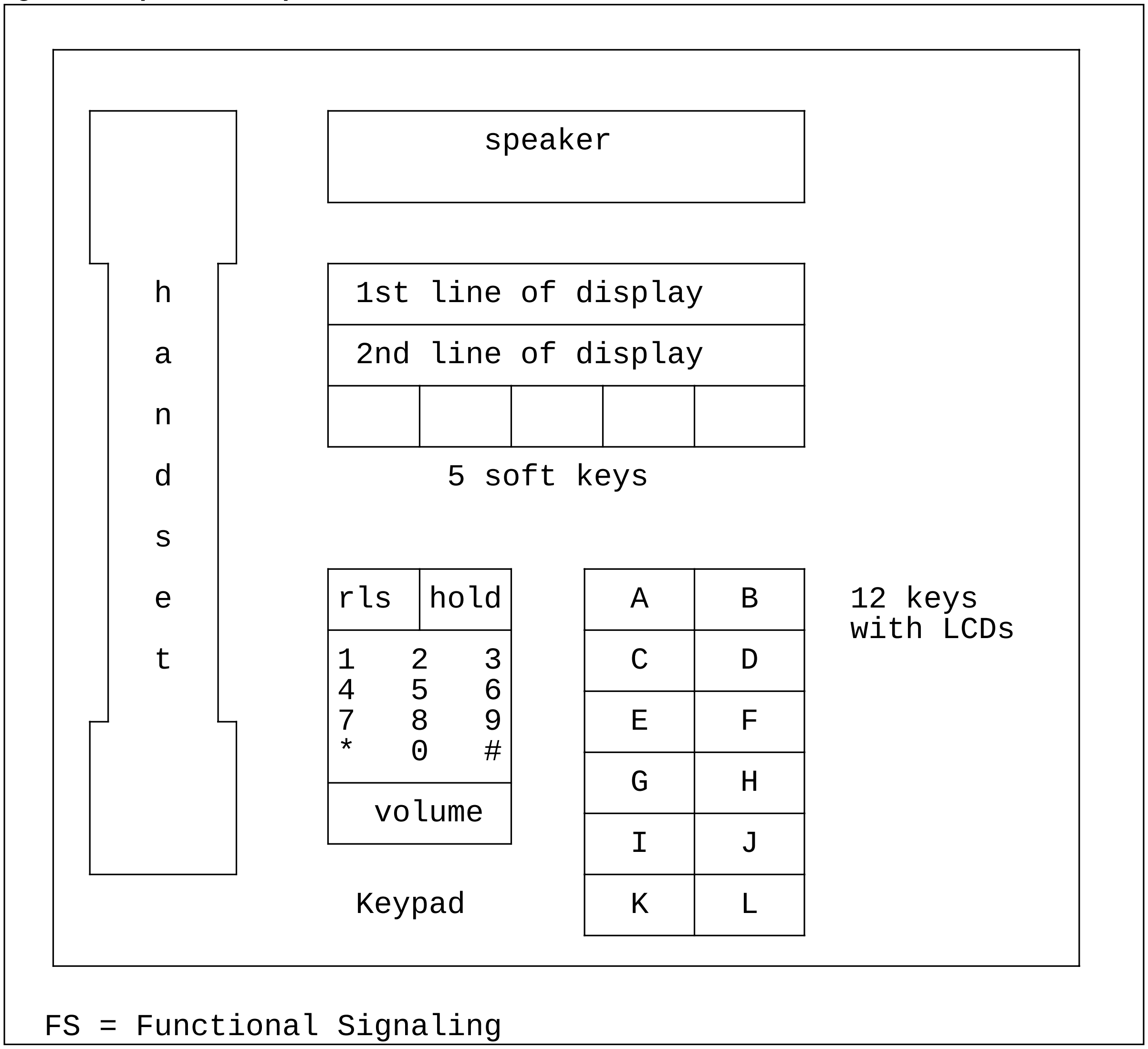
The FKM component also makes use of the keypad for sending additional information pertaining to feature activation.

Additional information (such as authorization codes, call forwarding address), may be sent by the terminal to the network by En bloc or Overlap sending. Section 6.10, “Generic procedures for supplementary service access”, describes En bloc and Overlap sending procedures.

6.4 Mapping physical terminal to Abstract Terminal

Figure 59, “A potential implementation of the Abstract Terminal”, illustrates how to implement it on a physical device equipped with five softkeys. Note the difference in appearance between this terminal and the Abstract Terminal. There are only 12 hard keys where A - B could be DNs, C-J keys map to FA/FIs (opposed to the 64 keys on the Abstract Terminal), and K-L map to specific functions. In addition this terminal has five softkeys and a speaker, that the Abstract Terminal does not have.

Figure 59 A potential implementation of the Abstract Terminal



- DNs are mapped onto keys A and B.
- The first eight feature activators and feature indicators of the Abstract Terminal map directly onto the hardkeys C-J.
- Specific functional messages are mapped onto hardkeys K and L. These keys could be used for the “HOLD and RETRIEVE” service.
- Softkeys are identified by the corresponding label on the second line of the display, referred to as the screen. The labels automatically change during call processing when progress indicator states change.

In this example, the user goes offhook and selects an idle DN (A) to establish a connection. The terminal sends a SETUP to the network, and the call proceeds in accordance to the procedures specified in Chapter 5.

6.5 Functional terminal management component

This component interacts with the network to maintain the service data associated with the other three logical components of the Abstract Terminal. For example, this component maintains the assignment of a specific feature, such as Ring Again, to a particular FA key of the FKM component.

Currently, the only function provided by this component is to ensure the alignment of the Abstract Terminal definition between the terminal and switch. For further information, refer to the description of the Parameter Downloading capability in Chapter 9.

6.6 Definition of busy

In general, an ISDN endpoint is considered busy whenever the resources associated with it (and those needed to successfully complete the call) exist, but are not available for that call. In a PSTN network, this is indicated to the calling party by busy tone.

Also, the operation of certain supplementary services are affected when certain of these resources are busy.

6.6.1 Busy conditions

- Subscriber busy - indicated by the subscriber's terminal equipment, for example, by having all compatible terminals which could respond to the call request indicate “user busy” when offered the call
- Channel or interface busy - when no appropriate B-channel is available for the call
- Call reference busy - when all of the call references (in either direction), allowed to be active concurrently for a given DN on an ISDN interface are active (that is, the maximum number of calls subscribed to has been reached). A given DN is considered to be busy if it is call reference busy. The call reference busy limit is in addition to the interface busy limit.
- Notification busy - when all of the call references that may be used concurrently for user notification of waiting calls (as provided by ACO) for a given DN on an interface are in use. When this occurs, the given DN is considered by the switch to be busy.

6.6.2 Procedural aspects

The resource busy conditions described above significantly influence the call offering procedures, both for the basic call and for calls that involve ISDN supplementary services. The procedural aspects of call offering are outlined below:

- Assume that a call is about to be offered.
- If all of the appropriate user-network interface B-channels are busy (that is Channel Busy), and either the network does not support the offering of additional calls beyond the number of appropriate channel(s), or the maximum number of such additional calls has been reached, the network clears the call sending cause value #17 “user busy” back to the calling subscriber.
- Similarly, if the maximum number of calls supported at the given subscriber's interface(s) has been reached, the network clears the call, sending cause value #17 “user busy” back towards the calling subscriber.
- Otherwise, the network offers the call to the subscriber.

- If any compatible terminal responds “positively” to the call offering, that is, gives some indication that the call may progress toward successful completion, the normal call offering procedures follows.
- If no terminal responds positively, but one or more terminals respond “user busy”, then when the response-to-call-offering time-out occurs, the network clears the call with cause value #17, “user busy”.
- Note that since every compatible terminal must respond in some way to an incoming call offering, if no terminal responds before the above time-out occurs, the network clears the call with cause value #18, “no user responding.”

6.7 Terminal Identification Procedures

Terminal identification procedures enable the network to uniquely identify a terminal on a multi-terminal interface. These procedures, also called terminal initialization procedures, provide a layer 3 handshake between the network and terminal, to associate the terminal with a specific TSP. (For terminals that do not initialize at layer 3, see Section 6.8, “Non-Initializing Terminals”.)

6.7.1 Static or fixed terminals

For terminals that use static (or provisioned) Terminal Endpoint Identifiers, the network can always identify a terminal based on the TEI value which is assigned and associated with its service parameters at subscription time. Static TEI terminals (D-channel data-only terminals, for example) do not require additional terminal identification procedures.

6.7.2 Dynamic terminals

Dynamic TEIs are either network assigned (TEI values in the range 64 - 126), or user-assigned (values in the range 0 - 63). For terminals using dynamic TEIs, the TEI value alone is insufficient for the network to associate a particular terminal with its Terminal Service Profile. Such terminals must initialize using the procedures described in this section. The network only supports association of one terminal with a TSP.

6.7.3 After initialization

Once initialization is complete, the network can directly address a terminal by including a specific layer 3 Endpoint IDentifier information element in SETUP, KEY SETUP, or INFO message(s). Note, however, that not all SETUPs contain endpoint identifier information. Such information is only included if the SETUP is sent to a terminal that is part of an EKTS group or a member of a multi-line hunt group.

6.7.3.1 Terminal selection procedures

The protocol specification of some features require the switch to target a broadcasted SETUP at a specific terminal. To do this, the switch sends the SETUP with the appropriate Endpoint IDentifier information element, and other information elements as required.

Only the terminal addressed by the Endpoint identifier information element, and compatible with any other existing compatibility checks (bearer capability, for example), responds. The switch ignores any terminal that responds but does not satisfy the above conditions.

6.7.4 Initializing Terminal Procedures

This chapter describes the SPID initialization procedures, based on CCITT Recommendation Q.932 *Generic Procedures for the Control of ISDN Supplementary Services*, Bellcore TR-TSY-000847 *ISDN Features - Common Switching and Signaling Requirements* and Bellcore GR-2941-CORE *Automated SPID Selection*. These procedures, in addition to the information elements in Chapter 5, are required for initializing terminals.

6.7.4.1 Definitions

The following terms are used this chapter:

- terminal - the user equipment that terminates a layer 2 data link signaling connection on the D-channel.
- Service Profile Identifier (SPID) - an identifier used by a terminal in the initialization procedures.
  - A SPID uniquely identifies a terminal on an interface and is established during layer 3 initialization. The SPID is the concatenation of a TSPID and a TID.
  - The length of a SPID is from 3 to 20 characters, as defined in the SPID information element in Section 5.5.5.29, “Service Profile Identification information element”.
  - The TSPID uniquely identifies the terminal service profile (TSP) to be associated with the terminal. The TSPID may be provisioned so that it starts with the primary DN of the TSP, but this is not required.
  - The last two digits of the SPID represent a Terminal Identifier (TID). When the SPID is downloaded to the terminal - as part of autoSPID - the TID of the SPID is always set to 01. If the SPID is manually entered into the terminal, the range of values allowed for the TID is 00-62.
  - The TID portion is intended to allow more than one terminal to associate with a TSP, however the network only supports the association of one terminal to a TSP, that is, no more than one SPID may identify a particular TSP.

    A SPID is of significance at the local access interface only, that is, the identifier is not conveyed to transit or remote switches in association with a call setup or supplementary service invocation.
- Endpoint Identifier- a layer 3 information element included in either the SETUP, KEY SETUP, or INFO message(s) to indicate the User Service IDentifier (USID) and the Terminal IDentifier (TID) to identify or select a specific terminal. For a description of the Endpoint Identifier information element, refer to Section 5.5.5.11, “Endpoint Identifier information element”.
- Terminal Service profile (TSP) - a set of service or feature parameters, subscribed to by a terminal and associated with it after successful SPID initialization.

- Timer TI-T1 - the time within which the network expects a terminal to request initialization after a TEI was assigned or after initialization was requested by the network. The value of this timer is fixed at 20 seconds.

A terminal service profile, SPID, and terminal may be used interchangeably in the sense that they have a one-to-one mapping. Note, however, that terminal service profiles do not necessarily have to contain unique parameter values; that is, two terminal service profiles may have exactly the same parameter values but be associated with different terminals through different SPIDs.

6.7.4.2 SPID initialization

SPID initialization associates a terminal with a terminal service profile; the SPID is used to correlate them. Subsequent to a successful initialization request, all service requests and responses from that terminal may be interpreted and coordinated in association with the terminal service profile identified in the initialization.

SPID initialization (and reinitialization) must occur, in terms of layer 2 states (see Chapter 4) after each transition from the TEI-unassigned state to the Multiple-frame established state, and before any other layer 3 call/service requests are sent over that TEI by the terminal to the switch. The terminal should perform SPID initialization immediately after layer 2 data link establishment. SPID initialization must have been successful before the switch will accept any other layer 3 message or service request from that data link connection.

Similarly, a terminal having requested and been assigned a new TEI value (for example, after removal of a previous TEI by the switch) must undergo SPID initialization so that the switch can reinstate service.

In the case of a 2 B-channel FIT, only a single SPID is required for simultaneous circuit-mode access to both B-channels.

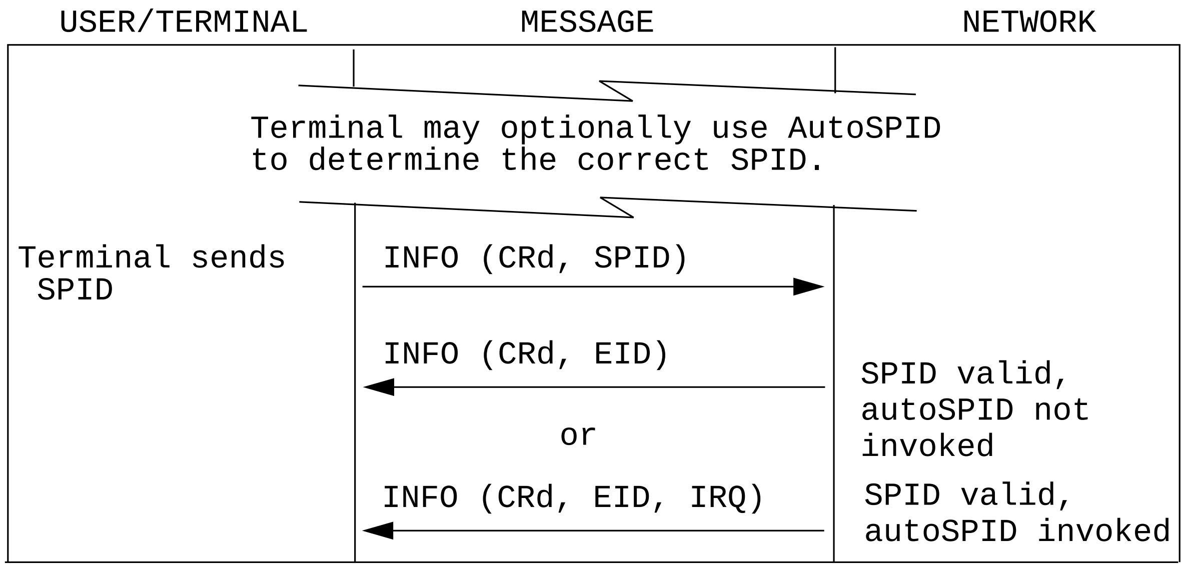
Usually the terminal requests SPID initialization; in some cases, the network may request SPID initialization. The layer 3 messages in both the terminal-requested and switch-requested initialization procedures are transmitted and received over the layer 2 data link connection whose TEI is to be associated with the appropriate service profile. SPID assignment and initialization is not required for NITs (see Section 6.8, “Non-Initializing Terminals”).

6.7.4.2.1 Terminal-requested Initialization

Terminals request initialization, as shown in Figure 60, "Terminal-requested initialization", by sending an INFO message with a null call reference (CRd) and the SPID information element containing the SPID value (as defined in Chapter 5). The terminal may choose to use AutoSPID procedures (see Section 6.7.4.3, “Automated SPID Selection”) to determine its SPID.

Figure 60 Terminal-requested initialization

Scenario: Terminal has been assigned a dynamic TEI, and established the data link layer connection for that TEI. Terminal requests initialization by transmitting its SPID parameter.



If successful (that is, the SPID is valid), the network responds with an INFO message containing the null call reference and the appropriate endpoint identifier. The response contains an IRQ if the terminal requested AutoSPID (see Section 6.7.4.3, “Automated SPID Selection”).

Terminals, on receiving the Endpoint IDentifier information element, store the identifier value.

On successful initialization, the network associates the TEI with the appropriate service profile.

A terminal may implement a timer, set to 15 seconds, on first transmission of the INFO message containing the SPID value.

- If no response is received from the network upon the first expiry of this timer, the terminal re-transmits the initialization request.
- If the network rejects the initialization attempt, or if there is no response from the network after the second expiry of the timer, the terminal repeats the request for initialization until the correct ACK comes from the switch.

6.7.4.2.2 Network-requested initialization

Under some circumstances, the network requests that a terminal initialize its SPID. This happens if the terminal had not requested initialization within a time specified by TI-T1, after assignment of a TEI, or after the first request for service from a terminal that has not previously undergone initialization and is not associated with the default TSP.

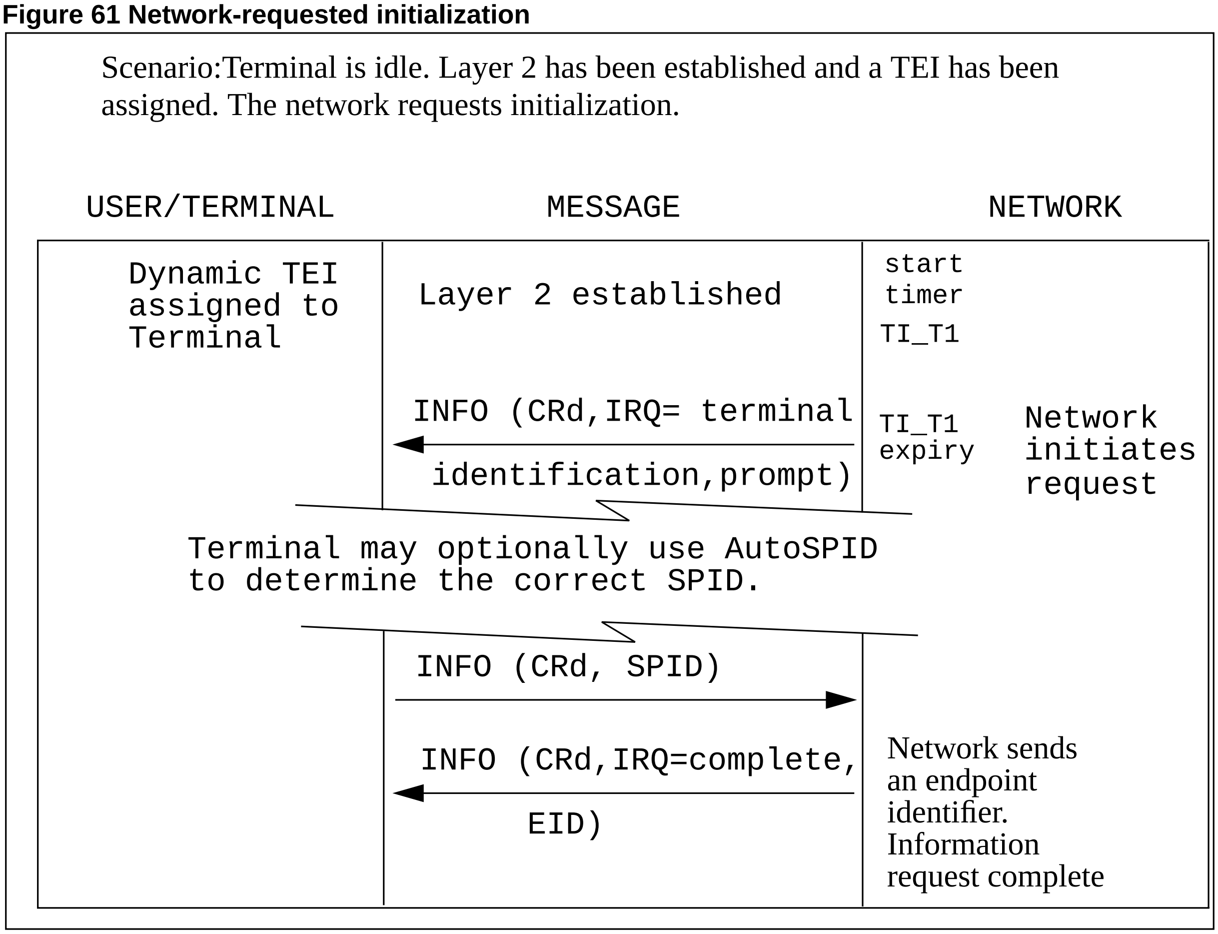
The network requests that a terminal initialize, by sending to the terminal an INFO message containing the null call reference, and an Information Request (IRQ) information element specifying “prompt” for terminal identification, with the type of information parameter coded to “terminal identification”.

Terminals must respond to this request by returning an INFO message with a null call reference and their respective SPID. The terminal may choose to use AutoSPID procedures (see Section 6.7.4.3, “Automated SPID Selection”) to determine its SPID.

The terminal response must be received prior to the expiration of the time specified for TI-T1. If a terminal does not respond correctly within the TI-T1 period, the network returns an INFO message containing a null call reference, and an IRQ information element encoded to “IRQ = complete”. However, the network will not offer the terminal any services and may remove the terminal's TEI.

If the initialization is successful, the switch returns an INFO message containing the null call reference, the Endpoint IDentifier information element, and the Information Request (IRQ) information element, indicating that initialization is complete (IRQ = complete). This is illustrated in Figure 61, “Network-requested initialization”.

Figure 61 Network-requested initialization



Terminals, on receiving the Endpoint IDentifier information element, store the identifier value. (Additional information about the EID, is available in Section 5.5.5.11, “Endpoint Identifier information element”.)

On successful initialization, the switch associates the dynamic TEI with the appropriate service profile.

6.7.4.3 Automated SPID Selection

A terminal may request AutoSPID during procedures for terminal-requested initialization (see Section 6.7.4.2.1, “Terminal-requested Initialization”) and during procedures for network-requested initialization (see Section 6.7.4.2.2, “Network-requested initialization”).

Automated SPID is enabled/disabled on a switch-wide basis.

6.7.4.3.1 Normal Flow

Terminals request autoSPID, as shown in Figure 62, "Normal Flow of Auto SPID", by sending an INFO message with a null call reference (CRd) and with the SPID Information Element encoded to the Universal SPID (value = 01010101010101).

When the network receives a valid Automated SPID request, the network returns the SPID, Primary DN, and all call types available for each TSP provisioned on the interface. This information is returned in a series of Q.931 INFO messages with the null call reference. One Q.931 INFO message is sent for each SPID on the interface, as shown in Figure 62, "Normal Flow of Auto SPID". The TID suffix in the SPID is always sent as 01 by the network.

After the last SPID is sent to the requesting terminal, the network returns another Q.931 INFO message with the IRQ IE encoded to “prompt for additional information, terminal identification” and starts timer TI_T1.

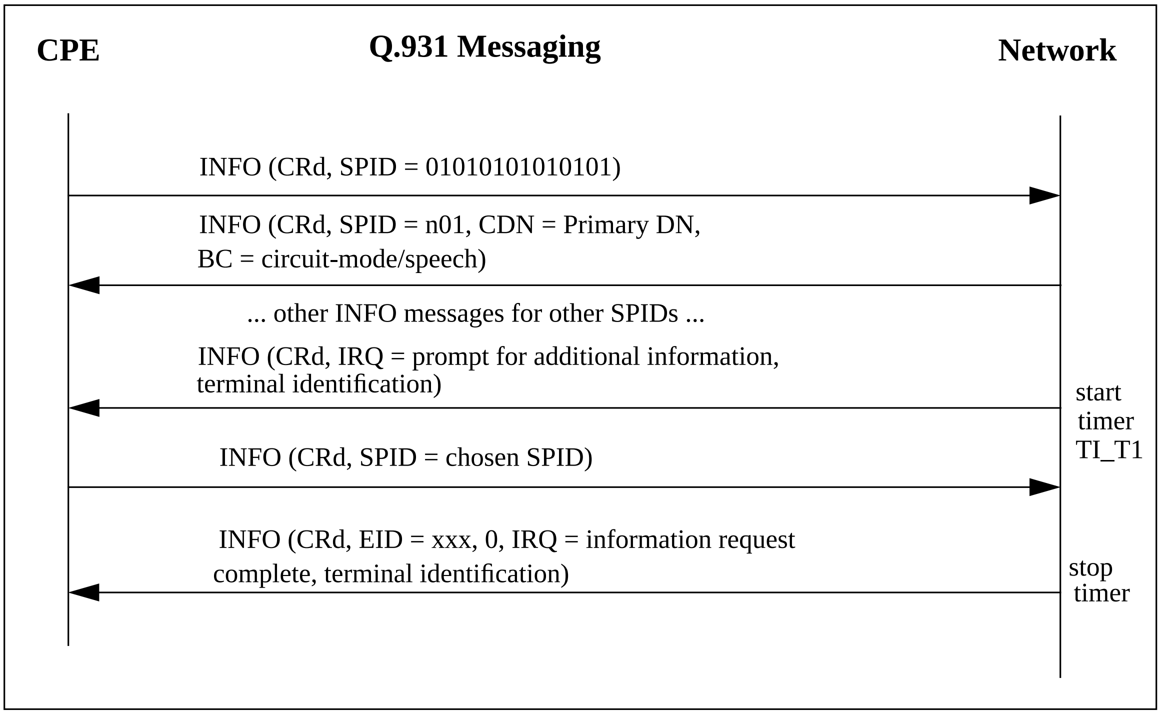
After the terminal is prompted to select a SPID, it is expected to respond with an INFO message containing the SPID it selects before the expiration of timer TI_T1.

The terminal may choose to use a different TID suffix in the SPID, instead of using the TID of 01 provided by the network.

The network responds with an INFO message containing: the IRQ information element encoded to “information request complete” and the Endpoint Identifier (EID) information element.

The process is illustrated in Figure 62, “Normal Flow of Auto SPID”.

Figure 62 Normal Flow of Auto SPID

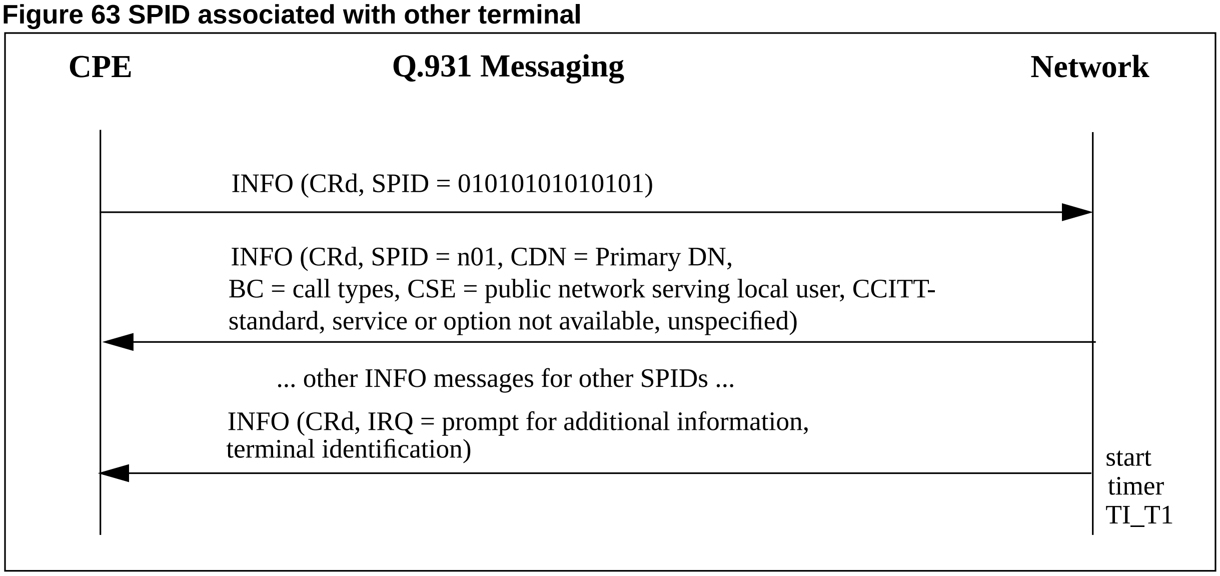


6.7.4.3.2 Normal Flow Details

SPID already associated with other terminal

If a SPID is already associated with a Terminal Endpoint Identifier (TEI) in the Multiple Frame Established (MFE) state, the network marks the SPID as unavailable by adding a Cause IE to the Q.931 INFO message, as shown in Figure 63.

Figure 63 SPID associated with other terminal



Primary DN

The network returns the ten digit primary DN for each SPID in the Called Party Number (CDN) IE. If the TSP associated with the SPID is provisioned without a Primary DN, the CDN IE is excluded from the Q.931 INFO message.

Signaling of Call Type Information

The network also returns up to three different call types associated with each TSP on the interface as shown in Figure 64. The call types are returned as multiple Bearer Capability (BC) information elements in the INFO message. The returned bearer capabilities provide the call types of all the DN's associated with a TSP.

For the purposes of determining subscription and ISDN interface parameters, bearer capabilities are categorized into three Call Types.

1 The Voice and voiceband data Information (VI) call type refers to the speech and/or 3.1-kHz audio bearer service. The network indicates this call type with a Bearer Capability IE of "Speech, Circuit Mode".

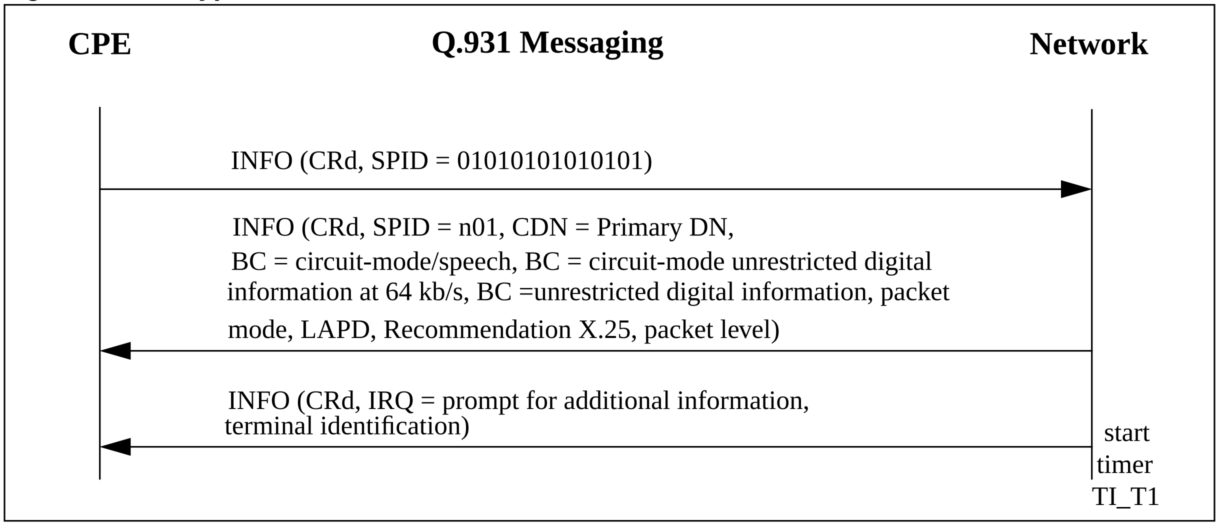
2 The Circuit-Mode Data (CMD) call type refers to circuit-mode unrestricted digital information at 64 kb/s and/or the circuit-mode unrestricted digital information rate adapted from 56 kb/s to 64 kb/s bearer service. The network indicates this call type with a Bearer Capability IE of "64 kb/s, unrestricted digital information, circuit mode".

3 The Packet-mode Data (PMD) call type refers to the packet-mode unrestricted digital information bearer service (using link access procedures on the D channel). The network indicates this call type with a Bearer Capability IE of "Packet Mode Data".

See Section 5.5.5.2, "Bearer Capability information element" for the encoding of the bearer capabilities. For instance, if the primary DN only supports the Voice Interface (VI) call type and a secondary DN supports both the Circuit Mode Data (CMD) and Packet Mode Data (PMD) call types, then three BC IEs are sent in the Q.931 INFO message with the SPID, as shown in Figure 64.

For pre-NI and NI-1 terminals, the call types are derived from the provisioned Authorized Bearer Services (ABS). For NI-2 terminals, the call types are derived from the call types against every provisioned DN. For NI-1 2B terminals, call types cannot be determined for the TSP. In this situation, the BC IE is excluded from the Q.931 INFO message with the SPID.

Figure 64 Call Types



6.7.4.3.3 Other Interactions

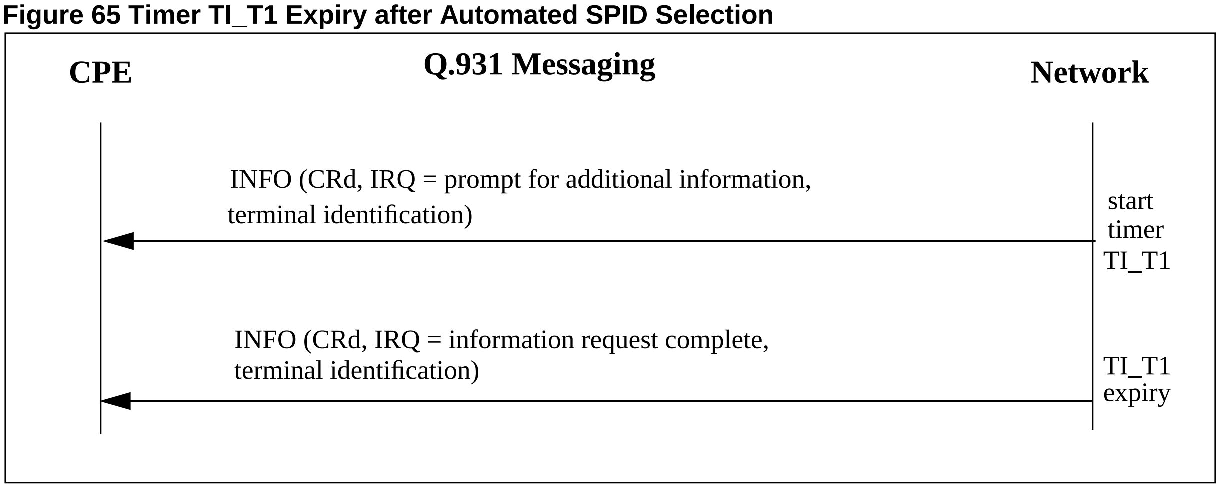
If the network receives an Automated SPID request from a terminal that is already initialized, the network processes the request. However, the SPID that the terminal is currently using is marked as unavailable.

If the terminal doesn’t initialize before the expiry of timer TI_T1, a Q.931 INFO message with the IRQ IE encoded to “information request complete” is sent to designate that initialization is complete. However, the terminal remains uninitialized. (See Figure 65, "Timer TI_T1 Expiry after Automated SPID Selection".)

A terminal may start a timer, set to 15 seconds, on the first transmission of the INFO containing the SPID value.

- If no response is received from the network upon the first expiry of this timer, the terminal re-transmits the initialization request.
- If the network rejects the initialization attempt, or if there is no response from the network after the second expiry of the timer, the terminal repeats the request for initialization until the correct response comes from the switch.

Figure 65 Timer TI_T1 Expiry after Automated SPID Selection



6.7.5 Exceptions and Error Conditions during Terminal Initialization

This section describes the exceptions and error conditions that can occur during terminal initialization.

6.7.5.1 Static/Fixed Terminal requests SPID Initialization

The network rejects a SPID initialization requested by a terminal using a static (that is, datafilled) TEI. In this case, the network sends an INFO having cause value #99, “information element nonexistent or not implemented”.

6.7.5.2 Terminal initializes with invalid SPID

If the SPID value received by the network in an initialization attempt is invalid, that is, not assigned to that interface, the network indicates an unsuccessful initialization attempt by sending an INFO message containing the null call reference and a Cause IE, with cause value #100, “invalid information element contents” (CSE = 100). See Figure 66.

In the event of an unsuccessful initialization attempt, no ongoing association is made by the network between the terminal and a service profile.

Figure 66 Unsuccessful initialization request

Scenario: Terminal has been assigned a dynamic TEI, and established the data link layer connection for that TEI. Terminal sends invalid SPID to network, as part of automated or non-automated SPID initialization.

USER/TERMINAL	MESSAGE	NETWORK
User sends SPID	INFO (CRd, SPID) →	
	← INFO (CRd, CSE= #100, “invalid info element contents”)	SPID invalid

6.7.5.3 Terminal re-initialization

The network handles a terminal’s request for re-initialization differently according to (1) the SPID sent, (2) the TEI used, and (3) the status of any call on the terminal. Table 168, “Re-initialization and network responses”, specifies all potential re-initialization conditions and the appropriate network responses.

Table 168 Re-initialization and network responses

SPID sent	TEI used	Call status	Network action	Cause value
same SPID	same TEI	don’t care	Acknowledge successful initialization	N/A
different SPID	same TEI	no active call	De-initialize old TSP, initialize on new one	N/A
different SPID	same TEI	active call	Reject initialization request	#53
same SPID	different TEI, which is active	don’t care	Reject initialization request	#100
same SPID	different TEI, which is not active	don’t care	Accept initialization request	N/A

6.7.5.4 Invalid requests for Automated SPID

If Automated SPID selection is attempted on an interface when AutoSPID is not enabled on the switch, the network rejects the request as shown in Figure 67 and Figure 68. As shown in the diagrams, the cause values returned during the rejection change based on the logical terminals associated with the interface.

Figure 67 Auto SPID Rejected Request, AUTOSPID = OFF, Initializing Interface

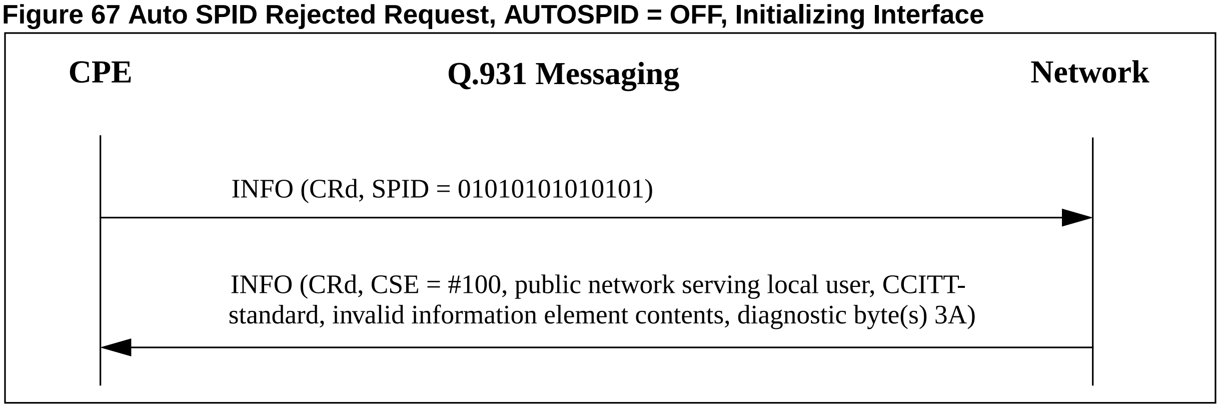
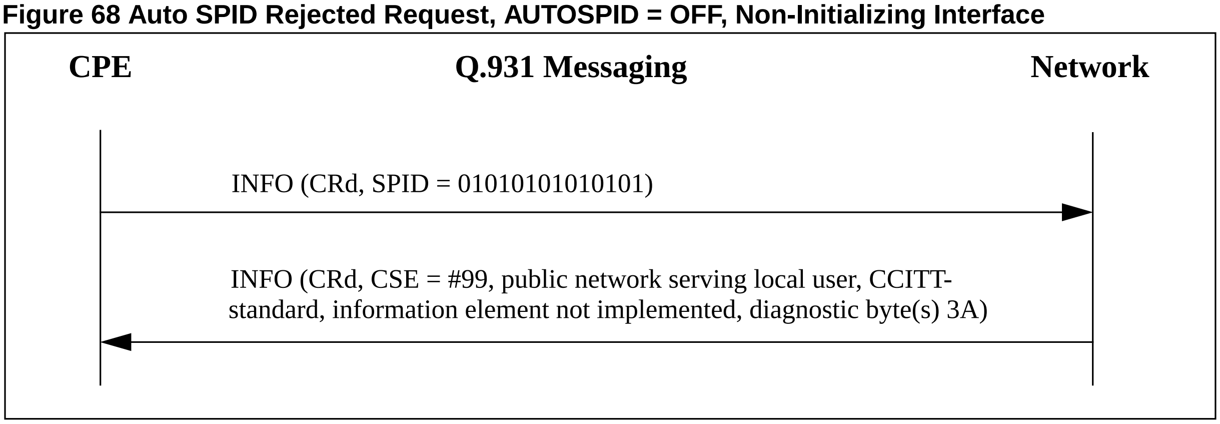
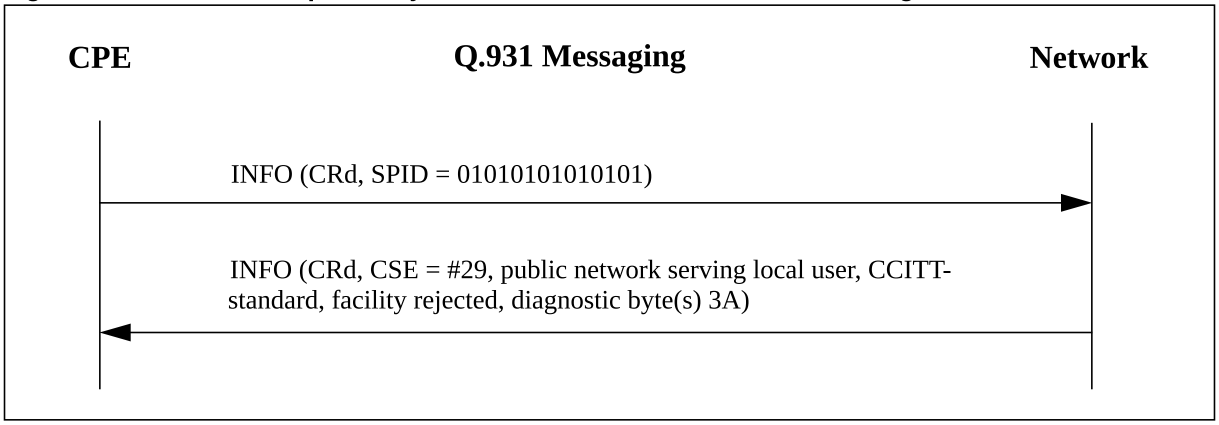


Figure 68 Auto SPID Rejected Request, AUTOSPID = OFF, Non-Initializing Interface



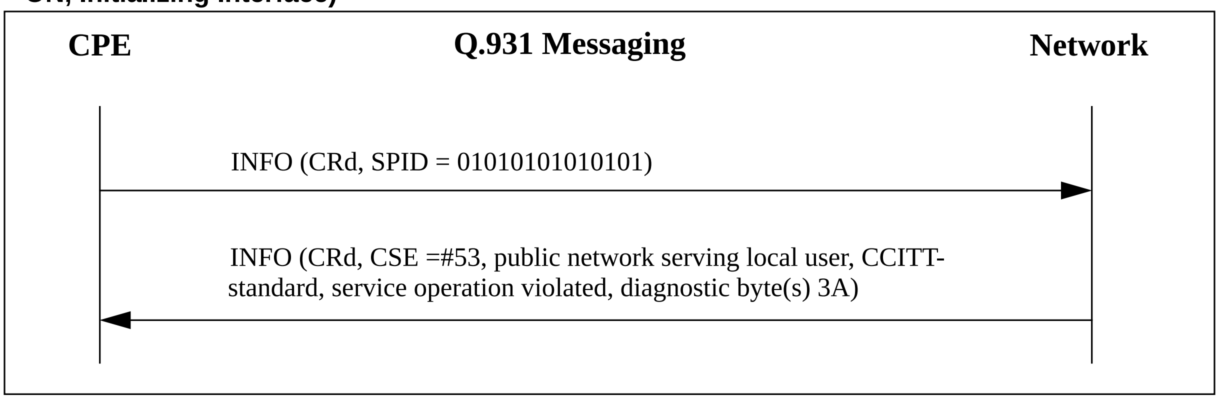
If AutoSPID is enabled, but Automated SPID selection is attempted on a non-initializing interface, the network rejects the request as shown in Figure 69.

Figure 69 Auto SPID Request Rejected, AUTOSPID = ON, Non-Initializing Interface



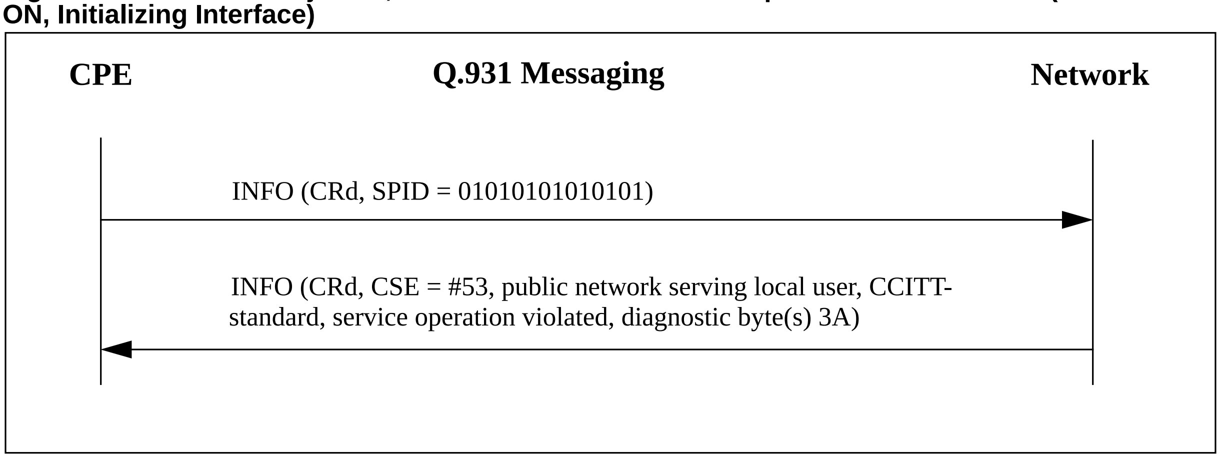
When the network is in the process of handling a Parameter Downloading request for a terminal, a request for Automated SPID selection is rejected as shown in Figure 70.

Figure 70 Auto SPID Rejected, Terminal is Processing Parameter Download Request (AUTOSPID = ON, Initializing Interface)



To prevent network abuse, terminals are allowed to request Automated SPID selection only three times in ten minutes. Any requests which exceed that amount are rejected as shown in Figure 71.

Figure 71 Auto SPID Rejected, Terminal Exceeds Three Requests in Ten Minutes (AUTOSPID = ON, Initializing Interface)



6.7.5.5 Invalid initialization threshold

The network keeps a count of the number of invalid initializations (both invalid SPIDs and requests from static TEI terminals) and service requests before initialization. When this count reaches a threshold, the logical link to the associated TEI may be disabled.

6.7.5.6 Error condition summary table

Table 169, “Error condition summary information”, summarizes all error conditions, network responses, and cause values associated with terminal initialization procedures.

Table 169 Error condition summary information

Error condition	Network action	Cause value
Terminal attempts to initialize using static TEI	Reject by sending in INFOrmation	#99
Terminal attempts to initialize using an invalid SPID	Reject by sending in INFOrmation	#100
Terminal attempts to re-initialize with different SPID while calls are active	Reject by sending in INFOrmation	#53
Terminal attempts to re-initialize with different TEI which is active	Reject by sending in INFOrmation	#100
Terminal requests Automated SPID when not enabled on switch	Reject by sending in INFOrmation	#100 for initializing interface; #99 for non-initializing interface
Terminal requests Automated SPID on non-initializing interface	Reject by sending in INFOrmation	#29
Terminal is Processing Parameter Download Request	Reject by sending in INFOrmation	#53
Terminal requests Automated SPID more than three times in ten minutes	Reject by sending in INFOrmation	#53
SETUP sent prior to terminal initialization	Return a RELEASE COMPLETE	#50
Network receives INFOrmation with null call reference from terminal with uninitialized or invalid service profile	Ignore message and send an INFOrmation	#100
Initialization Threshold exceeded	May disable logical link to TEI	N/A

6.8 Non-Initializing Terminals

A non-initializing terminal (NIT) is one that can operate without requiring SPID initializing procedures.

On DMS-100, an NIT may use a dynamic network-assigned or user-assigned TEI to gain layer 2 access. Once the terminal has entered the layer 2 TEI assigned state, it can originate and terminate calls and have access to the services assigned to the default TSP on the interface.

The DMS-100 requires a default TSP to be provisioned to allow a NIT to operate, even if there are no services associated with it.

6.8.1 Default TSP

The default TSP is stored against an interface in the DMS-100 provisioned to provide the services for a NIT. A terminal that successfully enters the layer 2 TEI assigned state, but does not request SPID initialization, is associated with the default TSP.

One or more NITs may be active on an interface. A subscription parameter assigned on the default TSP allows the number of NITs to be set to a value between 1 and 8.

6.8.2 Service restrictions for Non-Initalizing Terminals

Three services, EKTS, Multi-Line Hunt (MLH), and Distributed Line Hunt (DLH), as provided on the DMS-100, use the endpoint identifier in the SETUP(s) as part of their functional behavior. Since an endpoint identifier can only be assigned to a terminal initialized at layer 3, these services are not available to NITs.

A NIT, by definition, does not support the downloading of terminal profile information through Service Profile Management or Parameter Downloading. Requests for SPM or Parameter downloads by NITs are denied by the DMS-100.

6.9 Feature Indicator Lamp Refresh

Feature Indicators on an ISDN terminal are a means by which the DMS-100 informs the user about feature status. The indicators associated with these features will be updated automatically by the switch for both NI-1 and NI-2 terminals. Feature Indicator refresh occurs whenever terminals are brought into service or restored to the “In Service” condition by Rapid Messaging.

Examples of effected lamps include:

- CFW - Call Forward (for NI-1 terminals)
- CFXDNCT - Call Forward for DN Call Type (for NI-2 terminals)
- RAG - Ring Again (for NI-1 terminals)
- MSB - Make Set Busy
- MWT - Message Waiting.

For capability requirements for NI-1 and NI-2 devices, see Chapter 2: "ISDN BRI Configurations".

Indicator refresh will happen in response to the following conditions:

- a terminal is powered down and powered up
- a terminal is disconnected and reconnected
- a diagnostic is performed on a line causing it to lose Layer 1 synchronization
- certain switch reinitialization or restart conditions
- a terminal is restored to the “In Service” condition by Rapid Messaging

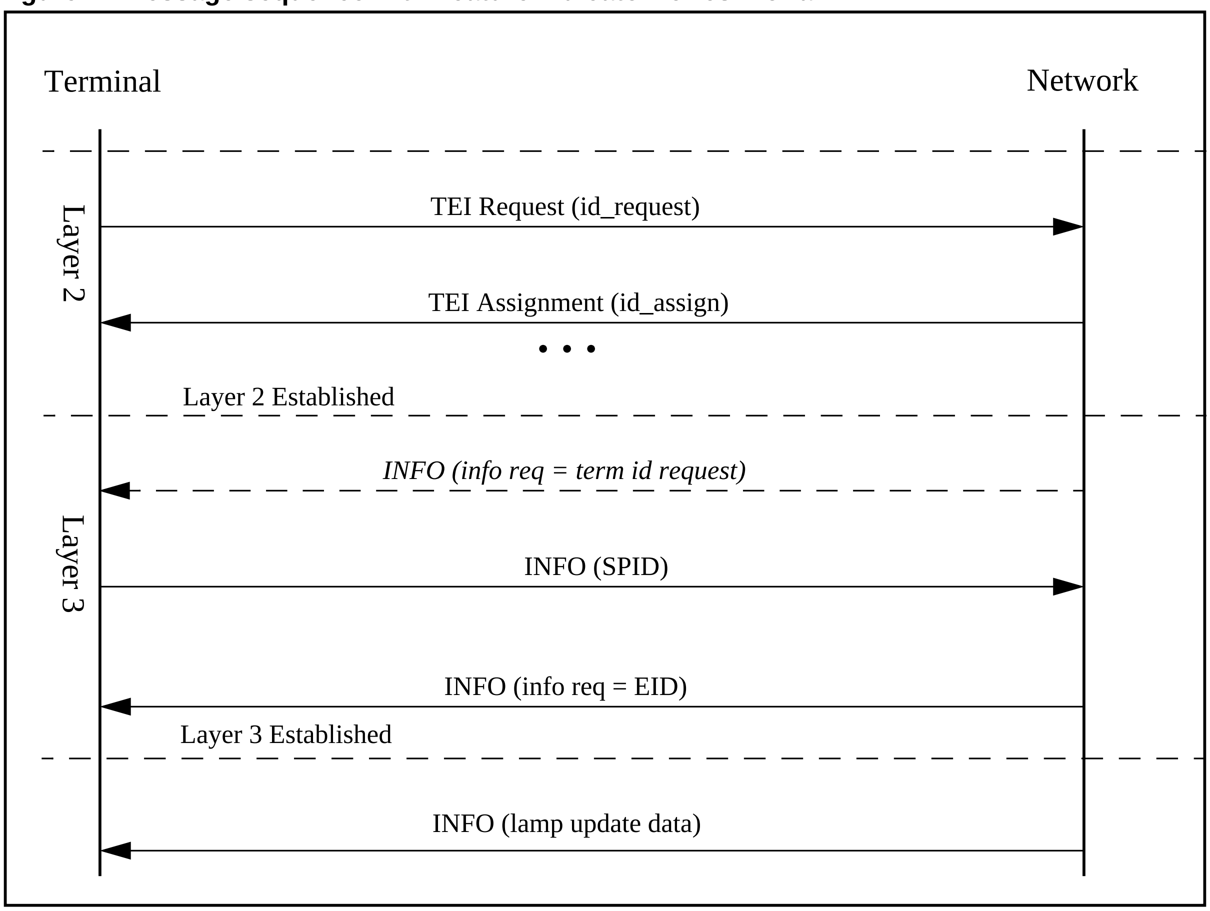
INFOrmation messages containing lamp update data are sent to terminals restored to the “In Service” condition by Rapid Messaging. These messages follow those sent to a formerly out-of-service terminal that full service has been restored. (Refer to Section 5.10, “Rapid Messaging”, for additional information).

The feature indicator refresh timing during terminal initialization depends on the type of terminal. For Fully-Initializing Terminals, refresh occurs immediately after layer 3 initialization. For Non-Initializing Terminals, refresh occurs after the layer 2 data link establishment when the Terminal End Point reaches the Set Asynchronous Balanced Mode Extended (SABME) state. These are described in the following sections.

6.9.1 Message sequence for a Fully-Initializing Terminal (FIT)

Figure 72, “Message sequence with Feature Indicator refresh for a FIT”, illustrates the initialization message sequence between the switch and a Fully-Initializing Terminal (FIT) as it pertains to Feature Indicator Lamp Refresh. The bottom arrow indicates the message updating the indicators.

Figure 72 Message sequence with Feature Indicator refresh for a FIT

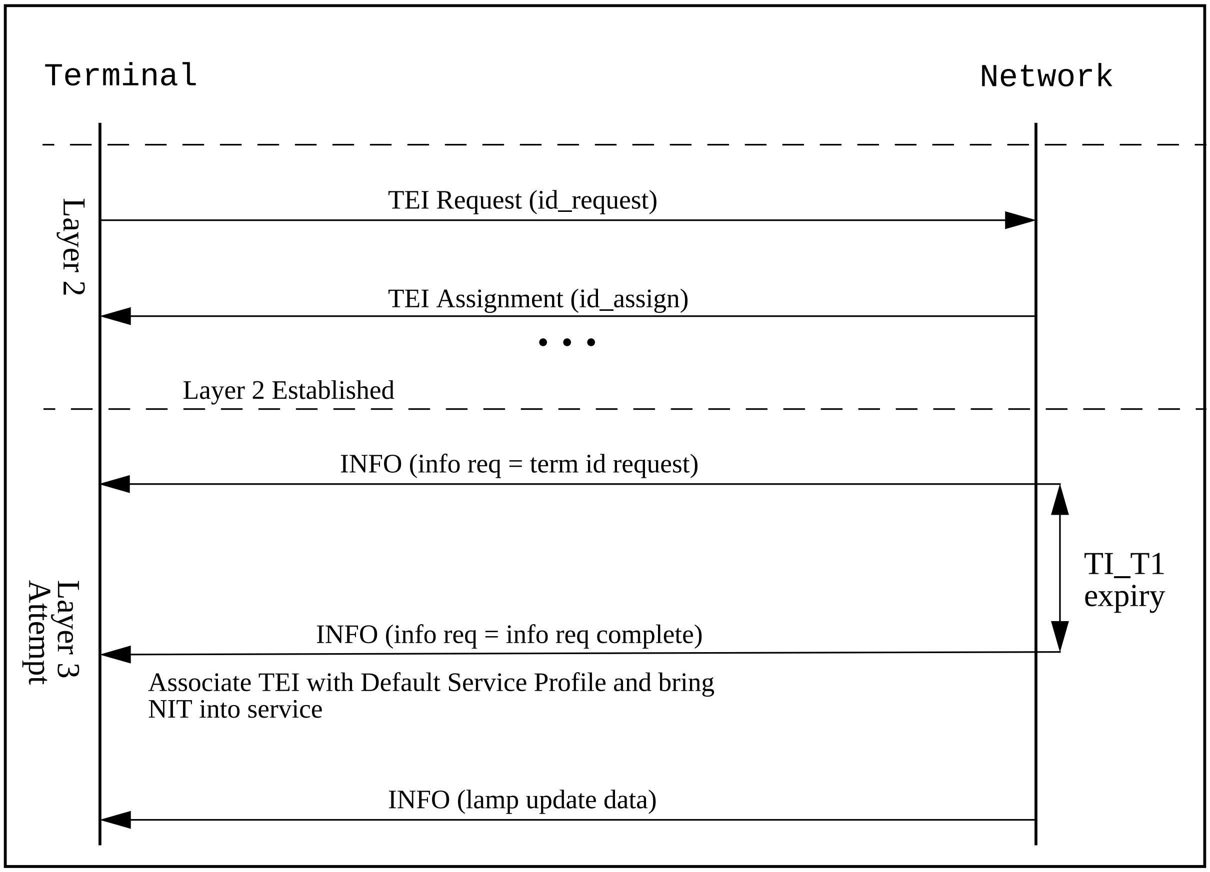


Note: If the layer 3 initialization is user-initiated, the dashed arrow labeled “INFO (info req = term id request)” will be absent.

6.9.2 Message sequence for a Non-Initializing Terminal (NIT)

Figure 73, “Message sequence with Feature Indicator refresh for a NIT”, illustrates the message sequence between the switch and the terminal for a non-initializing terminal (NIT) as it pertains to Feature Indicator Lamp Refresh. The bottom arrow indicates the message updating the lamps.

Figure 73 Message sequence with Feature Indicator refresh for a NIT



If a terminal does not attempt layer 3 initialization prior to the expiration of timer TI_T1, the terminal will be associated with the default Terminal Service Profile (TSP), if provisioned. The switch will then refresh the Feature Indicator lamp status.

If both NITs (with the default TSP) and FITs are provisioned on the same loop, a NIT will not receive its Feature Indicator Lamp Refresh until the second expiration of TI_T1. Consequently, if the TI_T1 default is 20 seconds, a NIT is refreshed 40 seconds after receiving dialtone.

6.9.3 Restrictions

Terminals which use a static TEI will not be refreshed. All other configurations of NI-1 and NI-2 NITs and FITs are supported.

An INFOrmation message will be sent for each Feature Indicator being updated.

Feature Indicator Lamp Refresh messages are processed at a lower priority than call processing; the refresh occurs immediately after all higher priority processing has been completed.

6.10 Generic procedures for supplementary service access

This section specifies generic signaling procedures for the invocation of supplementary services through Feature Key Management (FKM) and Code Access. Specific service descriptions and procedures are detailed in Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”.

6.10.1 Introduction

6.10.1.1 Applicability

Each generic procedure is applicable to a specific group of features according to which phase of the call the feature can be invoked. This approach highlights the commonalities of signaling requirements in different phases of the call and assists terminal vendors in structuring their feature access implementation.

6.10.1.2 Background

The generic procedures are based on the procedures defined in CCITT Recommendation Q.932 *Generic Procedures for the Control of ISDN Supplementary Services* and Bellcore TR-TSY-000847 *ISDN Features - Common Switching and Signaling Requirements,* Issue 1, December 1988.

6.10.1.3 Notes concerning this chapter

- The examples in this chapter only show the optional informational elements, related to FKM or Access Codes, required in each scenario. Mandatory information elements (bearer capability, for example) are not shown to simplify the diagram.
- The network may send a Feature Indication information element in a call control, or an INFOrmation message at any time, to provide a feature indication status update. For example, the network sends a Feature Indication information element in response to a feature request using a feature activator.
  - A feature indicator may also be sent in response to a feature invoked through dial access procedures.
  - The status of the particular feature is returned as a parameter of the feature indicator.
  - The value of Feature Status is dependant on the specific feature requested.
  - To present a generic procedure, and to reflect the requirement to include this value the line diagrams in this chapter, simply refer to the value as “status”.
- When using an En bloc sequence, send the digits together in one message. The terminal sends the called number digits, En bloc, in either Keypad or Called Party Number information elements. For a routing feature, code the access code in the Transit Network Selection (TNS) information element with any supplemental address information coded in the called party number.
- In the subsequent diagrams illustrating these generic procedures, CRn represents a non-null, or established call reference (call related). CRd represents the null call reference (non-call related).

- The following are definitions for the logical call phases:
  - — Call Initiation/Establishment Phase - starts with a call initiation request (SETUP) and ends when the network has received sufficient information to establish a basic outgoing call (CALL PROCeeding sent to terminal).
  - — Call Progress/Active Phase - starts from the time the call initiation phase ends (after the CALL PROCeeding is sent, and before call clearing is initiated).
- Tones and announcements are always provided (inband) by the network.
- Feature invocation when there is an established call (Call Progress/Active phase) is only supported through FKM.
- Feature invocation using the null call reference (non-call related) is only supported through FKM.
- Here are definitions for the messaging sequences:
  - — Overlap Sending - the sequences presented in this chapter refer to a message sequence where the user/terminal invokes a feature in one of the following ways:
    - – by sending a feature request to the network after receiving dial tone
    - – by sending a feature request together with partial supplementary information in the SETUP.

  Where supplemental address information is being sent "Overlap", following a network prompt (refer to generic procedure G4 for example), the address information is sent in one or more INFOrmation message(s).
  - — En bloc Sending - the En bloc sending sequences presented in this chapter refer to a block of information combined and sent in one message.
    - – In the call initiation case, the user/terminal can request both call setup and feature activation by including a FA request in the SETUP.
    - – Sending supplemental address information En bloc, means that all of the supplementary address digits are sent in one INFOrmation.

Supporting activities for feature invocation

- End of Dialing Determination - Call Related
  - — End of dialing is determined when the network recognizes a complete sequence.
  - — When the network recognizes a complete sequence, and there is potential for that sequence to be interpreted as either a complete address or feature access code plus partial address, the network applies critical interdigit timing to determine end of dialing.
  - — The user may indicate end of dialing by sending the octothorpe (#) after the complete sequence of digits. The "#" may also be used as a delimiter within a collection of digits in the Keypad or Called party number information element. The "#" may only be included in the Called Party Number information element when the Type of Number

and Numbering Plan Identification are “unknown”. Refer to Section 5.5.5.4, “Called Party Number information element”, for a description of the Called Party Number information element.

- End of Dialing Determination - Non-Call Related
  - As mentioned above, only FKM procedures are applicable to “non-call related” feature invocation. Indicate the end of dialing sequence by re-sending the feature activator to the network at the end of the dialing sequence. See Section 6.13, “G2 - Interactive Feature Key Management (non-call related)”.

    End of dialing is also done for some features via an inter-digit timer (e.g. NI-2 Call Forward Programming).

- Invalid Information Handling - Call Related

  If the user inputs a digit sequence not allowed in the dialing/numbering plan currently in use, the network clears the call as described in Section 5.7.1.3, “Call clearing”, and where applicable, includes the following:
  - If a feature indicator is associated with the requested feature, the FI information element is included in the first call clearing, or in a preceding INFOrmation.
  - If information request procedures (see generic procedure G4 or G8 for examples) were used, the IRQ information element coded to indicate that the request for information is complete is included in the first call clearing, or in a preceding INFOrmation.

- Invalid Information Handling - Non-Call Related

  If the user inputs a digit sequence not allowed in the dialing/numbering plan currently in use, the network sends:
  - an INFOrmation containing the null call reference
  - the Information Request information element coded to indicate that the request for information has been completed
  - the Feature Indication information element coded as specified for the particular feature involved, to indicate that the request was not accepted.

- Feature Programming Abandon - Non-Call Related

  To allow the user to abandon feature programming/invocation during the Non-Call Related Feature Key Management procedure (G2), terminals are required to support the release feature as described in Section 6.53, “Release (RLS)”.

6.11 Generic Feature Management procedure summary

Depending on the specific feature to be accessed, a terminal should use either FKM or DCA procedures. The set of generic procedures for supplementary service access are:

1 Procedure G1 - Feature Key Management, Non-Call-Related (see Section 6.12)

2 Procedure G2 - Interactive Feature Key Management, Non-Call-Related (see Section 6.13)

3 Procedure G3 - Feature Key Management, Call Initiation Phase (see Section 6.14)

4 Procedure G4 - Interactive Feature Key Management, Call Initiation Phase (see Section 6.15)

5 Procedure G5 - Feature Key Management, Call Progress/Active Phase (see Section 6.16)

6 Procedure G6 - Interactive Feature Key Management, Call Progress/Active Phase (see Section 6.17)

7 Procedure G7 - Dial Access, Call Initiation Phase (see Section 6.18)

8 Procedure G8 - Interactive Dial Access, Call Initiation Phase (see Section 6.19)

9 Procedure G9 - Network Notification Of Feature Information (see Section 6.20)

10 Procedure G10 - Network Notification of Events (see Section 6.21)

11 Procedure G11 - Call Related Notification of Feature Information (see Section 6.22).

6.12 G1 - Feature Key Management (Non-call related)

This procedure applies when a user invokes a feature, not related to a call in progress, using feature key access (see Figure 74, “Feature Key Management, Non-call related”).

- The terminal requests a feature be activated by sending an INFOrmation, with a Feature activation information element specifying the feature identification number.
- If the network accepts the request, the terminal receives an INFOrmation with Feature Indication information element specifying status “active”.
- If the feature can not be activated, the network ignores the message sent by the terminal, or returns an INFOrmation with an appropriate cause value.

When the feature indicator contains status “active”:

- the terminal requests the feature be deactivated by sending an INFOrmation with a Feature Activation information element specifying the feature identification number.
- If the network accepts the request, the terminal receives an INFOrmation with Feature Indication information element specifying status “idle”.
- If the feature can not be deactivated, the network ignores the message sent by the terminal or sends an INFOrmation with an appropriate cause value.

An example of a feature using this procedure is Make Set Busy.

Figure 74 Feature Key Management, Non-call related

Scenario:A user attempts to activate a feature, using activator #x, while there is no currently active call. The user then deactivates the again using feature, activator #x.

USER/TERMINAL	MESSAGE	NETWORK
feature request	INFO (CRd,FA=x) →	
feature activated	INFO (CRd,FI=x,active) ←	accept feature request
feature deactivation request	INFO (CRd,FA=x) →	deactivate feature
feature deactivated	INFO (CRd,FI=x,idle) ←	

6.13 G2 - Interactive Feature Key Management (non-call related)

This procedure applies when a user requests a feature requiring the entry of supplemental information (an address, for example), not related to a call in progress, using feature key management (see Figure 75, “Interactive Feature Key Management - Non-Call Related”).

The procedure is initiated when an message is sent to the network containing the null call reference, and either:

1 a FA (FA = x) specifying the feature identification number,

2 a feature activator, and partial supplemental (address) information in the Keypad information element, or[1]

3 a feature activator and complete information in either the Keypad or the Called Party Number information element.[1]

In cases (1) and (2), where no information or partial information is sent along with the FA, the network prompts the user for additional information with:

- an INFOrmation containing the null call reference
- the Feature Indication information element corresponding to the specified feature identification number, with status “prompt” (FI = x, prompt)
- also included is the IRQ information element, coded to prompt for address digits (IRQ = prompt, address). See Section Figure 75, “Interactive Feature Key Management - Non-Call Related”, case 1 and 2.

Address sending from the terminal then begins by:

- Sending one or more INFOrmation message(s), En bloc or Overlap, to the network
- In case (2) where partial information is sent with the FA, the remaining information is sent in the Keypad information element in one or more INFOrmation message(s) including the null call reference
- In case (1), where no supplemental information is sent with the FA, the supplemental information is sent En bloc in the Called Party Number or Keypad information element, or Overlap in the Keypad information element, contained in multiple INFOrmation message(s).
- In all cases, the user indicates the end of the dialing sequence by again sending the INFOrmation containing the null call reference, and the FA (FA = x) information element. (See Figure 75, “Interactive Feature Key Management - Non-Call Related”.) Note that some features, such as NI-2 call forward programming, do not require the second feature activator to be entered in order to complete address sending. The features use an inter-digit timer to determine the completion of address sending.

1. At this time the network will not support the receipt of a feature activator together with either a Keypad IE or a Called Party Number IE in an INFO message containing the null call reference. Consequently, cases (2) and (3) described above are not currently supported.

- The network completes the sequence by returning an INFOrmation containing the null call reference, and a FI corresponding to the specific feature identification number with the appropriate status for the given feature (FI = x, status).
- In cases (1) and (2) where the network requested additional information, the IRQ information element, coded to “complete” (IRQ = complete) is also included in the INFOrmation.
- Depending on the specific feature, the network uses status “idle” to indicate rejection of the digits entered.

Examples of features using this procedure are CFAC programming and Speed Calling programming.

Figure 75 Interactive Feature Key Management - Non-Call Related

Scenario: A user attempts to activate a feature using activator #x, while there is no currently active call. The network prompts the user for additional information.

USER/TERMINAL	MESSAGE	NETWORK
Case 1 and 2 feature request	INFO (CRd,FA=x, KP*) →	network accepts feature request,
* if KP included only partial information		
prompt for input	INFO (CRd,FI=x,prompt, ← IRQ=prompt,address)	prompts user for additional information
user sends additional digits	INFO (CRd,KP) → " "	
	INFO (CRd,KP) →	
programming completion request	INFO (CRd,FA=x) →	accepts digits
	INFO (CRd,FI=“status”, ← IRQ=complete)	
	========================	
Case 3 feature request with complete information	INFO (CRd,FA=x, → KP or CDN)	network accepts feature request,
programming completion request	INFO (CRd,FA=x) →	accepts digits
	INFO (CRd,FI=“status”) ←	

6.14 G3 - Feature Key Management (Call Initiation Phase)

This procedure applies when a user invokes a feature, using feature key management during call establishment, and no supplemental information (address, for example) is required (see Figure 76, “Feature Key Management - Call Initiation Phase”).

- The FA request is sent to the network either En bloc in the SETUP, or Overlap in an INFOrmation, after receipt of the SETUP ACKnowledge.
- In the En bloc case, include the FA in the SETUP sent to the network. Depending on the specific feature, the call either proceeds or is cleared as described in Section 6.23, “Common call clearing/establishment procedures”.
- In the Overlap case, the user sends a SETUP to the network, with no FA information element included in the message.
- The network responds with a SETUP ACK containing:
  - the established call reference
  - a B-channel assignment (CID = B-ch)
  - the Progress Indicator coded to inband information or appropriate pattern now available
  - the Signal information element coded to “dial tone on”
  - the network provides dial tone at this time.
- After receipt of the SETUP ACKnowledge, the user sends an INFOrmation to the network containing the established CRn, and the FA (FA = x) specifying the feature identification number.
- Depending on the specific feature, the call then proceeds or is cleared, as described in Section 6.23, “Common call clearing/establishment procedures”.
- If the feature request is rejected, the network clears the call in accordance with the procedures in Chapter 5.

Examples of features using this procedure are Automatic Dial and Call Pickup.

Figure 76 Feature Key Management - Call Initiation Phase

Scenario: A user attempts to activate a feature, using activator #x during call initiation

USER/TERMINAL	MESSAGE	NETWORK
(Overlap case)		
call request	SETUP (CRn, BC,..) →	
connect B–ch	SETUP ACK (CRn, CID=B–ch,..) ←	connect B–ch
feature request	INFO (CRn,FA=x) →	accept feature request
	Note	
	========================	
(En bloc case)		
Feature/Call request	SETUP (CRn, BC, FA=x) →	accept feature/ call request
	Note	

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

6.15 G4 - Interactive Feature Key Management (Call Initiation Phase)

This procedure applies when a user invokes a feature using FKM, during call initiation, and must enter supplemental (address) information.

This procedure includes a number of alternative sequences depending on how the supplemental information is sent to the network, and on whether the feature activation request is included in the SETUP, or a subsequent INFOrmation. The following sequences are supported:

1 Single En bloc

2 En bloc followed by supplemental information sent En bloc or Overlap

3 Single Overlap

4 Overlap followed by supplemental information sent En bloc or Overlap.

These sequences are designated here as case (1), case (2), case (3), and case (4), respectively.

In all cases, the user establishes a call using the normal call establishment procedures as described in Chapter 5.

If the feature request or digits entered are rejected, the network clears the call in accordance with the procedures in Chapter 5.

An example of a feature using this procedure is Speed Calling User.

In case (1), refer to Figure 77, “Single En bloc sequence”.

- the user sends a SETUP to the network including the FA (FA = x), and the complete supplemental information encoded in either the Keypad or Called Party Number information element.
- Depending on the feature invoked, the call either proceeds or is cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 77 Single En bloc sequence

Scenario:The user requests feature activation with complete supplemental information included in the SETUP message.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request	SETUP (CRn, BC, FA=x, KP/CDN,...) → (See Note)	Feature request with complete information in either KP or CDN

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

In case (2), refer to Figure 78, “En bloc followed by En bloc / Overlap sequence”.

- The user sends a SETUP to the network, including the FA (FA = x), and no supplemental information.
- The network returns a SETUP ACKnowledge containing:
  - — the established call reference
  - — the B-channel assignment (CID = B-ch)
  - — the FI corresponding to the specified feature identification number with status prompt (FI = x, prompt)
  - — the IRQ element coded to prompt for address digits (IRQ = prompt, address).
  - — The network also includes the Signal information element coded to “recall dial tone”, and the PI coded to “inband information or appropriate pattern now available.”
  - — The network now provides recall dial tone.
- Address sending from the terminal begins by sending one or more INFOrmation message(s), either En bloc or Overlap.
- For the En bloc sequence, place all of the supplemental address digits in the Keypad or Called Party Number information element.
- For the Overlap sequence, the terminal sends multiple INFOrmation message(s) to the network containing the established call reference and the supplemental address digits in the Keypad information element.
- After receipt of the first message the network sends an INFOrmation containing the established call reference, and the Signal information element coded to “tones off”.
- At this time the network removes dial tone.
- The user sends the remaining supplemental information (digits) contained in the Keypad information element in one or more INFOrmation message(s).
- Depending on the specific feature, the call proceeds or is cleared using the procedure described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 78 En bloc followed by En bloc / Overlap sequence

Scenario:The user is prompted by the network to provide additional information.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request	SETUP (CRn, BC, FA=x...) ——►	More input needed accept feature/ call request
Supplemental information required	SETUP ACK (CRn,CID=B–ch, ◄—— PI=#8, IRQ=prompt, address, SIG= dial tone, FI=x,prompt)	Connect B–channel Prompt user for additional information dial tone
	========================	
En bloc sending of supplemental information	INFO (CRn,KP/CDN) ——► (See Note)	
	========================	
Overlap sending of supplemental information	INFO (CRn,KP) ——► "	Interdigital timing
	INFO (CRn,SIG=tones off) ◄——	Tones off
	INFO (CRn,KP) ——► " "	Interdigital timing
	(See Note)	

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

In case (3), refer to Figure 79, “Single Overlap Sequence”.

- The user initiates a call which includes a feature activator and, partial but not complete supplemental (address/digit) information contained in the Keypad information element.
- The network returns:
  - — a SETUP ACKnowledge containing the established call reference
  - — the B-channel assignment (CID = B-ch)

— the FI corresponding to the specified feature identification number with status prompt (FI = x, prompt).

- The user sends the remaining supplemental address information coded in the Keypad information element, contained in one or more INFOrmation message(s).
- Depending on the specific feature, the call proceeds or is cleared, using the procedure described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 79 Single Overlap Sequence

Scenario: The user requests feature activation with partial supplemental information included in the SETUP.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request with partial digits	SETUP (CRn, BC, FA=x, KP,..) →	Feature request More input needed
Additional information required	← SETUP ACK (CRn,CID=B–ch, FI=x,prompt)	Connect B–channel
User enters first additional digit	INFO (CRn,KP) →	Interdigital timing
User enters remaining digits	INFO (CRn,KP) →	Interdigital timing
	"	
	"	
	(See Note)	

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

In case (4), refer to Figure 80, “Overlap Followed by En bloc / Overlap Sequence”.

- the user sends a SETUP to the network, with no feature activator or supplemental information included.
- The network responds with a SETUP ACKnowledge containing:

— the established call reference

— a B-channel assignment (CID = B-ch)

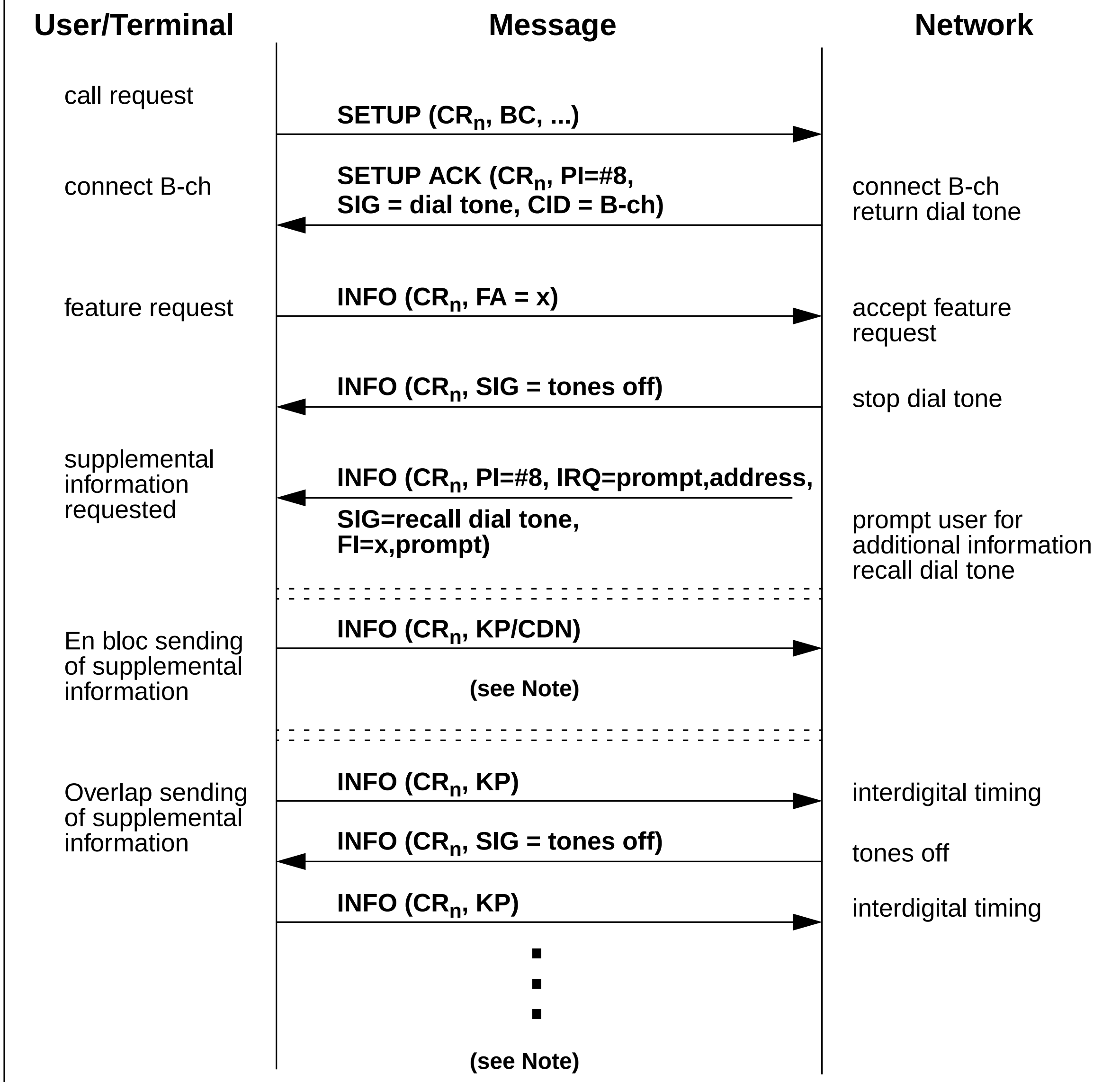
— the PI coded to “inband information or appropriate pattern now available”

— the Signal information element coded to “dial tone on”.

- The network now returns inband dial tone.
- After receipt of the SETUP ACKnowledge, the user sends an INFOrmation to the network containing the established call reference, and the FA (FA = x) specifying the feature identification number.
- The network returns an INFOrmation, containing the Signal information element coded to “tones off” (signal) and removes inband dial tone.
- If the feature request is accepted, the network prompts the user for additional information with an INFOrmation, containing:
  - — the established call reference
  - — the FI corresponding to the specified feature identification number with status prompt (FI = x, prompt)
  - — the Signal information element, coded to “recall dial tone”
  - — the PI coded to “inband information or appropriate pattern now available”
  - — the IRQ element coded to prompt for address digits (IRQ = prompt, address).
- The network now provides inband recall dial tone.
- Digit transmission from the terminal begins by sending one or more INFOrmation message(s) (En bloc or Overlap).
- In either case, after receipt of the first message, the network returns an INFOrmation containing the established call reference, and the Signal information element coded to “tones off”.
- The network removes recall dial tone.
- For En bloc, all of the supplemental address digits are contained in the Keypad or Called party number information element.
- For Overlap, the terminal sends multiple INFOrmation message(s) containing digit information coded in the Keypad information element.
- The user/terminal continues digit transmission by sending multiple INFOrmation message(s) coded in the same fashion as the first.

Depending on the specific feature, the either call proceeds or is cleared, as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 80 Overlap Followed by En bloc / Overlap Sequence



Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

6.16 G5 - Feature Key Management (Call Progress/Active Phase)

This procedure applies when a user requests feature invocation using feature key management during the call progress or active phase of a call, and no supplemental information is required (see Figure 81, “Feature Key Access - Call Progress/Active Phase”).

The procedures apply for example, when the terminal has received a busy or call active indication.

- The user sends an INFOrmation containing the established call reference and a FA information element (FA = x) corresponding to the feature identification number.

- If the feature request is accepted, the network returns an INFOrmation containing the established call reference, and a FI corresponding to the feature identification number with the appropriate status (FI = x, status).

An example of a feature using this procedure is Call Park Store.

Figure 81 Feature Key Access - Call Progress/Active Phase

Scenario:A user attempts to activate a feature, using feature activator #x, during the call progress/active phase.

USER/TERMINAL	MESSAGE	NETWORK
	call in progress/active	
feature request	INFO (CRn,FA=x)	accept feature request
feature activated	INFO (CRn, FI=x,status)	

6.17 G6 - Interactive Feature Key Management (Call Progress/Active Phase)

This procedure applies when a user requests feature invocation using feature key management during the progress or active phase of a call, and additional supplemental (address/digits) information is required (see Figure 82, “Interactive Feature Key Management - Call Progress/Active Phase”).

The procedures apply, for example, when the terminal has received a busy or call active indication. It is initiated when a user sends an INFOrmation to the network containing the established call reference, and either:

1 FA (FA = x) specifying the feature identification number,

2 FA and partial supplemental (address) information in the Keypad information element, or

3 FA and complete information in either the Keypad or Called Party Number information element.

In cases (1) and (2) above:

- where no information or partial information is sent along with the FA, the network prompts the user for additional information with an INFOrmation containing the established call reference, and the FI corresponding to the specific feature identification number with status prompt (FI = x, prompt).
- The IRQ element is also included to prompt for address digits (IRQ = prompt, address).
- The user then sends the supplemental information in one or more INFOrmation message(s) (En Bloc or Overlap) to the network. Note that if the terminal does not support IRQ type B requests, it may send the digits in-band using DTMF tones rather than out-of-band using INFOrmation messages.
- In case (2) where partial information was sent with the FA, send the remaining information in the Keypad information element in one or more INFOrmation message(s), including the established call reference.
- In case (1) where no supplemental information was sent with the FA, send the supplemental information either En bloc in the Called party number or Keypad information element, or Overlap in the Keypad information element contained in multiple INFOrmation message(s).
- In each case, the network completes the sequence by returning an INFOrmation containing the established call reference, and a FI corresponding to the specific feature identification number, with the appropriate status (FI = x, status).
- In cases (1) and (2), where the network requested supplemental address information, the IRQ information element, coded to complete (IRQ = complete) is also included in the INFOrmation.

Figure 82 Interactive Feature Key Management - Call Progress/Active Phase

Scenario: A user attempts to activate a feature, using key feature access, during the call progress/active phase.

USER/TERMINAL	MESSAGE	NETWORK
	call in progress/active	
Case 1 and 2 feature request	INFO (CRn,FA=x, KP)*	network accepts feature request,
* KP included if partial information		
prompt for input	INFO (CRn,FI=x,prompt, IRQ=prompt,address)	prompts user for additional information
user sends additional digits	INFO (CRn,KP)	interdigit timer
	" "	
	INFO (CRn,KP)	interdigit timer
	INFO (CRn,FI=status, IRQ=complete)	information request complete
=======================	=======================	=======================
Case 3 feature request with complete information	INFO (CRn,FA=x, KP or CDN)	network accepts feature request,
	INFO (CRn,FI=active) IRQ=complete) **Note**	

Note: Depending on the specific feature activated, the call will proceed, continue as before, or be cleared according to the specific supplementary service that has been invoked.

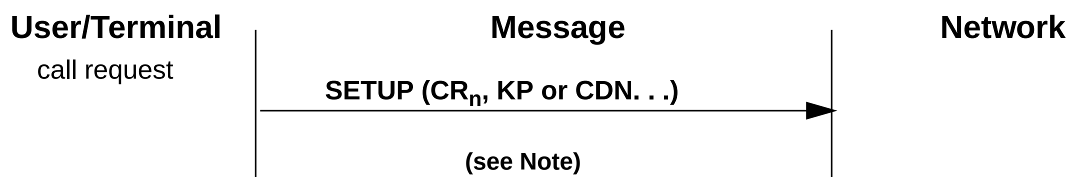
6.18 G7 - Dial Management (Call Initiation Phase)

This procedure applies when a user invokes a feature using dial access, during call initiation, and no supplemental (address/digit) information is required. The user may enter the access code either En bloc or Overlap.

- In the En bloc case, the user sends all of the access code digits encoded in either the Keypad or Called party number information element in the SETUP. (See Figure 83, “Feature Activation Request – En bloc Sending of Access Code”.)
- Depending on the specific feature, the call either proceeds or is cleared, using the procedures as specified in Chapter 5.
- In the Overlap case, the user sends the SETUP to the network containing the established call reference, and either does or does not included the Keypad information element.
- The network responds by sending a SETUP ACK containing the established call reference, and a B-channel assignment (CID = B-ch).
- In the case where the Keypad information element was not included in the SETUP, the Progress Indicator, coded to “inband information or appropriate pattern now available”, and the Signal information element, coded to “dial tone on”, are also included in the SETUP ACK. The network provides inband dial tone at this time. (See Figure 84, “Feature Activation Request - Code Access (Overlap sending)”.)
- Address sending from the terminal begins by sending one or more INFOrmation message(s) to the network containing the established call reference, and the Keypad information element, containing one or more Feature Access code digits.
- If the Signal information element was included in the SETUP ACK, an INFOrmation is also sent to the terminal containing the established call reference, and the Signal information element coded to “tones off”.
- The user/terminal sends the remaining access code digits in the Keypad information element contained in one or more INFOrmation message(s).
- Depending on the specific feature, the call then proceeds or is cleared, using the procedure as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 83 Feature Activation Request – En bloc Sending of Access Code

Scenario: A user invokes a feature during call initiation by entering the Feature Access Code using En bloc sending



Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 84 Feature Activation Request - Code Access (Overlap sending)

Scenario:A user invokes a feature during call initiation by entering the Feature Access code using Overlap sending.

USER/TERMINAL	MESSAGE	NETWORK
Call request *If KP included only partial partial access code contained	SETUP (CRn, KP*,..) ——————————→	
	SETUP ACK (CRn, ←—————————— CID=B–ch, PI=#8, SIG=dial tone on) **	Connect B–ch Dial tone on ** SIG, PI only included if no KP in SETUP
User enters access code digit(s)	INFO (CRn,KP=digit) ——————————→	Interdigital timing
	INFO (CRn,SIG=tones off) ←——————————	Tones off (sent if SIG included in SETUP ACK)
User enters remaining access code digits	INFO (CRn,KP=digit) ——————————→ " " (See Note)	Interdigital timing Accept feature request

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

6.19 G8 - Interactive Dial Access (Call Initiation Phase)

This procedure applies when a user requests feature invocation, using code access during call initiation, and supplemental (address/digit) information is required. This procedure includes a number of alternative sequences depending on how the supplemental information is sent to the network (En bloc or Overlap), and on whether the feature access code is sent En bloc or Overlap. The following sequences are supported:

1 Single En bloc

2 En bloc followed by supplemental information sent En bloc or Overlap

3 Single Overlap

4 Overlap followed by supplemental information sent En bloc or Overlap.

These sequences are designated here as case (1), case (2), case (3), and case (4), respectively.

In all cases, the user establishes a call using the normal call establishment procedures as described in Chapter 5.

If the feature request or digits entered are rejected, the network clears the call in accordance with the procedures in Section 6.23, “Common call clearing/establishment procedures”.

In case (1) Single En bloc, see Figure 85, “Single En bloc sequence”:

- the user sends a SETUP to the network including the feature access code, and the complete supplemental information encoded in the Keypad, or
- the access code for a routing feature:
  - — may be coded in the Transit Network Selection (TNS) information element, with supplemental information in the Called party number information element, or
  - — for operator access, the Operator System Access (OSA) information element with supplemental information in the Called party number information element.
- Depending on the feature invoked, the call either proceeds or is cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 85 Single En bloc sequence

Scenario: The user requests feature activation using dial access with complete supplemental information included in the SETUP message.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request	SETUP (CRn, BC, KP or ——→ TNS and CDN or OSA and CDN,...) (See Note)	Feature request with complete information

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

In case (2), En bloc followed by supplemental information sent En bloc or Overlap, see Figure 86, “En bloc followed by En bloc/Overlap sequence”:

- The user sends a SETUP, including the complete access code encoded in the Keypad information element to the network.
- The network returns a SETUP ACKnowledge containing:
  - — the established call reference

— the B-channel assignment (CID = B-ch)

— the IRQ information element to prompt for supplemental address information (IRQ = prompt, address).

- The network also includes the Signal information element coded to “recall dial tone”, and the PI coded to “inband information or appropriate pattern now available”.
- The network now provides inband recall dial tone.
- On receipt of the network prompt, the user/terminal sends supplemental (address/digit) information to the network in one or more INFOrmation message(s) (En bloc or Overlap).
- After receipt of the first message, the network returns an INFOrmation containing the established call reference, and the Signal information element coded to “tones off, and simultaneously removes recall dial tone.”
- For the En bloc sequence, all of the supplemental address information is in the Keypad information element.
- For the Overlap sequence, the terminal sends multiple INFOrmation message(s) containing digit information in the Keypad information element.

Depending on the specific feature the call will then proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 86 En bloc followed by En bloc/Overlap sequence

Scenario: The user requests feature activation En bloc using dial access and is prompted by the network for supplemental information.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request	SETUP (CRn, BC, KP,..) →	More input needed accept feature/ call request
Additional information required	SETUP ACK (CRn,CID=B–ch, ← PI=#8,IRQ=prompt,address, SIG = dial tone On)	Connect B–channel Prompt user for supplemental information Recall dial tone
	=======================	
En bloc sending all digits sent En bloc	INFO (CRn,KP=digits) →	
	(See Note)	
	=======================	
Overlap sending User enters first additional digit	INFO (CRn,KP=digit) →	Interdigital timing
	INFO (CRn,SIG=tones off) ←	Tones off
User enters remaining digits	INFO (CRn,KP=digits) → " "	Interdigital timing
	(See Note)	

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

For the single Overlap case (3), see Figure 87, “Single Overlap sequence”:

- The user sends a SETUP to the network which includes all of the feature access code, and partial, but not complete supplemental (address/digit) information contained in the Keypad information element.
- The network returns a SETUP ACKnowledge containing the established call reference and the B-channel assignment (CID = B-ch).
- The user then sends the remaining supplemental information coded in the Keypad information element contained in one or more INFOrmation message(s).

- Depending on the specific feature the call proceeds or is cleared, using the procedure as described in Section 6.23, “Common call clearing/establishment procedures”.

Figure 87 Single Overlap sequence

Scenario: The user requests feature activation using dial access with partial supplemental information included in the SETUP.

USER/TERMINAL	MESSAGE	NETWORK
Feature/Call request with partial digits	SETUP (CRn, BC, KP) →	Feature request More input needed
Additional information required	SETUP ACK (CRn,CID=B–ch, ←	Connect B–channel
User enters first additional digit	INFO (CRn,KP=digit) →	Interdigital timing
User enters remaining digits	INFO (CRn,KP=digits) → " "	Interdigital timing
	(See Note)	

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

In case (4), Overlap followed by Overlap / En bloc, see Figure 88, "Overlap followed by En bloc / Overlap sequence":

- The user sends a SETUP to the network, which may or may not contain the Keypad information element.
- If it is included, part, but not all of the feature access code is included. The network responds with a SETUP ACKnowledge containing the established call reference, and a B-channel assignment (CID = B-ch).
- If the Keypad information element was not included in the SETUP, the network returns inband dial tone, and includes the PI coded to “inband information or appropriate pattern now available”, and the Signal information element coded to “dial tone on” in the SETUP ACKnowledge.
- After receipt of the SETUP ACKnowledge, the user sends either the access code, or the remaining digits of the access code, in the Keypad information element contained in one or more INFOrmation message(s).
- If the Signal information element was included in the SETUP ACKnowledge, after receipt of the first message the network removes inband dial tone and returns an INFOrmation containing the established call reference and the Signal information element coded to “tones off”.

- If the feature request is accepted, the network prompts the user for additional information with:
  - an INFOrmation containing the established call reference
  - the Signal information element coded to “recall dial tone”
  - the PI coded to “inband information or appropriate pattern now available”
  - the IRQ information element to prompt for supplemental address information (IRQ = prompt, address).

The network now provides inband recall dial tone.

- On receipt of the network prompt, the user/terminal sends supplemental (address/digit) information to the network in one or more INFOrmation message(s) (En bloc or Overlap).
- After receipt of the first message, the network returns an INFOrmation containing the established call reference, the Signal information element coded to “tones off”, and simultaneously removes recall dial tone.
- If the En bloc sequence is used, all of the supplemental address information is in the Keypad information element.
- If the Overlap sequence is used, the terminal sends multiple INFOrmation message(s), containing digit information coded in the Keypad information element.
- Depending on the specific feature the call may then proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

An example of a feature using this generic procedure is Speed Calling User.

Figure 88 Overlap followed by En bloc / Overlap sequence

Scenario: The user requests feature activation using Overlap dial access and is prompted by the network for supplemental information.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC,KP,..) →	
connect B–ch	SETUP ACK (CRn, PI=#8, ← SIG=dial tone,CID=B–ch)	connect B–ch return dial tone if no KP in SETUP
feature request	INFO (CRn,KP) →	access code digit
	INFO (CRn,SIG=tones off) ←	stop dial tone
remaining access code digit(s)	INFO (CRn,KP) → "	Interdigital timing
Supplemental information reqd	INFO (CRn, PI=#8, ← IRQ=prompt,address, SIG=recall dial tone) ========================	Feature request received, prompt for supplemental information Recall dial tone
En bloc sending all digits in KP	INFO (CRn,KP) → (See Note) ========================	
Overlap sending User enters first supplemental address digit	INFO (CRn,KP) →	Interdigital timing
	INFO (CRn,SIG=tones off) ←	Tones off
User enters remaining digits	INFO (CRn,KP=digits) → " (See Note)	Interdigital timing

Note: Depending on the specific feature activated, the call will proceed or be cleared as described in Section 6.23, “Common call clearing/establishment procedures”.

6.20 G9 - Network notification of Feature Information

The network sends INFOrmation message(s) with Feature indication, and other information elements to convey feature information not related to any calls currently in the initiation, call progress, or active phase, (see Figure 89, “Network notification of feature information”). The terminal does not acknowledge receipt of this message.

A FI information element is also included in certain call control messages.

An example of a feature using this procedure is Ring Again.

Figure 89 Network notification of feature information

USER/TERMINAL	MESSAGE	NETWORK
status info. for feature #x	INFO (CRd, FI=x,y,..) ◄────────	

6.21 G10 - Network Notification of Events

The network sends NOTIFY(s) with Notification indicator, Display Text, and other information elements to convey information on events that occurred to either a call in progress or to an active call (see Figure 90, “Network Notification of Event”). The terminal does not have to acknowledge receipt of this message.

- If multiple events are being reported by the network, send one or more NOTIFY(s) containing a NI, and optionally include a Display Text information element.
- Notification Indicator and Display Text information elements also included in certain call control messages.
- If the user receives a NOTIFY, even if there is an information element error, the call state does not change.

Examples of features using this procedure are Executive Busy Override, and Flexible Calling.

Figure 90 Network Notification of Event

USER/TERMINAL	MESSAGE	NETWORK
event information	NOTIFY (CRn, FI,NI,..) ◄────────	

6.22 G11 - Call-Related notification of feature information

The network sends INFOrmation message(s) with FI, Display Text, Connected number, and other information elements to convey information relating to either a call in progress or to an active call. The terminal does not have to acknowledge receipt of this message.

Examples of features using this procedure are Speed Call and Name and Reason.

Figure 91 Call-Related notification of feature information

USER/TERMINAL	MESSAGE	NETWORK
Call related info	INFO (CRn, FI, DT, CN,..) ◄────────────	

6.23 Common call clearing/establishment procedures

The following two subsections describe the continuation of those sequences described earlier in this chapter for generic procedures which, depending on the specific feature, result in a call either being established or being cleared.

6.23.1 Call establishment following feature request

This procedure applies when the user has initiated a call to invoke a feature using DCA or FKM, and the feature dictates that a call should be established. (Refer to Figure 92, “Call establishment - following feature request”.)

- The network return a Call PROCeeding containing the establish call reference, and, if no SETUP is returned in the previous sequence, the B-channel assignment (CID = B-ch).
- If FKM was used to invoke the feature (that is, a FA was sent to the network), the Call PROCeeding also contains the FI information element corresponding to the specific feature with the appropriate status (FI = x, status).
- Also, if in the preceding sequence the network sent the IRQ information element to prompt the terminal for supplemental information, the Call PROCeeding contains the IRQ information element indicating digit collection is complete (IRQ = complete).

Call establishment/connection continues as described in Chapter 5.

Figure 92 Call establishment - following feature request

Scenario:Upon completion of feature activation sequence a call is established.

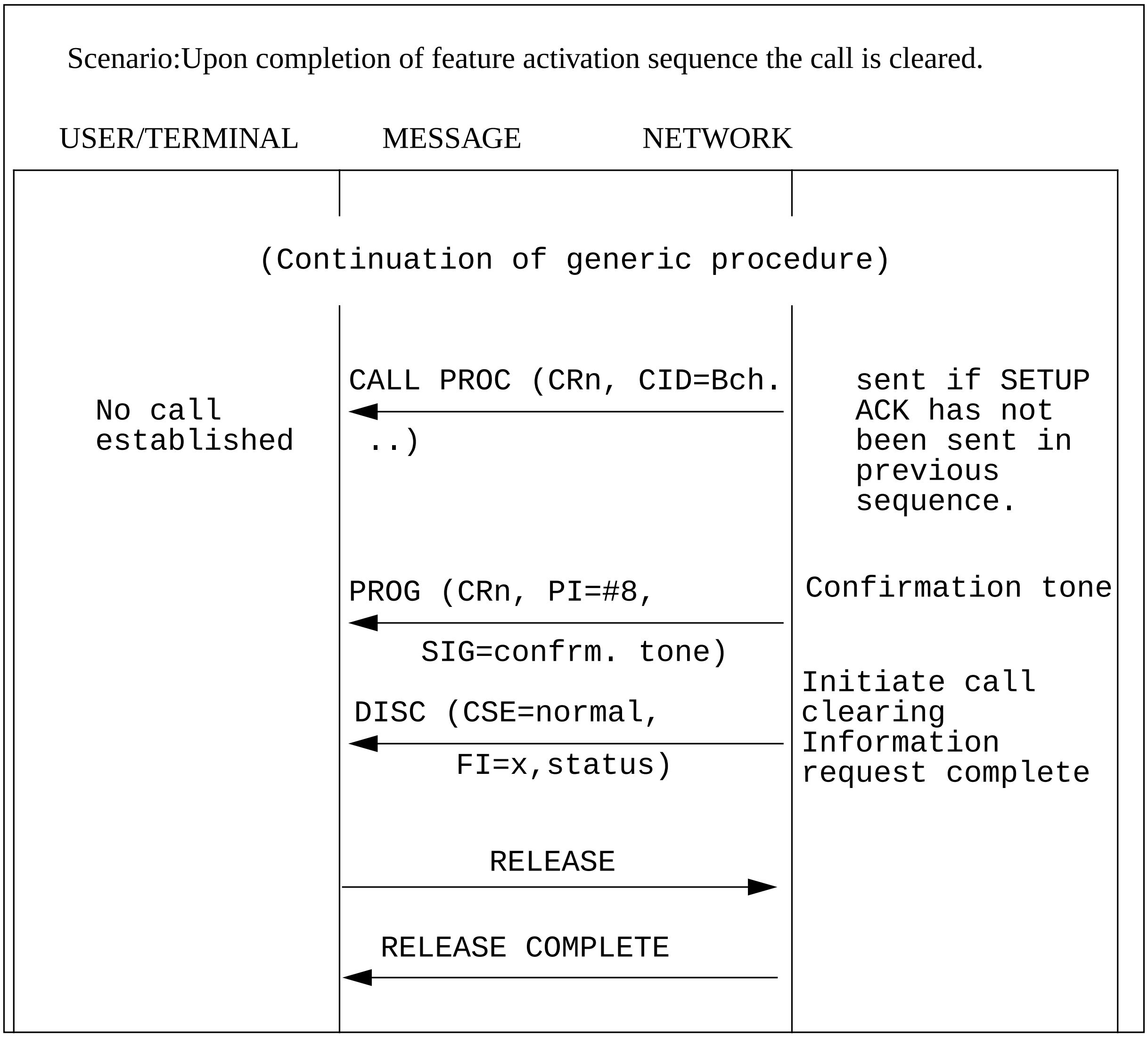
USER/TERMINAL	MESSAGE	NETWORK
	(Continuation of generic procedure)	
Call established	← CALL PROC (CRn, CID=B–Ch IRQ=complete, FI=x,status)	Call can proceed Information request complete
	. .	establishment

6.23.2 Call clearing following feature request

If the feature dictates that no call is to be established, the network initiates the call clearing sequence in accordance with the procedures described in Chapter 5. (See Figure 93, “Call termination - following feature request”.)

- The network returns a CALL PROCeeding containing the B-channel assignment (CID = B-ch) if the previous sequence (the En bloc sequence, for example), has not returned a SETUP ACKnowledge.
- The network sends a PROGress containing
  - — the established call reference
  - — the PI coded to “inband information or appropriate pattern now available”
  - — the Signal information element coded to “confirmation tone”.
- The network now provides confirmation tone.
- Following the PROGress, the network sends:
  - — a DISConnect containing the established call reference
  - — the Signal information element coded to “tones off”
  - — the cause value (CSE = normal) coded to indicate “normal clearing”.
- The IRQ information element, coded to “complete” (IRQ = complete), to indicate that digit collection has ended, is also included in the DISConnect if the IRQ information element was used in the proceeding sequence to request supplemental information.
- If this sequence follows a FKM sequence, the first call clearing message from the network also includes the FI (FI = x, status) with the appropriate status parameter for the particular feature.
- This clearing message is either a RELease, RELease COMPlete or DISConnect, depending on whether the user/terminal sends a DISConnect or RELease before network release.

Figure 93 Call termination - following feature request



6.24 System features

In addition to the features described in this document, a number of system features are available. These include the following:

- Audio interlude
- Automatic route selection
- Class of Service restrictions
- Direct inward dialing
- Direct outward dialing
- Star/Octothorpe translation
- Station to station dialing, that permits the following:
  - — a station user to enter a cost accounting or client billing number into a SMDR record
  - — a station user to be prompted for an account code because of the called number and the station's attributes
  - — a station user to be prompted by the DMS for an account code because of the authorization code or the called number
  - — a station user to enter a cost accounting or client billing number when an incoming call is answered.

6.24.1 Feature activation and limitations

The user is prompted for account code by the DMS, if the data associated with the call, the authorization code, or the NCOS dictates it. The procedures used for network prompted account code are similar to those used for DISA.

User-activated account code entry will be provided in the future, by using a FA, according to procedure G6, see Section 6.17, “G6 - Interactive Feature Key Management (Call Progress/Active Phase)”.

6.25 Anonymous Call Rejection (ACRJ)

6.25.1 Definition

Anonymous Call Rejection (ACRJ) allows a subscriber to block incoming calls from parties with suppressed name/number display information. The ACRJ feature operates independently of any other delivery features.

6.25.2 Procedures

When the ACRJ feature is assigned, the ACRJ subscriber may activate and deactivate delivery of anonymous calls via feature access codes. Feature activation and deactivation is achieved via the G8 dial access procedures.

When ACRJ is active on the set, incoming anonymous calls will be routed to treatment. If ACRJ is disabled on the switch and the subscriber attempts to activate the service, the Feature Not Allowed treatment will be applied. Feature Not Allowed treatment may be a tone or announcement.

When ACRJ is activated or deactivated from a DN on an ISDN set, the activation/deactivation applies to all DNs on the set.

6.25.3 Limitations

The ACRJ feature only applies to calls where the calling party identity has been intentionally blocked. If the calling party identity is unavailable because it has not been provided, then the caller is not considered to be anonymous.

ACRJ may only be assigned to the primary member of an EKTS group. When ACRJ is assigned to the primary member, anonymous calls will be rejected for the entire group.

ACRJ may only be assigned to the MADN CACH controller. When ACRJ is assigned to the controller, anonymous calls will be rejected for all call appearances of the CACH group. Additional information is available in Section 6.67.1.2, "EKTS Call Appearance Call Handling (CACH)," on page 575.

ACRJ may be assigned to pilots and individual members of Multi-line Hunt groups (MLH) and Distributed Line Hunt (DLH) groups. If ACRJ is assigned to the MLH/DLH pilot, all anonymous calls to that group will be rejected and receive ACRJ treatment. When ACRJ is assigned to an MLH/DLH member, an incoming call to that member will be rejected but will continue to hunt rather than receive treatment.

ACRJ may be assigned to Directory Number Hunt (DNH) pilots and members on an individual line basis. If ACRJ is assigned to a DNH pilot, incoming anonymous calls will be rejected for the entire group. When ACRJ is not assigned to the pilot and a call hunts to a member which has ACRJ assigned, the incoming call is rejected by that member, but rather than receiving ACRJ treatment, the incoming call will continue to hunt.

Denied Termination (DTM) takes precedence over ACRJ.

ACRJ is currently incompatible with Group Intercom (GIC).

The Screen List Editing features Selective Call Arrangement, Selective Call Forwarding and Selective Call Rejection take precedence over ACRJ.

6.26 Automatic Callback (ACB)

6.26.1 Definition

The Automatic Call Back (ACB) feature allows the last DN a subscriber called to be automatically re-dialed.

- Activate ACB-I only after the ACB-I subscriber attempts a call to a user (ISDN or non-ISDN) the serving switch judges to be network-determined busy.
- After activating ACB-I, the switch monitors the busy/idle status of the called user, and retains the subscriber-provided call-establishment information during the monitoring period.
- When the busy/idle status changes from busy to idle, the switch informs the subscriber via a NOTIFY message.
- If the subscriber responds with a SETUP message, the switch attempts to establish the call, using the stored information.
- The called user may be on the same switch or another switch.

6.26.2 Feature Key Activation

FKM procedures refer to the use of feature keys on an ISDN set to activate and deactivate the ACB feature. “Toggle-key” operation refers to the use of one key which will handle activation and deactivation of ACB.

The operation of the ACB toggle key is designed to resemble the existing ACB key feature for Meridian Business Sets (MBSs) as closely as possible. In general, toggle key activates an ACB request, if there are none currently active; deactivate all ACB requests, if there are any ACB requests outstanding against any DN on the set.

Feature key activation method applies only to FITs. Using this activation method, ACB can be invoked while in three set state/call state combinations.

The ACB toggle key is assignable only once per ISDN set.

6.26.3 Feature Key Deactivation

If the ACB feature key is pressed when there are outstanding ACB requests for any DN on the set, the hit results in ACB deactivation. All ACB requests associated with that set are canceled. (The ISDN set must be on-line and call processing enabled).

6.26.4 Feature Code Activation

The ACB service can also be activated by dialing an access code from a FIT or NIT. Using the access code method, ACB can be successfully invoked when the user is receiving dial tone. The access code is defined on a customer/residential group translator basis. Thus, there can be several access codes for ACB activation per office and per customer/residential group. Once the dialed access code is translated and it is determined to be destined for ACB, the ACB feature is invoked. The destination DN is retrieved from the outgoing memory slot for ACB.

ACB re-activation is also supported. If the ACB access code is entered for an ACB request and the DN to be called back already has an active outstanding ACB request against it, then the switch resets the timers associated with the outstanding ACB request instead of activating a duplicate ACB request.

- Two-level activation is not available for ACB-I.
- Activation of the feature using access codes requires the subscriber to:
  - — lift the handset
  - — receive dial tone
  - — enter the service access/activation code
  - — obtain a system response.
- Service access/activation codes are market-dependant, and should be capable of being changed on a per-office basis. The code can be XX, *XX, or 11XX.
- System responses, upon activation, should consist of a confirmation message, indicating a successful activation, and a recorded announcement, indicating an unsuccessful activation of the feature.

6.26.5 Feature Interactions for ACB

The interactions are covered below in the AR interactions.

6.27 Automatic Recall (AR)

The Automatic Recall (AR) feature allows the directory number of the last incoming call to a subscriber to be automatically dialed.

6.27.1 AR only supported by Access Code

Activate the AR services by dialing access code from a FIT or NIT. Using the access code method, AR can be successfully invoked when the user is receiving dial tone. Once the dialed access code is translated, and it is determined to be destined for AR, the AR feature is invoked. The destination DN is retrieved from the incoming call memory slot for AR.

AR re-activation is also supported. If the AR access code is entered for an AR request and the DN to be recalled already has an active outstanding AR request against it, then the switch resets the timers associated with the outstanding AR request instead of activating a duplicate AR request.

AR is applicable only for VI and CMD call types.

6.27.1.1 Feature interaction for ACB & AR

6.27.1.1.1 ACB/AR interactions with Call Forwarding

If the calling party attempts to activate ACB or AR to a called party DN that activated Call Forwarding Variable (CFV), Call Forward Intragroup (CFI) or CF fixed, the calling party receives the Short Term Denial announcement.

If the calling party has some form of call forwarding activated, it is still given ACB/AR recall (that is, the ACB or AR recall does not follow the call forwarding feature).

6.27.1.1.2 ACB/AR interactions with Call Forwarding Busy (CFB)

ACB/AR attempts to a busy called party DN with the CFB option, when the called party DN is busy will be denied. If the called party DN has the CFB option and the called party is ‘idle’, immediate processing is performed and the call will be connected.

If the called party becomes busy during call set-up then the ACB/AR feature resumes monitoring.

6.27.1.1.3 ACB/AR interaction with Call Forwarding Don’t Answer

If the called party has CFD and does not answer, the chain is not followed, instead scanning is triggered.

6.27.1.1.4 ACB/AR interactions with Multiline Hunt Group

- The calling party can activate ACB or AR against a DN in a DNH, MLH, DLH hunt group.
- For a DLH or MLH hunt group, the request is placed against the pilot of the hunt group.
- For a DNH hunt group, the request is placed against the member corresponding to the DN to which the request is activated.
- However the entire hunt group is scanned so that call setup for ACB/AR is attempted when any member of a hunt group, not just the pilot DN, becomes idle.
- A member of a hunt group can activate ACB/AR. When recall is given to the calling party, the notification is provided only to the calling party, and hunting does not apply.

6.27.1.1.5 ACB/AR interactions with Flexible Call (FC)

- ACB/AR can be activated from the second leg of a FC.
- ACB/AR can be deactivated from the second leg of a FC.
- ACB/AR recall notification is not provided until the calling party is completely idle.
- The calling party can activate ACB or AR against another station involved in a FC.

6.27.1.1.6 ACB/AR interactions with ACO

When the calling party DN attempts to activate ACB/AR to a called party DN with ACO, the following apply:

- If called party is “call-reference-busy”, it can not offer the call.
- If the called party is no longer “notification-busy”, it can be offered using ACO.

6.27.1.1.7 ACB/AR interactions with EKTS

A calling party may activate ACB or AR against a EKTS group in the same manner as normal lines.

6.27.1.1.8 ACB/AR interaction with MADN DNs

- The calling party can activate ACB/AR from a MADN DN in a SCA or CACH group.
- For a MADN DN, the request is placed against the CA key corresponding to the DN to which the request is activated.
- For a MADN SCA or CACH DN, ACB can be provisioned against any Primary or Secondary member of a MADN DN/ CA group.
- For a MADN SCA or CACH DN, AR can only be provisioned against the SCA or CACH Primary member of the MADN DN/ CA group. The Secondary member can activate AR as long as a Primary member is provisioned with AR within the same MADN DN/ CA group.
- When an activation of ACB/AR is set against a MADN SCA or CACH DN/ CA key and the called party is idle, automatic re-dial is initiated immediately and the call is connected. If the called party is busy during call set-up, then the ACB/AR feature continues to monitor the called party. As soon as the called party becomes idle, a NOTIFY message is sent to only the MADN DN/ CA key that had initiated the ACB/AR activation. The MADN DN/ CA key sends a SETUP message to the called party and the call is connected.
- The NOTIFY message includes the CAPI of the MDN DN/ CA key that invoked the ACB/AR feature.
- Once an activation occurs (from a MADN DN/ CA) against a busy DN, no duplicate activation from the MADN DN/ CA can occur against that same busy DN.
- ACB/AR interaction with MADN functionality allows normal bridging, hold/ retrieve, and other services with the ACB/AR feature interaction. See Section 6.67, “Electronic Key Telephone Service” for further details on MADN functionality.

6.27.1.1.9 ACB/AR interactions with Calling Identity Delivery and Suppression (CIDS)

If the Directory Number of the ACB/AR calling party is public and does not subscribe to Calling Identity Delivery and Suppression (CIDS), the DN is delivered. If the DN subscribes to CIDS, the DN is delivered if the suppression code is not dialed prior to the ACB/AR activation. The DN is not delivered on the subsequent call setup if the CIDS code is dialed prior to ACB/AR.

If the Directory Number of the ACB/AR calling party is private and does not subscribe to CIDS, the DN is not delivered. If the DN of the ACB/AR calling party is private and subscribes to CIDS, the private indicator is delivered to the called party DN. If the delivery code is dialed prior to activating ACB/AR, the DN is delivered.

6.27.2 Restrictions/limitations

ACB/AR is not allowed to be imposed in combination with the following features:

- Automatic Line

- Denied Termination
- Ring Again.

6.28 Additional Call Offering (ACO)

6.28.1 Definition

- Additional Call Offering (ACO) uses the basic functional call offering procedures, with no channel indication for ACO.
- ACO permits a user to be notified of an incoming call when all user subscribed B-channels, over which the call can be offered, are in use.
- The maximum number of such notifications (for example, the number of simultaneous incoming calls that can be offered to the given ISDN DN) is specified at subscription time, as a Notification Busy Limit (NBL).
- The terminal is responsible for presenting a suitable ‘call waiting’ indication to the user.
- The user has a choice of accepting, rejecting, or ignoring the additional offered call.

The B-channel allocation procedures for incoming calls are different depending on whether a free B-channel is available, and if the customer subscribes to ACO.

- For example, when a second call comes into a terminal that subscribes to 2 B-channel access, and one of the B-channels is busy, the call is offered per GR-268 procedures.
- If a third call comes into the terminal, while both B-channels are active, it is offered as an ACO call.
- Additional calls are offered to a given DN up to the CRB and the NB limits.
- The first additional VI calls (a second VI call being offered when a VI or CMD call is currently active on one B-channel, and the other B-channel is free) are offered per GR-268 procedures, using the available B-channel, rather than as an ACO Call. In Section 5.7.1.2.3, “B-channel allocation for 2B-channel terminals”, all the possible conditions of B-channel availability and incoming calls to the 2 B-channel terminal are covered.

6.28.2 Procedures

When an incoming call arrives at the terminating exchange, the network checks that the BC and the called number are supported on the interface, before offering the call. If there is a B-channel available to the user that can handle the incoming CT, the network offers the call using the normal call offering procedures specified in Chapter 5.

When all user-subscribed B-channels over which the call may be offered are in use, and the NBL has not been exceeded, the network offers the incoming call using a broadcast SETUP, specifying a ‘no channel’ condition in the Channel Identification IE.

The user may choose to handle the incoming call in one of the following ways:

1 Ignore the incoming call, (for example, not respond to the incoming SETUP).

2 Reject the call by sending a RELease COMplete, as defined in Chapter 5.

3 Accept the additional call by first clearing the existing call, using the clearing procedures defined in Chapter 5.

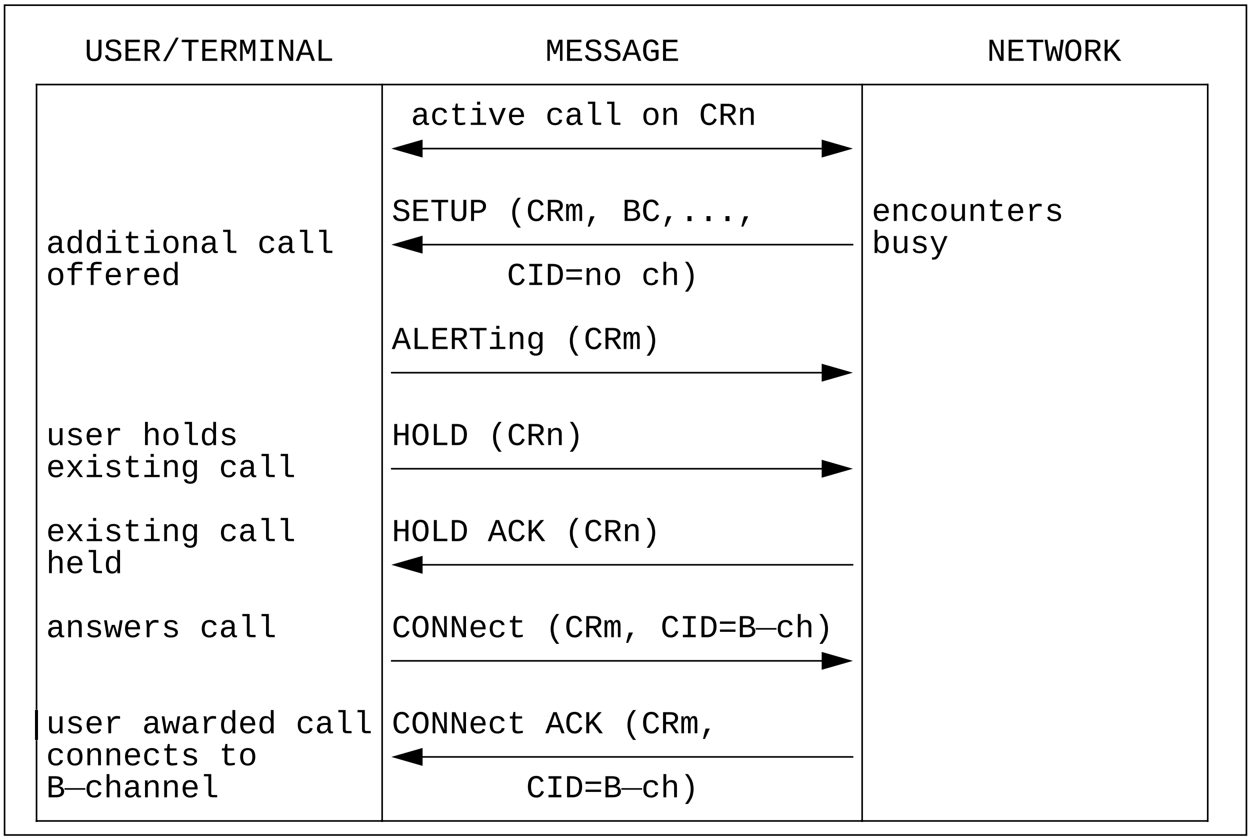
4 Accept the incoming call by first placing the existing call on hold, using the Hold procedures, as defined in Section 6.44, “Hold and Retrieve”.

In cases 3 and 4, on receipt of the first CONNect from the user, the network completes the circuit switched path to the selected B-channel and sends a CONNect ACKnowledge.

- The CONNect may contain a Channel Identification IE and can be assigned as “any channel”, “preferred B1/B2”, or “exclusive B1/B2”.
- If the Channel Identification IE is not present, the network assumes any channel is acceptable.
- If the channel is successfully assigned, the CONNect ACKnowledge contains the Channel Identification IE specifying the assigned B-channel indicated as exclusive.
- Otherwise, the network responds with a RELease containing the appropriate cause value, either #34, “no channel/circuit available” or # 44, “requested circuit/channel not available”.
- The network releases any other users that responded to the incoming call, as specified in Chapter 5.
- If a user sends a CONNect prior to a B-channel being made available, network rejects the call using a RELease and follows the procedures described in Chapter 5.
- If the network is unable to select a free B-channel, it rejects a CONNect from the user by sending a RELease and follows the procedures described in Chapter 5.

- Case 4 is illustrated in Figure 94, "Additional Call Offering with Explicit Hold".

Figure 94 Additional Call Offering with Explicit Hold



6.28.3 Feature interactions and limitations

ACO is not compatible with:

- DN Hunting (DNH), Multi-Line Hunting, and Distributed Line Hunting.
- EKTS; a comparable capability is inherent to the normal call offering procedures within EKTS
- the Series Completion feature.

6.29 Automatic Dial (AUD)

6.29.1 Definition

Automatic Dial (AUD) permits a terminal to automatically dial a frequently-called number by selecting the AUD Feature Activator. The user may program the automatically-dialed number from the terminal.

6.29.2 Programming and feature activation

To assign, change, or delete the number stored against the AUD Feature Activator, the terminal can not have any calls in an active state, although one can be on hold.

6.29.2.1 Assigning a number

To assign an AUD number:

- Select the AUD Feature Activator.
- Wait for the prompt for parameter entry from the network.
- Enter the stored number.
- Select the Feature Activator to signify that the last number has been entered.

6.29.2.2 Changing a number

To change an AUD number, overwrite the existing number by following the same practice as assigning a number.

6.29.2.3 Deleting a number

To delete a number:

- Select the Feature Activator.
- Enter an octothorpe (#).
- Select the AUD Feature Activator for the second time to complete the action and turn off the AUD Feature Indicator.

6.29.2.4 Originating a call

To originate a call, originate a call request and select the AUD Feature Activator.

6.29.3 Procedures

The AUD programming procedure is illustrated in Figure 95, "Automatic Dial programming"; the invocation procedure is illustrated in Figure 96, "Automatic Dial usage".

- To initiate programming an AUD number, invoke any of the sequences specified in the generic procedure G2, as described in Section 6.13, “G2 - Interactive Feature Key Management (non-call related)”.
- Although not mandatory, an octothorpe (#) may be used as the last keypad entry to serve as a “last digit entry flag”. It is not stored.
- To establish a call, invoke AUD by feature key access during call initiation, using any of the sequences specified in the generic G3 procedure, as

described in Section 6.14, “G3 - Feature Key Management (Call Initiation Phase)”.

- Upon receiving the selected AUD Feature Activator, the network establishes the call based on the stored digits and returns a CALL PROCeeding having the Called Party Number (CDN) IE containing the stored digits.

The programmed number can be:

- any DDD (direct distance dialing)
- any DDO (direct dialing overseas)
- any local or operator assisted number
- an account code
- an authorization code
- a feature access code.

6.29.4 Limitations

- A valid AUD destination address can be up to 24 digits long.
- The following conditions relate to actions taken while programming a new AUD number:
  - If the network receives two consecutive INFOrmation(s) with Feature Activator information elements corresponding to the AUD feature, they do not affect the current number stored. After receiving the second INFOrmation, the network returns an INFOrmation with a Feature Indicator information element specifying the AUD Feature Indicator (FI) having an idle status.
  - Selecting any Feature Activator does not invalidate the programming procedure; the activator selection is not processed. Only the second AUD FA selection ends the programming sequence. Call initiation while programming invalidates the procedure, and the associated AUD FI is idle.

Figure 95 Automatic Dial programming

Scenario: Terminal is idle. The user programs a frequently-dialed number by using the AUD activator #x.

USER/TERMINAL	MESSAGE	NETWORK
AUD programming request	INFO (CRd, FA=x) →	
	← INFO (CRd, FI=x,prompt, IRQ=prompt,address)	prompt for address digits
user enters address digits	INFO (CRd, KP=digit) → "	
	INFO (CRd, KP=digit) →	
AUD programming complete request	INFO (CRd, FA=x) →	
	← INFO (CRd, FI=x,idle, IRQ=complete)	AUD number stored
programming complete		

Figure 96 Automatic Dial usage

Scenario: Terminal is idle. The user has previously-programmed an AUD number. The AUD activator #x is used to make an outgoing call.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC...) →	
connect B–ch	← SETUP ACK (CRn, CID=B–ch)	connect B–ch
AUD request	INFO (CRn, FA=x) →	
	← INFO (CRn, SIG= Tones off)	
display called party number	← CALL PROC (CRn, CDN=dest addr) : (as in basic call)	establish call

6.30 Automatic Line (AUL) and Warm Line (WML)

6.30.1 Definition

Automatic Line (AUL) allows the user to access a pre-determined destination by selecting the call appearance pre-assigned to this destination.

Warm Line (WML) behaves the same as AUL, except that it connects to a pre-determined destination only if no address digits are received within a short interval. If address digits are supplied before the timer expires, the call follows the standard GR-268 call origination procedures.

6.30.2 Programming and feature activation

There is no programming associated with this feature. The destination DN of the AUL or WML call is provisioned in the switch.

6.30.3 Procedures

6.30.3.1 Activating AUL

The procedure to activate automatic line (AUL) is illustrated in Figure 97, "Automatic Line Call origination".

- The terminal initiates a call request by sending a SETUP to the network.
  - It may include a Calling Party Number (CGN) Information Element containing a DN provisioned as an AUL DN for the call type associated with the Bearer Capability information element included in the SETUP.
  - If the calling party number default DN is an AUL DN for the call type associated with the Bearer Capability IE, the Calling Party Number information element need not be included (unless the provisioned parameter Calling Number Provision Necessary is set to “yes”, in which case the CGN IE must be provided).
- Upon receiving the SETUP, based on the pre-assigned destination address, the network establishes the call, and returns a CALL PROCeeding containing a Channel Identification (CID) IE specifying the B-channel.
- The call then proceeds in accordance with the basic call establishment procedures described in GR-268.

Figure 97 Automatic Line Call origination

Scenario: Terminal initiates a AUL call by including an AUL DN in the SETUP.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC, CGN) →	maps to predefined destination
connect B–ch	← CALL PROC (CRn, CID=B–ch)	
	(as in basic call)	

6.30.3.2 Activating WML

To activate WML:

- The terminal initiates a call request by sending a SETUP to the network.
  - — It may include a Calling Party Number information element containing a DN provisioned as an WML DN for the call type associated with the Bearer Capability information element included in the SETUP.
  - — If the calling party number default DN is an WML DN for the call type associated with the Bearer Capability IE, the Calling Party Number IE need not be included (unless the provisioned parameter Calling Number Provision Necessary is set to “yes”, in which case the CGN IE must be provided).
  - — Neither the CGN, KP, nor Operator System Access IE may be included in the SETUP. If any are, WML does not activate.
- The switch responds to the SETUP with a SETUP ACKnowledge.
  - — If the terminal subsequently sends an INFOrmation before the time-out ends, the feature does not terminate to the WML DN; the switch continues with standard GR-268 call origination procedures. If the time-out occurs, the feature operates as previously described for AUL.

6.30.4 AUL and WML provisioning parameters

The AUL parameter, associated with a DN/CT, is defined as either a string of up to 15 digits, or the value NULL. There can be only one AUL for a DN/CT, but there is no restriction on the number of DN/CTs associated with an interface associated with an AUL parameter.

The WML parameter, associated with a DN/CT, is defined to be a string of up to 15 digits, or the value NULL. There can be only one WML for a DN/CT, but there is no restriction on the number of DN/CTs associated with an interface associated with a WML parameter.

6.30.5 Limitations

- The following features can not be used on a DN/CT that has AUL assigned: Speed Calling, Automatic Dial (AUD), Last Number Redial, and Last Number Redial Associated.
- AUL can park a call but cannot unpark it.
- Ring Again and Call Back Queuing (CBQ) may be activated from an AUL DN but cannot be recalled from one.

6.31 Basic Rate Interface Verification - Office Equipment

6.31.1 Definition

The ISDN Basic Rate Interface (BRI) access line parameter verification (BRIV-OE) feature allows a user to retrieve the Office Equipment (OE) identification of a particular ISDN BRI line. BRIV-OE is a service assurance feature intended for use by telephone company installation and maintenance personnel to identify the Office Equipment that a particular BRI access line is connected to from the far-end of the line (such as, the Main Distribution Frame (MDF), junction box, or customer premises).

6.31.2 Feature activation

The BRIV-OE feature is accessible over a BRI access line (2-wire U-interface or 4-wire S/T-interface) via a Fully Initializing Terminal (FIT) or a Non-Initializing Terminal (NIT). In order to use the BRIV-OE capability, the ISDN terminal must have the capability to display the call control display information.

The BRIV-OE feature is accessed by dialing a Telephone Company defined 3-digit access code or 7-digit directory number. Both CMD and VI call types are supported for the BRIV-OE feature activation. If the correct access number for BRIV-OE is dialed and the access is gained, the text “OE=” followed by the Office Equipment identification is displayed on the ISDN terminal display panel.

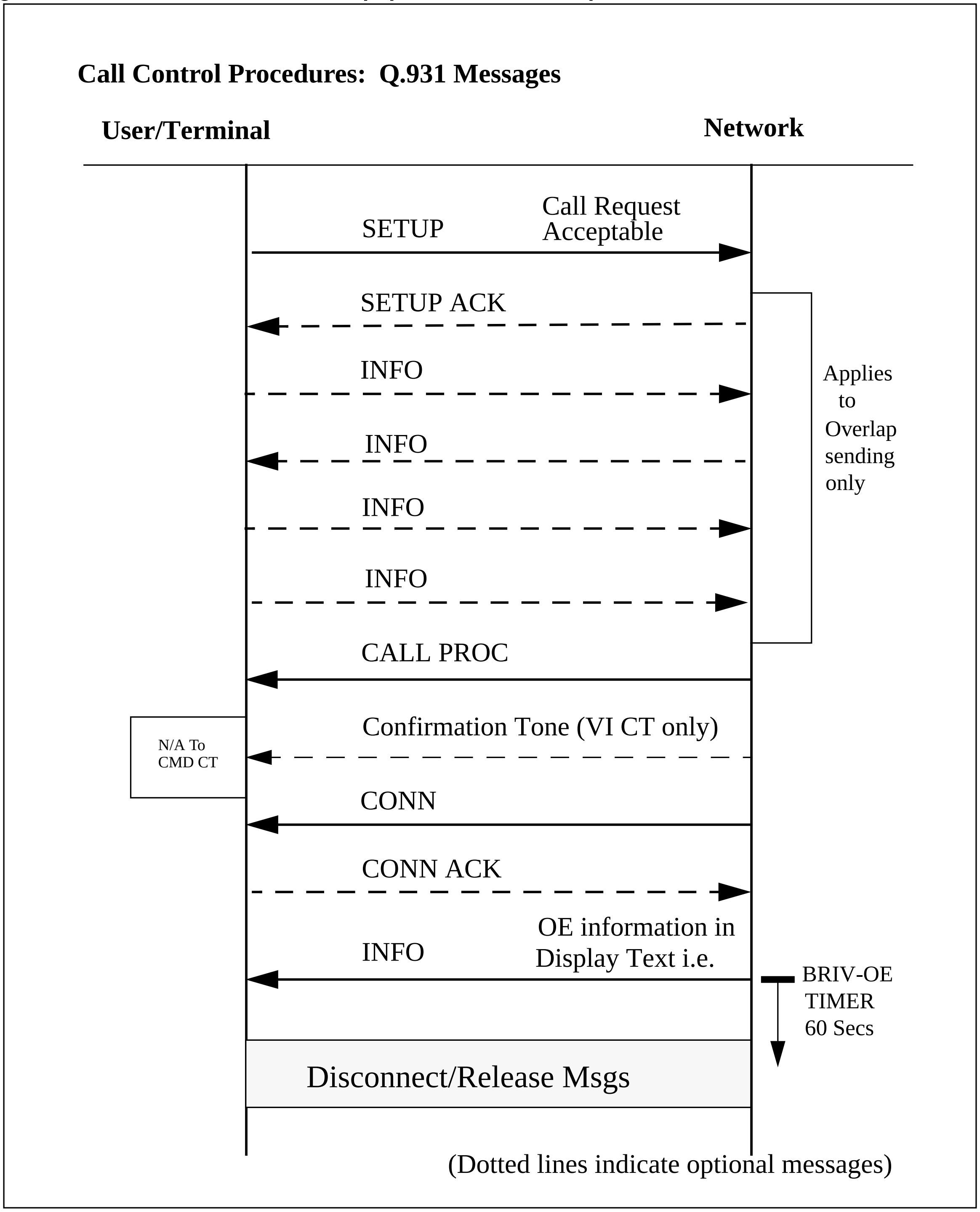
6.31.3 Procedures

6.31.3.1 BRIV-OE Activation

The call signaling (from call setup to call release) between the network and the terminal when successfully accessing the BRIV-OE capability follows the VI/CMD call control procedures as described in Section 5.7, “Call control procedures”. The BRIV-OE message flows are shown in Figure 98, “BRI Verification - Office Equipment call control procedures”. BRIV-OE may use either En bloc or Overlap sending.

The BRIV-OE call is made using an available B-channel. When the network is ready to proceed with the call it sends a CALL PROCeeding message to the terminal, followed by a confirmation tone applied to the B-channel if the call type is VI. A CONNect message is then sent to the terminal to complete the connection. The terminal may respond with an optional CONNect ACKnowledge message.

Figure 98 BRI Verification - Office Equipment call control procedures



The Office Equipment information is sent to the terminal in the Display Text information element of an INFOrmation message. The format of the Display

Text information element for the BRIV-OE display is shown in Table 170, " Display Text information element format for BRIV-OE display”.

Table 170 Display Text information element format for BRIV-OE display

Display Line	Display Text (20 Characters Display) 1234567891 1234567892	Display Text (40 Characters Display) 1234567891 1234567892	1234567893 1234567894
Line 1	OE=[oe#]	OE=[oe#]	
	Status Tag (Group 1/Field 1)	Status Tag (Group 1/Field 1)	Blank Tag (Group 2/Field 2-3)
Line 2			
	Blank Tag (Group 2/Field 2-3)	Blank Tag (Group 3/Field 4)	Blank Tag (Group 4/Field 5)

As indicated in the table above, a status tag is associated with the Display Text information element. The Office Equipment information display text is 20 characters. It contains a leading indication “OE=”, followed by the LEN of 15 characters, and a trailing indication of 2 characters that indicates the termination of the line is either in the switch or in a remote peripheral. The detailed format of the BRIV-OE display text is shown in Table 171, " BRIV-OE Display Text format”.

Table 171 BRIV-OE Display Text format

Display Form	Description		Positions
OE=SITE FRM_U_LS_CC-T	**Context**	**Format**	**1-20**
OE=	OE=, the leading indicator	OE=	1-3
SITE	Site name, 4 Characters	AAAA	4-7
FRM	Frame, 2/3-digit(0-511)	_ ## or ###	8-10
_	space	_	11
U	LCME Unit, 1-digit(0-1)	#	12
_	space	_	13
LS	Line Subgroup, 2-digit(0-15)	##	14-15
_	space	_	16
CC	Circuit, 2-digit(0-31)	##	14-15
-T	OE type, -S for in the switch, -I for in a remote peripheral	-A	N/A
Note: Underscore _ is used for a space; A is used for an alphanumeric; # is used for a digit.			

Table 172, " Example of BRIV-OE display”, contains an example of the BRIV-OE display text.

Table 172 Example of BRIV-OE display

1	2	3	4	5	6	7	8	9	1	11	12	13	14	15	16	17	18	19	20
O	E	=	H	O	S	T		1	2		1		0	8		0	4	-	S

6.31.3.2 BRIV-OE call clearing

The BRIV-OE call is released using the normal call clearing procedures either by the user or by the network when the 60 second BRIV-OE timer expires. If the call is released by the user before the INFormation message containing the Office Equipment identification value is sent to the terminal, the OE information is not displayed on the terminal. The Office Equipment information display is cleared after the call is taken down. Also, the Office Equipment information display is cleared upon an incoming call.

6.31.4 Restrictions/limitations

- The ISDN terminal must have a display panel.
- The layer 3 connection must be established for the terminal.
- There must at least one B-channel available for the BRIV-OE call.
- The Office Equipment information may be overwritten or cleared due to an incoming call.

6.32 Call Back Queuing

Note: Call Back Queuing (CBQ) is only supported on the National ISDN-1 Basic Rate Interface. CBQ is not supported on the NI-2 interface.

6.32.1 Definition

From the user point of view, Call Back Queuing is similar to the Ring Again feature. The difference is that the user can make a CBQ request when encountering a busy trunk group or dialing to a different customer group.

Call Back Queuing can be invoked in the following situations:

- the outgoing trunk group has the CBQ feature assigned and an idle trunk is not available in the trunk group.
- the call is placed on a direct outward dialed number and the called busy line is served by the same network.
- the call is placed on a terminal-to-terminal basis which is internal to the network. The called busy line is a line belonging to another customer group.
- the user has been given an Expensive Route Warning Tone. The subscriber can wait for the ERWT delay time to expire, abandon the call, or activate Call Back Queuing. (See Section 6.64, “Expensive Route Warning Tone (ERWT)” for a description of the Expensive Route Warning Tone service.)

6.32.2 Feature Activation/Deactivation

Call Back Queuing activation and deactivation are the same as those for Ring Again; refer to Section 6.59, “Ring Again (RAG),” on page 561.

6.32.3 Call Offer Notification

Call Back Queuing call offer notification is the same as that for Ring Again; refer to Section 6.60.3, “Call Offer Notification,” on page 562.

6.32.4 Recall Answer

Call Back Queuing recall answer is the same as that for Ring Again, refer to Section 6.60.4, “Recall Answer,” on page 562.

6.32.5 Feature Interactions and Limitations

A request to activate the Call Back Queuing feature is disallowed if the direct outward dialed call is for another Customer Group's attendant queue. Call Back Queuing cannot be activated against an attendant queue.

A user must be assigned the Ring Again feature to activate Call Back Queuing.

6.33 ISDN Calling Name Identification Services

6.33.1 Definitions

ISDN Calling Name Identification Services is a set of services for the control and display of calling name information. It consists of the following subfeatures:

- ISDN Calling Name Delivery (I-CNAM)
- ISDN Calling Identity Delivery and Suppression (I-CIDS)
- ISDN Delivery Feature Deactivation/Activation

Each of these features is described in more detail below.

6.33.1.1 ISDN Calling Name Delivery

This feature allows the called user to have the name associated with the calling party number delivered when a call is offered to the interface. The calling party's name is accessed from an Service Control Point-based database using an SS7 Transaction Capabilities Application Part (TCAP) query.

6.33.1.2 ISDN Calling Identity Delivery and Suppression

This feature allows the calling party to specifically set the presentation status of the calling party number and name on a per-call basis, which will either allow or suppress the delivery of the calling name and number to the called party. If the user invokes ISDN Calling Identity Delivery (CIDSDLV), then the calling party PI and PNI are set to "presentation allowed" and the calling name and number may be delivered to the called party (provided the called party has subscribed to delivery of this information). If the user invokes ISDN Calling Identity Suppression (CIDSSUP), then the calling party PI and PNI are set to "presentation restricted" and the calling name and number will not be delivered to the called party.

This feature is only active for the duration of a call. Subsequent calls will use the provisioned privacy status unless CIDS or other subscribed method is used to change the per-call privacy status.

6.33.1.3 ISDN Delivery Feature Deactivation/Activation

This feature allows subscribers to ISDN Calling Name Delivery on a usage-sensitive basis the ability to activate or deactivate the delivery of all ISDN Delivery information (i.e., the calling party number and calling party name).

Once deactivated, the name and number will not be delivered until reactivated by the user.

6.33.2 Feature Activation

6.33.2.1 ISDN Calling Name Delivery Feature Activation

There are no activation procedures associated with this feature. See for activation procedures for both Calling Name and Calling Number Delivery.

6.33.2.2 ISDN CIDS Feature Activation

The CIDS feature may be activated by an originating BRI subscriber by either dial access or with feature keys.

6.33.2.3 ISDN Delivery Feature Activation

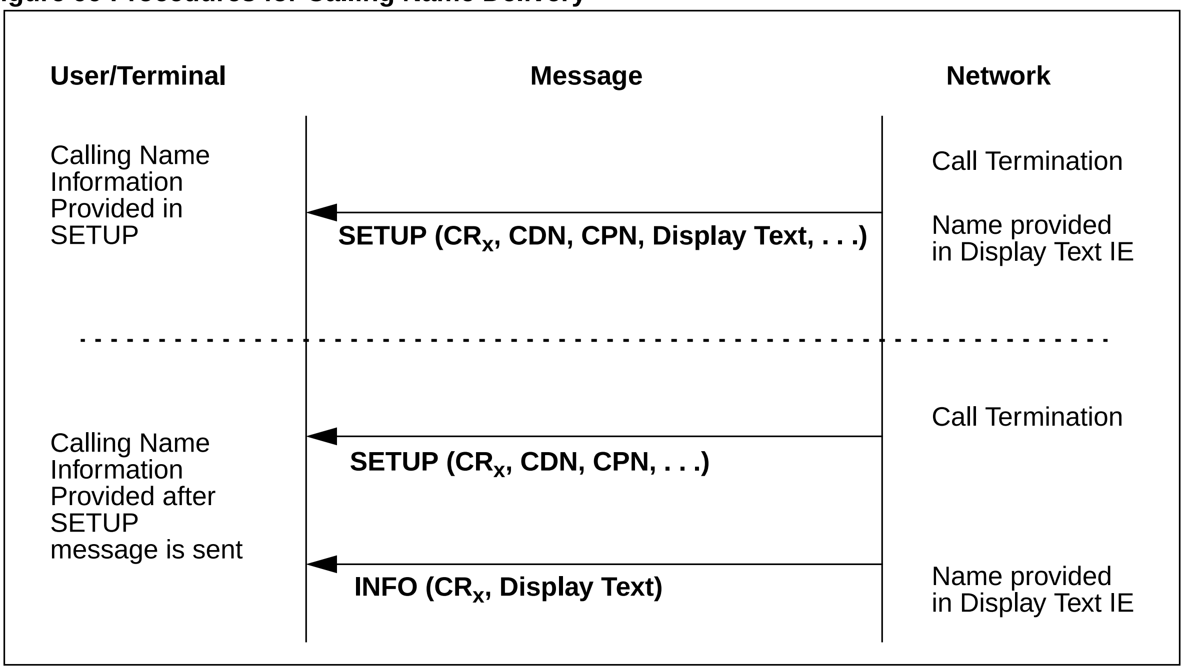
To activate delivery of calling name and calling number, the user dials an access code. To deactivate delivery of calling name and calling number, the user dials a different access code. These access codes are administrable by the telco.

6.33.3 Procedures

6.33.3.1 Procedures for ISDN Calling Name Delivery

The calling party name information, if available, is sent in the SETUP message sent to the terminating interface. If the information is not available at the time the SETUP message is sent to the terminating interface (due to a delay in a response to the Transaction Capabilities Application Part query), the information is sent in a subsequent INFOrmation message. In either case, the name information is coded in a Display Text information element. These procedures are illustrated in the following figure.

Figure 99 Procedures for Calling Name Delivery



6.33.3.2 Procedures for ISDN CIDS

To invoke ISDN Calling Identity Delivery (CIDSDLV) or ISDN Calling Identity Suppression (CIDSSUP), the user must either use a dial access code or use feature key management.

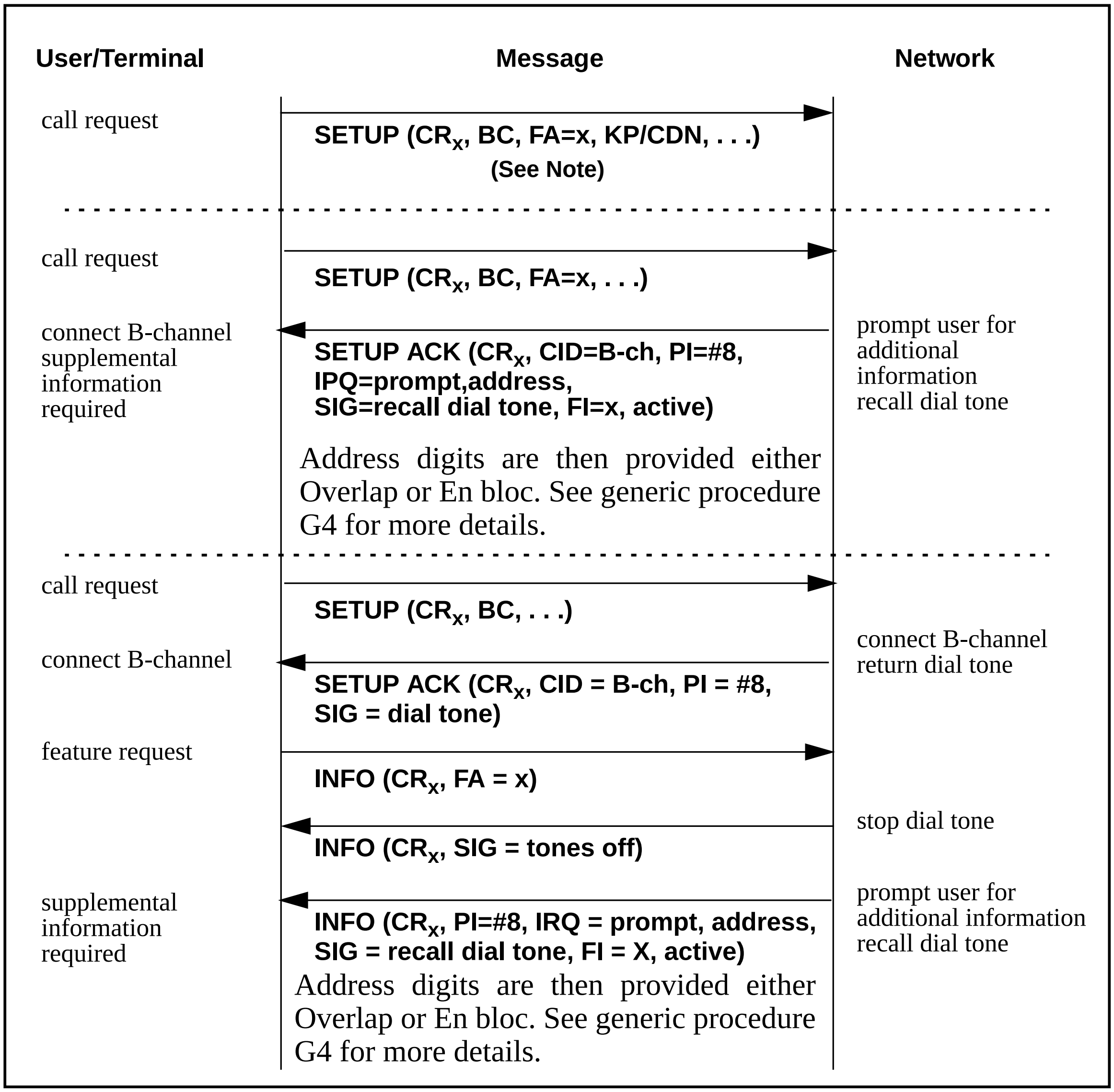
For dial access to CIDSDLV or CIDSSUP, the user follows generic procedure G8 and supplies the dial access code, followed by the called party destination DN. (Refer to Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)” for more information about generic procedure G8.)

For feature key access to CIDSDLV or CIDSSUP, the feature activator information element must be sent within the context of a call by the following methods, which are part of generic procedure G4 (see Section 6.15, “G4 - Interactive Feature Key Management (Call Initiation Phase)”):

- SETUP message with no KP or CDN, and no FA, followed by an INFO message with the FA and optionally KP or CDN
- SETUP message with a FA, followed by a INFO message with KP or CDN
- SETUP message with the Feature Activation information element, and the digits in either a Keypad or Called Party Number information element[1]

The feature activator cannot be sent after the destination address digits are sent. These methods are illustrated in Figure 100, “Procedures for Calling Identity Delivery and Suppression”.

Figure 100 Procedures for Calling Identity Delivery and Suppression



Note: This En bloc method is not currently supported.

1. This method for activating I-CIDS within the context of a call is not currently supported.

6.33.3.3 Procedures for ISDN Delivery

The procedures for activating or deactivating ISDN Delivery are via dial access codes. The procedures follow generic procedure G7, Dial Access (Call Initiation Phase). Refer to Section 6.18, “G7 - Dial Management (Call Initiation Phase)” for more specific details.

6.33.4 Error Conditions

If ISDN Calling Identity Delivery or Suppression or ISDN Delivery is invoked while not subscribed, the DMS-100 returns cause #50, “Requested facility not subscribed (location: public network serving the local use”, with the Signal information element coded as “reorder tone”.

6.34 Calling Number Identification Services (CNIS)

Calling Number Identification Services (CNIS) allows the calling party to provide a specific DN when originating a call for:

- use in identifying service options related to the call, and/or
- possible delivery to the called party. In turn, the called party can control the delivery of incoming DNs offered by calling parties.

Calling Number Identification Services is applicable to both circuit and in-band packet mode calls.

Circuit mode subscribers can:

- select privacy options that either restrict or allow Calling Party Number presentation to the called user
- include subaddress information when originating a call that can then be transferred to the called party as part of Calling Party Number delivery
- receive Redirecting number information identifying the original called party and last redirecting party when a call has been forwarded to them.

6.34.1 Functional procedures

The following sections describe protocol procedures for Calling Party Number Provision/Validation, Number Privacy, and Number Delivery as they relate to circuit mode calls. See Section 6.34.2, “In-band packet procedures” for protocol related to packet mode calls.

6.34.1.1 Calling Party Number provision/validation

If the user provides calling number information as part of call origination (for example, includes a Calling Party Number information element in the SETUP message), the Type Of Number/Numbering Plan Indicator and Calling Party Number must match one of the values shown in Table 173, “Coding for Calling Party Number Information Element in SETUP message”.

Table 173 Coding for Calling Party Number Information Element in SETUP message

Type of Number/ Numbering Plan Indicator	Digits
Local Number/E.164 Numbering Plan	7
National Number/E.164 Numbering Plan	10
Abbreviated Number/Private Numbering Plan	1-7
Local Number/Private Numbering Plan	1-15
International Number/X.121 Numbering Plan (+)	1-15
TN Unknown/NPI Unknown	0-15

Note: + = Not supported at the present time.

If either the User-Provided (UP) Calling Party Number violates any Calling Party Number information element coding conventions in Table 173, “Coding for Calling Party Number Information Element in SETUP message”, or the Calling Party Number provided by the user does not match one of the valid DNs assigned to the user’s service profile, the network:

— discards the user provided Calling Party Number information

— returns a STATUS containing cause #100, “invalid IE contents (location: public network serving local user, diagnostic: Calling Party Number information element identifier)”

— proceeds with call processing, using the default DN (for example, as if the user had not provided a Calling Party Number in the SETUP message).

If the user does not provide Calling Party Number information, the network uses the default DN associated with the user’s service profile as the Calling Party Number.

If the user-provided Calling Party Number passes validation, the DMS configures the Calling Party Number as follows before passing it on to the called party:

- The Screening Indicator (SI) value is set to User Provided Passed Screening (UPPS).
- The Type of Number/Numbering Plan Indicator (TN/NPI) is always coded to “National Number, E.164 Number Plan” unless:
  - — the call takes place on the same switch between two members of the same customer group, and
  - — the customer group uses a private numbering plan. In this case, the TN/NPI is coded as “Abbreviated Number, Private Numbering Plan”
- If the TN/NPI is “National Number, E.164 Numbering Plan”, the number of digits sent as the Calling Party Number is ten. If it is “Abbreviated Number, Private Numbering Plan”, the number of digits sent is from 1-7, depending on the numbering plan conventions.
- The Presentation Indicator is coded according to the Privacy options assigned to the calling party (see Section 6.34.1.2, “Number privacy”).

If the user-provided Calling Party Number fails validation or a default DN is used for any other reason, the DMS configures the Calling Party Number as follows before passing it on to the called party:

- The Screening Indicator (SI) value is set to Network Provided (NP).
- The Type of Number/Numbering Plan Indicator (TN/NPI) is always coded to “National Number, E.164 Number Plan” unless:
  - — the call takes place on the same switch between two members of the same customer group, and
  - — the customer group uses a private numbering plan. In this case, the TN/NPI is coded as “Abbreviated Number, Private Numbering Plan”
- If the TN/NPI is “National Number, E.164 Numbering Plan”, the number of digits sent as the Calling Party Number is ten. If it is “Abbreviated Number, Private Numbering Plan”, the number of digits sent is from 1-7, depending on the numbering plan conventions.
- The Presentation Indicator is coded according to the Privacy options assigned to the calling party (see Section 6.34.1.2, “Number privacy”).

6.34.1.2 Number privacy

DMS supports a Calling Party Number Presentation Allowed parameter (for example, SUPPRESS) that sets a default Presentation Indicator value for all calls originated from a given DN (for example, Presentation Indicator equals either “Presentation Allowed” or “Presentation Restricted”). Other DMS features, Calling Number Delivery Blocking (CNDB) and ISDN Calling Identity Suppression, allow a user to change the default Presentation Indicator value on a per-call basis through an access code (ISDN Calling Identity Suppression also allows feature keys to be used to invoke the feature). This Presentation Indicator value applies to both Calling Party Number and Redirecting Number delivery.

If the calling party subscribes to the Privacy Change Allowed (PCA) feature, the privacy status of the call can be set by using the Presentation Indicator field in the Calling Party Number information element (in octet 3a).

6.34.1.3 Calling Party Number Delivery

If the called party subscribes to Calling Party Number Delivery, and the Presentation Indicator value associated with the incoming Calling Party Number is “Presentation Allowed”, the network codes the Calling Party Number information element as shown in Table 174, “Network Coding for the Calling Party Number for Calling Number Delivery” and in Figure 101, “Intra-switch calls”. There is no difference in service offering between terminals that support on a single B-channel on a TEI and terminals that support two B-channel access on a single TEI.

Table 174 Network Coding for the Calling Party Number for Calling Number Delivery

Coding of Incoming CGN Indicators			Coding of CND Indicators for CGN Delivery		
SI	**NA/NP**	**PI**	**PI/SI**	**TN/NPI**	**Digits**
NP	National Number, E.164 Plan (digits = 10)	PCA Subscribed Presentation Allowed	Presentation Allowed, NP	National Number in E.164 Plan	10 Mapped
NP	National Number, E.164 Plan (digits = 10)	PCA Subscribed Presentation Prohibited	Presentation Prohibited, NP	National Number in E.164 Plan	None
NP	National Number, E.164 Plan (digits = 10)	PCA not Subscribed	Presentation Allowed, NP	National Number in E.164 Plan	10 Mapped
UPPS	National Number, E.164 Plan (digits = 10)	PCA Subscribed Presentation Allowed	Presentation Allowed, NP	National Number in E.164 Plan	10 Mapped
UPPS	National Number, E.164 Plan (digits = 10)	PCA Subscribed Presentation Prohibited	Presentation Prohibited, NP	National Number in E.164 Plan	None
UPPS	National Number, E.164 Plan (digits = 10)	PCA not Subscribed	Presentation Allowed, NP	National Number in E.164 Plan	10 Mapped
NP	International Number, E.164 Plan	PCA Subscribed Presentation Allowed	Presentation Allowed, NP	International Number in E.164 Plan	Mapped
NP	International Number, E.164 Plan	PCA Subscribed Presentation Prohibited	Presentation Prohibited, NP	International Number in E.164 Plan	None
NP	International Number, E.164 Plan	PCA not Subscribed	Presentation Allowed, NP	International Number in E.164 Plan	Mapped
UPPS	International Number, E.164 Plan	PCA Subscribed Presentation Allowed	Presentation Allowed, NP	International Number in E.164 Plan	Mapped
UPPS	International Number, E.164 Plan	PCA Subscribed Presentation Prohibited	Presentation Prohibited, NP	International Number in E.164 Plan	None
UPPS	International Number, E.164 Plan	PCA not Subscribed	Presentation Allowed, NP	International Number in E.164 Plan	Mapped

Coding of Incoming CGN Indicators			Coding of CND Indicators for CGN Delivery		
SI	**NA/NP**	**PI**	**PI/SI**	**TN/NPI**	**Digits**
NP or UPPS	Other Than National or International Number, E.164 Plan or, National Number, E.164 Plan (digits ≠ 10)	Any Value	Number Unavailable Due to Interworking, NP	Unknown, unknown	None
NP or UPPS	No Value	Any Value	Number Unavailable Due to Interworking, NP	Unknown, unknown	None
UPFS Only	Any Value	Any Value	Number Unavailable Due to Interworking, NP	Unknown, unknown	None
UPNS Only	Any Value	Any Value	Number Unavailable Due to Interworking, NP	Unknown, unknown	None

Figure 101 Intra-switch calls

CGN TO BE OFFERED FOR DELIVERY		CODING OF CGN INDICATORS FOR CGN DELIVERY: PI/SI	TN/NPI	DIGITS
User-Provided, Validated	→	Pres. Allowed, UPPS or Pres. Prohib, UPPS	National Number in E.164 Plan or Abbreviated Number in Private Num. Plan	10 1-7
Default DN	→	Pres. Allowed, NP	National Number in E.164 Plan or Abbreviated Number in Private Num. Plan	10 1-7
Number Unavailable	→	Number unavailable Due To Interworking NP	Unknown, Unknown	None

The {Abbreviated Number} TN/NPI and format are used if the call is intra-customer group and intra-switch, and if the customer group subscribes to a private numbering plan.

If the called party subscribes to CGN Delivery, and the PI value associated with the incoming CGN is coded to “Presentation Restricted”, the network codes the Calling Party Number information element as follows:

- the PI value is coded to “Presentation Restricted”
- the Screening Indicator and TN/NPI values are coded as described in the above table
- the digits field is left empty

If the called party subscribes to BLOCK Calling Party Number, no Calling Party Number information element is included in the SETUP.

If the called party subscribes to ISDN Delivery and delivery has been deactivated, then the calling party number will not be delivered in the SETUP message. Also, if the calling party invokes ISDN Calling Identity Suppression when initiating the call, then the calling party number will not be delivered in the SETUP message.

6.34.1.4 Redirecting number delivery

DMS circuit mode subscribers assigned Redirecting Party Number Delivery receive Redirecting Number information for a forwarded call, if delivery is permitted by the redirecting user's privacy subscription. This information identifies the original called party and is included in the Redirecting Number information element in the SETUP sent to the called party. These subscribers will also receive the last redirecting party information, in the case of multiple redirections. This information will not be displayed to the subscriber unless their set can support display of three numbers.

6.34.1.5 Calling Party Subaddress information transfer

To send Calling Party Subaddress information to a called party, the calling party includes a Calling Party Subaddress information element in the SETUP used for circuit-mode call origination. This SETUP must also include a valid Calling Party Number (see Table 173, "Coding for Calling Party Number Information Element in SETUP message"). If the Calling Party Subaddress information can be delivered, the network includes it in a Calling Party Subaddress information element in the SETUP sent to the called user. In such cases, however, the calling party receives no indication that Calling Party Subaddress information was delivered.

In any of the following situations, the network discards the Calling Party Subaddress information sent by the calling party and returns a STATus containing cause #43, "access information discarded" (location: public network serving local user; diagnostic: Calling Party Subaddress IE). In these cases, the called party does not receive notification that the Calling Party Subaddress was discarded.

- The calling party includes Calling Party Subaddress information, but no Calling Party Number information, in a SETUP.
- The user-provided Calling Party Number in the SETUP is invalid.
- The Calling Party Subaddress Information Transfer feature is not assigned to the validated, user-provided Calling Party Number.
- The Calling Party Subaddress information is more than 20 octets long.

If the called party does not subscribe to Calling Party Number Delivery, the network discards Calling Party Subaddress information without notifying either the calling or called party.

6.34.2 In-band packet procedures

6.34.2.1 Number provision/validation for In-band packet

To take full advantage of Calling Number Identification functionality and to be able to specify a Calling Party Number for delivery to the called party, the packet mode user must provide a valid Calling Address value as part of call origination.

- This value can be in either 7- or 10-digit E.164 format.

- If a 7-digit value is provided, the network converts the address to 10-digits before validation takes place (for example, the network prefixes the seven-digit number with the appropriate Numbering Plan Area (NPA) code).
- The network then validates the 10-digit, user-provided address value against a list of valid DNs for the calling party's service profile.
- If either no match is found, or the user failed to provide a Calling Address value when originating the call, the network uses the default DN, based on channel type/service profile used to place the call (for example, the channel default DN subscribed for the semi-permanent B-channel or LAPD D-channel packet connection in use).

Calling Number Privacy capabilities are not supported for packet mode calls.

6.34.2.2 Number delivery for In-band packet calls

Number delivery is required for all in-band packet calls and, for each call offered, the network always delivers the calling address to the called party in International E.164 format.

- If the in-band call occurs between subscribers using the E.164 Numbering Plan, the delivered calling address takes the form:
  — 1 + NPA + NXX XXXX (North America)
- If the in-band call is interworked from an X.25 subscriber using the data (X.121) Numbering Plan, the delivered calling address takes the form:
  — 0 + Data Network Identification Code + Network Terminal Number

6.34.3 Redirecting Number Delivery Services Re-engineering Database

6.34.3.1 Overview

The Custom Local Area Signalling Services (CLASS) Display features are those that allow caller information to be displayed on a screen device. These features include: Calling Number Delivery (CND), Calling Name Delivery (CNAMD), and Redirecting Number Delivery (RND). These CLASS Display features use sensitive pricing (SUSP) or Automatic Message Accounting (AMA) to store this information per DN per Call type per feature.

Billing information for these features are stored in Table RESFEAT. The following examples are provided for clarification of tuples to be found in Table RESFEAT for CLASSDSP features assigned to a DN:

ex.). For each DN on an LTID assigned CND there is a separate tuple in Table RESFEAT;

>> pos isdn1 1 CND

LINE	KEY	FEAT	VAR
isdn1	1	CND	CND AMA ACT 0 0 0 0
isdn1	4	CND	CND AMA ACT 0 0 0 0

6.34.3.2 Provisioning

When provisioning these CLASS Display features on an LTID, you must specify whether you are using Automatic Message Accounting (AMA) or not by provisioning AMA or NOAMA per feature. Table RESFEAT verifies AMA counts when SUSP is turned on in table AMAOPTS.

6.34.3.3 Feature Activation

Currently the only activation code associated with CLASS Display features is *50 which is defined in table IBNFEAT. This activation code is applicable to CND, CNAMD, and RND. However, you must provision the features with AMA, or it will not peg counts for number of calls delivered to each DN in Table RESFEAT.

6.35 Call Forwarding

6.35.1 Feature Overview

When Call Forward Universal (CFU) service is activated, all calls terminating to that DN are diverted to the remote DN, regardless of the status of the users line. When the CFU service is deactivated, calls are terminated to the users DN as before. Several variations of CFU exist. “Call Forwarding Fixed” allows activation and deactivation by the user but, limits the remote DN to a fixed predetermined station. There also exists several variations that either limit the originator or the remote DN to, internal to the customer group only or, external to the customer group only, or a combination applied to the originator and/or remote. Note that all flavors of CF allow for either customer, or telephone operating company activation/de-activation.

Call Forward Busy (CFB) allows a user to activate a service that re-directs all calls to another DN, when that user’s line is busy. When the switch determines a DN is busy, the call is forwarded to the remote DN. The remote DN is a unique one, used for the CFB condition. When the CFB service is not active, a call to the base receives busy treatment. There are several variations of CFB that involve:

- programmable remote
- fixed remote
- intra group only remote
- forward intra group originates only
- forward inter group originates only

CFB only forwards calls to intra group destinations, unless Call Forward, Busy, Unrestricted (CBU) exists. These are discussed in greater detail in Section 6.35.6.1.1, “Call Forward Busy (CFB)”.

The Call Forwarding Don’t Answer (CFD) service re-directs a call after a time, if no one answers it. A call attempting to terminate to a DN with the CFD service active, starts an answer timer when the base station starts to ring. If no one answers the base station before the timer expires, the call is forwarded to the stored DN. If CFD is not active, the call continues to ring and no forwarding takes place. There are also several variations of CFD that involve:

- programmable remote
- fixed remote
- intra group only remote
- forward intra group originates only
- forward inter group originates only

CFD only forwards calls to intra group destinations, unless Call Forward, Don’t Answer, Unrestricted (CDU) exists. These are discussed in greater detail in Section 6.35.6.1.2, “Call Forward Don't Answer (CFD)”.

6.35.2 Call Forward All Calls (CFAC)

6.35.2.1 Definition

The terminal assigned CF is called a base terminal. The terminal to which the calls are to be forwarded is called a remote terminal.

CFAC is a subset feature, it is available to any combination of the DNs on the set. It allows a base terminal to have incoming calls associated with a DN forwarded to a pre-determined address, regardless of the base terminal's status. The remote terminal DN is programmed by the user.

Figure 102 Call Forward All Calls - Originating End

Scenario: An idle terminal initiates an outgoing call. The destination (the base terminal) has activated CFAC. The calling terminal and base terminals are located at the same network node.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC, ...) →	
	← CALL PROC (CRn)	
ringback on, display	← ALERTing (CRn, PI, SIG)	forward call to remote terminal
	← CONNect (CRn)	remote terminal answered
call connected		

One of the following options may be assigned to a terminal:

- Call Forward Intra-group (CFI) - Allows a base terminal to forward calls to a user-defined remote terminal within the customer group.
- Call Forward Universal (CFU) - Allows a base terminal to forward calls to a user-defined remote terminal in or outside the customer group.

6.35.2.2 Call Forwarding Activation/Deactivation flexibility

The activate/de-activate of the CF service can be done in a variety of ways to give the terminal user flexibility. CF can be program activated through administration (service order), or by Dialed Access Codes (DCA), and by FKM.

For ISDN both CFI and CFU are user-programmable types of CF. Users may activate them using the FKM or DCA methods. FKM can be used either outside the context of a call or during call establishment.

A CPE built to this specification as of NA007 or earlier, utilizes a two key hit FKM procedure as shown in Figure 103, “Call Forward All Calls programming by FKM”. The first feature activator received by the network begins the CF programming request. The second FA received by the network ends the CF programing request.

Figure 103 Call Forward All Calls programming by FKM

Scenario: Terminal is idle. CFAC indicator (#x) shows status “idle”. The user programs CFAC using the CF activator #x.

USER/TERMINAL	MESSAGE	NETWORK
CF All Calls programming request	INFO (CRd, FA=x) →	
prompt for input	← INFO (CRd, FI=x,prompt, IRQ=prompt,address)	prompts for additional info.
user enters forward address digits	INFO (CRd, KP=digit) →	
	"	
	INFO (CRd, KP=digit) →	
CF programming completion request	INFO (CRd, FA=x) →	***Required for NI-1 only*.**
CF activated	← INFO (CRd, FI=x,active, IRQ=complete indicator)	accept CF request

Since NA008, the Network has supported the Bellcore CPE Guidelines specified method for single key hit activation for CF programing. The network maintains a Datafilled representation of each ISDN CPE. This is the Terminal Service Profile (TSP). See 6.32.2, “Feature Activation/Deactivation” for more information on the types of TSP supported and the services available to each. The ability to assign CF on a DN/CT basis requires the TSP to be datafilled as NI-2.

The two key hit method of CF programing continues to be supported on CPE datafilled as either NI-1 FITs or 2 B FITs. The single key hit method of CF programing is supported on CPE datafilled as NI-2 FITs. This operation is no changed.

CPE which operate using two key hit CF programming and are datafilled as NI-2 FITs will continue to operate. A second key hit received while the network timers is still running is ignored. The CF feature will be activated once the CF programing time has expired. Further details on the activation/deactivation procedures are provided below.

6.35.2.3 CF activation/deactivation using a single Feature Key hit

This requirement specifies that the activation sequence for CF using FKM complies to the Q.931 protocol, layer 3. Supported for NI-2 TSPs only.

This procedure supports the activation of CF through the network receipt of a single FA IE sent either within the context of a call or outside the context of a call.

The single key stroke method provides a time-out using the interdigit timer. If a second key hit is made during the time the timer is active, the message is ignored. Activation takes place after receiving a valid remote address. Activation to the last programmed remote takes place if no digits are received.

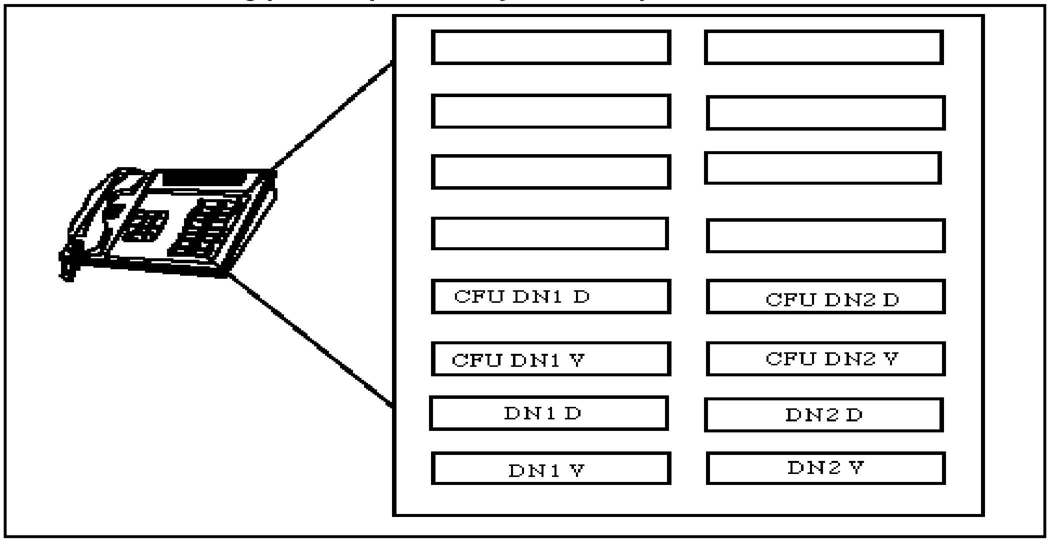
6.35.2.3.1 Deactivate Outside the context of a call

- Deactivate CFU and CFI outside the context of a call using procedure G1,see Section 6.12, “G1 - Feature Key Management (Non-call related)”, that the subscriber may invoke at any time. CF deactivation through G1 is illustrated in Figure 105, “Cancellation of Call Forward All Calls - Key Access”.
- The INFOrmation from the user to the network contains the CFAC FA.
- The network returns an INFOrmation with the FI IE specifying the CFAC FI having the status “idle”.
- When the feature is deactivated, the digits used to forward calls are left intact so they do not have to be re-entered when the feature is re-activated.

6.35.2.4 Per DN/CT Call Forwarding Key activation/deactivation

This capability enables the user to program CF for CFU, per DN, per CT, using FKM.

Figure 104 Call Forwarding per DN, per CT, Key Access option 1



6.35.2.5 CF activation/deactivation outside the context of a call

The network permits the user to activate and deactivate CFU outside the context of a call, if FKM control is used.

This activation procedure should be transparent to any activity on the interface’s B-channels.

The network expects the null call reference is in the INFOrmation message received from the base user. The network screens the information for validation. If it determines that the service/CT/DN assigned are valid, it activates the service.

Turn off “Establish Courtesy Call” provision for activation outside the context of a call.

Use procedure G2, refer to Section 6.13, “G2 - Interactive Feature Key Management (non-call related)” to perform CF programming outside the context of a call. There are several possible sequences within G2. One example of how to apply this procedure when the user is activating CF, is illustrated in Figure 103, “Call Forward All Calls programming by FKM”.

- Select the CF Feature Key as the FA.
- An INFOrmation with the FA IE corresponding to the CF FA is sent to the network.
- It responds with an INFOrmation containing the FI IE specifying the CF FI with status “prompt”, and the IRQ IE specifying “prompt” for address information.
- Using the KP IE, send the forwarding number contained in one or more INFOrmation(s).
- After sending the complete address, to signal the end of parameter entry, again send an INFOrmation with the FA IE corresponding to the CF FA.
- The network responds with an INFOrmation containing the FI IE specifying the CF FI with status “active”.

- Abandon the programming sequence at any time by selecting the Release activator. The terminal sends an INFOrmation, containing a FA IE, with the Release FA.
- If no address is entered during programming, re-activate the previous address used to forward calls.
- If an asterisk is the first digit entered, it and any following digits entered, are stored.
- If an asterisk is entered after digits have been entered, it and any following digits are not stored.
- If the octothorpe is entered, any further digits are ignored by the network.
- If the octothorpe is entered as the only addressed digit, this cancels the previously stored number.

6.35.2.5.1 Activation During call establishment

- Activate the CFU and CFI features during call establishment by using the FKM or dial access method.
- Procedure G4, refer to Section 6.15, “G4 - Interactive Feature Key Management (Call Initiation Phase)”, is applicable when activating CF using FKM during call establishment.
- Apply procedure G8, see Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”, when the subscriber is activating CF during call establishment using the dial access method.
- When using G4 or G8 to activate CFU or CFI, the network does not attempt to establish a call to the remote DN unless the subscribers” customer group has the CFWVAL terminating option.

6.35.2.6 Deactivation

6.35.2.6.1 During call establishment

CFU and CFI may be deactivated during call establishment by either the FKM or dial access method. Specifically, use procedures G3, see Section 6.14, “G3 - Feature Key Management (Call Initiation Phase)”, or G7, see Section 6.18, “G7 - Dial Management (Call Initiation Phase)”, to deactivate CFAC.

Figure 105 Cancellation of Call Forward All Calls - Key Access

Scenario: CFAC is in effect. CF indicator #x shows status “active”. Cancel CF using the CF FA#x.

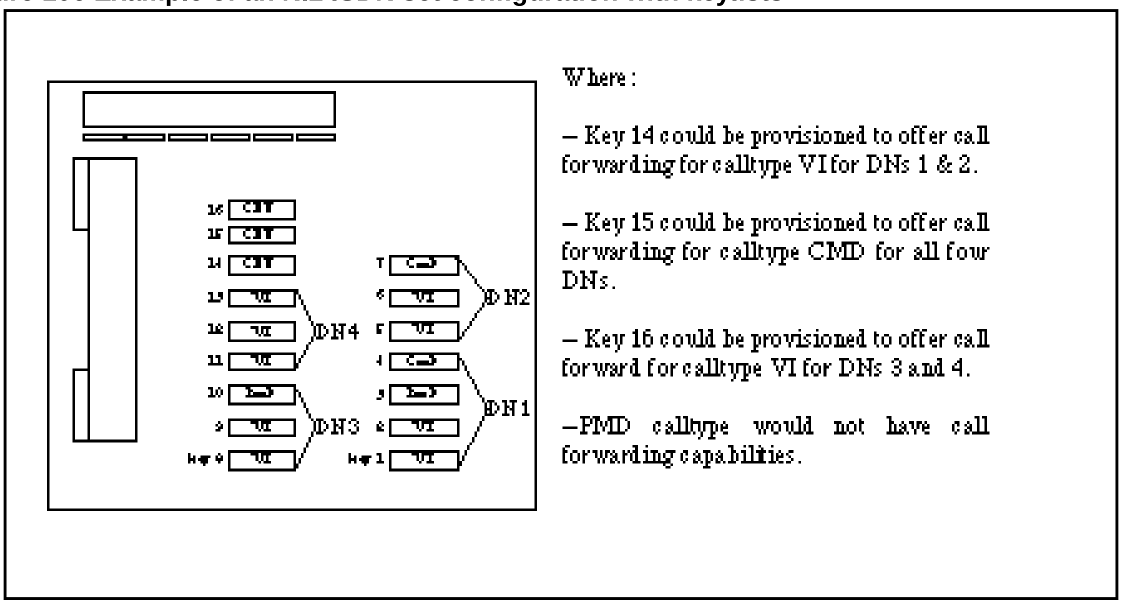
USER/TERMINAL	MESSAGE	NETWORK
CF cancel request	INFO (CRd, FA=x) →	
CF deactivated	INFO (CRd, FI=x,idle) ←	cancel CF all calls

6.35.2.6.2 Call Forwarding Keylist on a DN/CT Basis

NI-1 DMS-100 CF on a keylist basis is extended to allow DN/CT call forwarding. This gives the user the option to define two keylists, one Voice (VI), and one Circuit Mode Data (CMD). It covers all current CF subfeatures supporting keylist. There is a separate FKM for each CT.

The service is extended to cover CMD CT keylist.

Figure 106 Example of an NI2 ISDN set configuration with keylists



6.35.3 Call Forward Validation (CFWVAL)

6.35.3.1 Definition

Call Forward Validation allows CFU or CFI to automatically validate the forwarded-to DN when a station activates CFU or CFI. Two options are assigned on a customer group basis:

- Routing option - validation of the correctness of the DN as a routable number
- Terminating option - validation by attempting to complete the call to the target station upon FA

When a user programs a CF, destination validation is performed on the DN entered.

6.35.3.2 Procedures

With CF validation, confirmation indicates that the forwarding DN was successfully stored and validated, according to the validation option, either routing or terminating, used.

6.35.3.3 Routing option

- When routing is assigned, within the network CF FA may take place using procedure G2, see Section 6.13, “G2 - Interactive Feature Key Management (non-call related)”, G4, see Section 6.15, “G4 - Interactive Feature Key Management (Call Initiation Phase)”, or G8, see Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”.
- If routing is assigned, the user at the base station will not attempt to terminate the forwarding DN.
- If the received remote DN is not routable, the network returns the CF FI of “idle”, and re-order tone to the calling user.
- If the received remote DN passes screening by the network, the calling user receives confirmation tone, and CF FI having the status “active”.

6.35.4 Call Forward Validation (CFXVAL)

6.35.4.1 Definitions

CFXVAL is a line option of Call Forwarding Validation for NI-2 ISDN terminals on a per-terminal basis. CFXVAL validates the remote DN (routing validation) a call is forwarded to and may or may not provide courtesy call based upon termination option values (TERMOPT) selected if the remote DN is valid.

6.35.4.2 Provisioning

The CFXVAL option can only be assigned to the PDN key of the NI-2 ISDN terminals. There are four values for the subfield of TERMOPT as shown below:

ANSRQC - Courtesy call offered and answer required with confirmation indicator

ANSRQNC - Courtesy call offered and answer required without confirmation indicator

NANSR - Courtesy call offered and no answer required

NECC - Do not establish courtesy call

This provides to the NI-2 terminals the ability to provision CFXVAL on a terminal / Call Type (CT) basis and call processing for each the above values with the exception that the ANSRQC and ANSRQNC are not permitted on the Circuit Mode Data (CMD) CT.

CFXVAL is allowed to be added to a NI-2 terminal even if no other call forwarding subfeatures are assigned to the set. However, CFXVAL works only if the flavor of CFX or CFXDNCT CFX is provisioned on the same terminal and only if the CT of call forwarding subfeature assigned matches that of CFXVAL.

Either the terminal option CFXVAL or the customer group option CFWVAL works the way it should as described above if it is provisioned alone. The CFXVAL functionality always supersedes that of CFWVAL if both are provisioned.

6.35.5 Forwarding a call

- If a call is forwarded, the originating terminal receives the re-directing and re-direction addresses if the base terminal is within the same ISDN, as shown in Figure 102, “Call Forward All Calls - Originating End”. If it does not, the originating terminal is not aware that its call is being forwarded.
- The remote terminal receives the origination and re-directing addresses if the remote terminal and the originating terminal are within the same ISDN, as shown in Figure 107, “Call Forward All Calls, Busy or Don't Answer - terminating end”.
- When CF occurs, a reminder notification, consisting of:
  - — a NOTIFY with a null call reference
  - — the NI set to “call is forwarded” the Signal IE with value of alerting on
  - — pattern 4, reminder ring, is sent to the served user.
- A terminal with an activated CF feature can originate calls.

6.35.5.1 Call Forward reminder notification

Reminder notification is available for NI-2 ISDN terminals using a toggle method. Parameter NOTIFY, prompted for during the SERVORD addition of option CFXDNCT (subfeatures CFU, CFF, or CFI), provides the toggle mechanism for call forwarding reminder notification. If the user subscribes to the reminder notification, the network will send a NOTIFY message to the base station when a call to the base station is redirected by the call forwarding feature. The NOTIFY message includes the following information elements:

- Call Reference - Null Call Reference
- Bearer Capability (BC) - of the redirected call
- Signal - coded as reminder ring
- Calling Party Number (CGN)
- Calling Number Subaddress (CGS
- Called Party Number (CDN)
- Called Number Subaddress (CDS)
- First Redirecting Number (RN1)
- Last Redirecting Number (RGN)

6.35.6 Call Forward Busy (CFB) and Call Forward Don't Answer (CFD)

6.35.6.1 Definitions

6.35.6.1.1 Call Forward Busy (CFB)

Call Forward Busy allows calls to a terminal to be forwarded to a pre-determined terminal within the customer group, when the base terminal is busy, defined as CFB (see Section 6.6, “Definition of busy”, for a busy definition.)

An option is available to prevent the forwarding of incoming intragroup calls. Where a high proportion of incoming calls are of an intragroup origin, the option prevents the remote terminal from being flooded with calls.

CFB with CBU assigned, can forward to a remote as an inter group call.

6.35.6.1.2 Call Forward Don't Answer (CFD)

Call Forward Don’t Answer allows a base terminal, that does not answer an incoming call within a customer group prescribed time, to have the call routed to a remote terminal or to the attendant station.

An option is available that prevents the forwarding of intragroup calls to a remote terminal.

CFD with CDU assigned, can forward to a remote as an inter group call.

6.35.6.2 Feature activation

- Activated upon assignment - CFB and CFD may be activated at subscription time. When assigned to a terminal, the remote terminal's destination address must also be assigned.
- During call establishment - The dial access method may be used to activate CFB and CFD during call establishment. Use procedure G8, see Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”, when activating CFB and CFD.

6.35.6.3 Deactivation

- Deactivation upon assignment - CFB and CFD may be deactivated by service order.
- During call establishment - The dial access method may be used to deactivate CFB and CFD. Use procedure G7, see Section 6.18, “G7 - Dial Management (Call Initiation Phase)”, when deactivating CFB and CFD.

6.35.6.4 Forwarding a call

- Figure 107, “Call Forward All Calls, Busy or Don't Answer - terminating end” illustrates the delivery of the re-direction address to the called user interface during the forwarding of a call.
- Figure 102, “Call Forward All Calls - Originating End” illustrates the calling user interface during CFD feature operation. In this case the calling user receives the re-directing and re-direction addresses.

Figure 107 Call Forward All Calls, Busy or Don't Answer - terminating end

Scenario: A terminal receives a re-directed incoming call. It together with the base and originating terminal are located at the same network node.

USER/TERMINAL	MESSAGE	NETWORK
call offered	SETUP (CRn, BC, ←——— CID=B–ch, CGN=orig. addr, RGN=redir number)	incoming call
	ALERTing (CRn,...) ———→	
	(same as basic incoming call)	

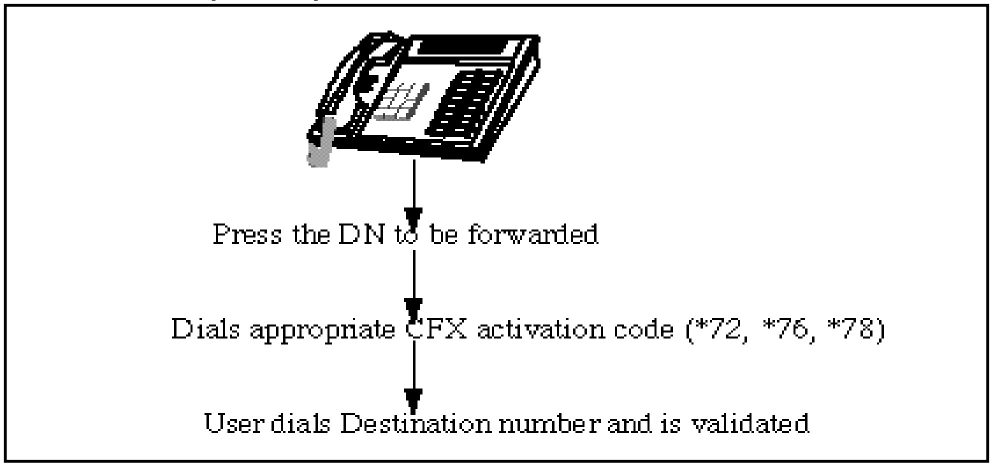
6.35.6.5 Per DN/CT Call Forwarding Dial Activation/Deactivation

Forwarding Activation/Deactivation is permitted for the CFB and CFD subfeatures is provided via Dial Access codes only. FKM activation/deactivation is not provided.

This feature enables the user to program CFB and/or CFD per DN and CT by dialing an access code followed by the appropriate information. The Bearer Capabilities (BCs) IE must be part of the SETUP message from the terminal. The switch uses the BC in the SETUP for determining CF activation for a particular CT. A separate Activation /Deactivation Code can be done via access codes only. FKM is not supported for activation/deactivation for CFB/ CFD. Each dial accessed may be from 2-5 digits, and are used for both VI and

CMD. The example below allows the customer to activate CFU, CFB, CFD via Access Codes.

Figure 108 Per CFB/CFD, per DN, per CT, Dial Access



6.35.6.6 CFB/CFD Feature interactions and limitations

- During CF of any kind, the BC of the call's originator is used to determine if it is possible to terminate on a terminal. If so, the call is forwarded, if not, it is routed to treatment.
- If a DN is assigned both CFB and CFD, the remote terminal can be different for each feature.
- When the base terminal activates the CFAC feature, it takes precedence over CFB or CFD.
- CFB and CFD may not be assigned to a hunt group, however, a remote terminal may be an intragroup hunt group.
- If the remote terminal can not receive the type of call being forwarded, the base terminal is alerted until the call is either answered or abandoned.
- CFDA does not apply to calls rejected by the user.

Figure 109 Call Forward All Calls, Don't Answer - originating end

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC, →	
	:	
ringback on	ALERTing (CRn,...) ←	
	(when the Don't answer timer expires, the call is forwarded to the remote terminal)	forward call to remote terminal
display	ALERTing (CRn,CRn,PI,SIG) ←	
call established	CONNect (CRn) ←	remote terminal answered

6.35.7 CFU Feature interactions and limitations

- During CF of any kind, the call originator's BC is used to determine if it is possible to terminate on a terminal. If it is, the call is forwarded, if not, it is routed to treatment.
- Programming can only take place when there are no CAs active, and when CFAC is inactive. If CFAC is active, deactivate it before programming.
- CFU and CFI may be assigned to a terminal in a hunt group, that is, CF takes precedence over hunting.
- The user can use Speed Call to enter the remote terminal address when activating CF.
- CF can not be assigned to AUL, lines with denied termination, denied origination, or suspended lines.
- A user activating CFU or CFI, if a forwarding address that the terminal is not permitted to dial is entered, those calls are not forwarded (this can be prevented if CF validation is assigned to the customer group). They receive the same treatment as the user would receive upon attempting to dial the number as a basic call.
- A call forwarded to a remote terminal with an activated CF feature is forwarded to the next remote terminal. Up to five consecutive CFs can be

handled. When the call progresses to a sixth remote terminal with an activated CF feature, the caller receives busy indication.

- Only one call may be forwarded at a time. A second caller receives busy indication, as defined above. However, more than one call is allowed if Multi-Call FC is assigned to the customer group.

6.35.7.1 Fixed key capability access from NITs

NITs that support fixed feature keys have access to fixed features key features on DMS-100.

The DMS-100 supports NITs that support FKM (as per the requirements in SR-4288). The feature identifiers are assignable to the default TSP. The DMS-100 supports the, “57 = Call Forwarding Variable (CFV, (main DN/voice))”, Bellcore-specified feature identifier value. Bellcore’s CFV is the same as the DMS CFU feature.

6.36 Call Park

6.36.1 Definition

Call Park (PRK) allows a user to hold a speech or 3.1 kHz audio call against a DN (that of the terminal CA issuing the feature). The call maybe retrieved later by the same or another terminal.

6.36.2 Programming and feature activation

To park a call in the talking state:

- Activate PRK by selecting the PRK FA.
- The PRK FI comes on, and the user receive confirmation tone indicating that the call is parked.
- If for any reason the call cannot be parked, the user receives five seconds of re-order tone, after which the original call is re-established.

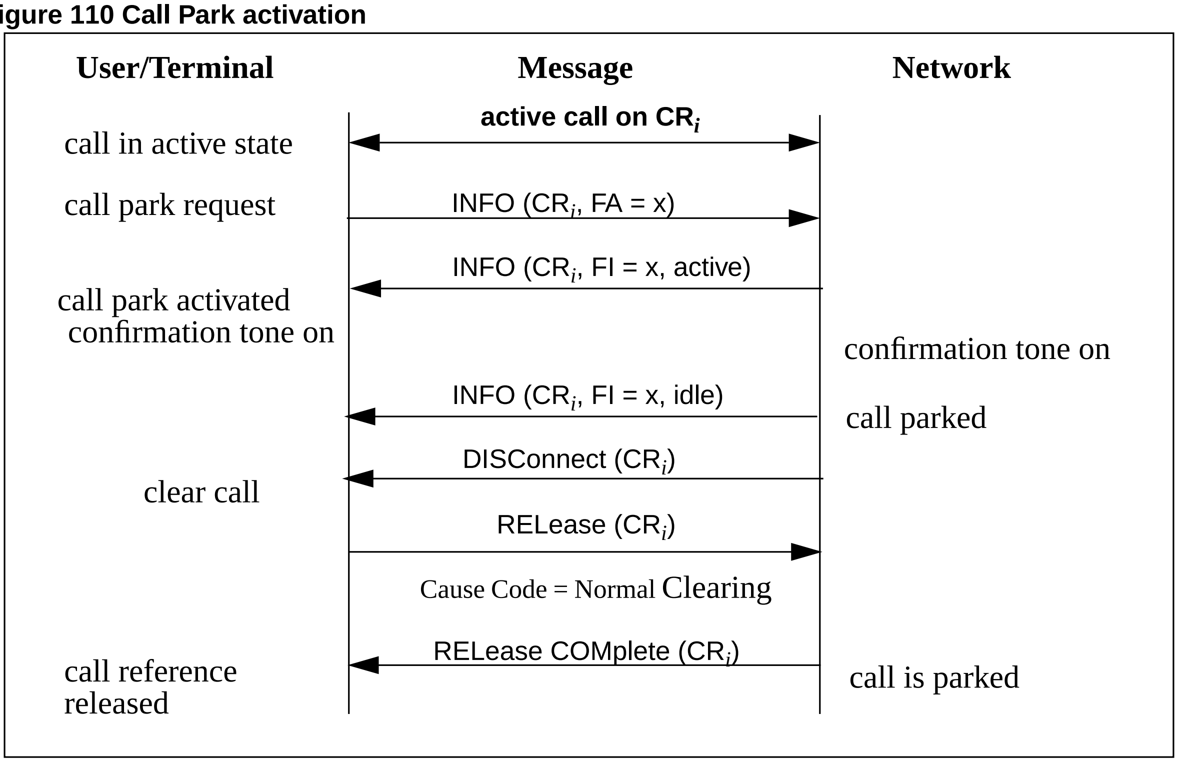
To retrieve a parked call, select the PRK FA, hear the recall dial tone, then dial the DN against which the call is parked.

6.36.3 Procedures

6.36.3.1 Call Park Store

The generic procedure specified in TR–TSY–00847, section 3.5.3.2.B.1, can be used to park a call. The procedure is illustrated in Figure 110, “Call Park activation”.

Figure 110 Call Park activation



To park a call:

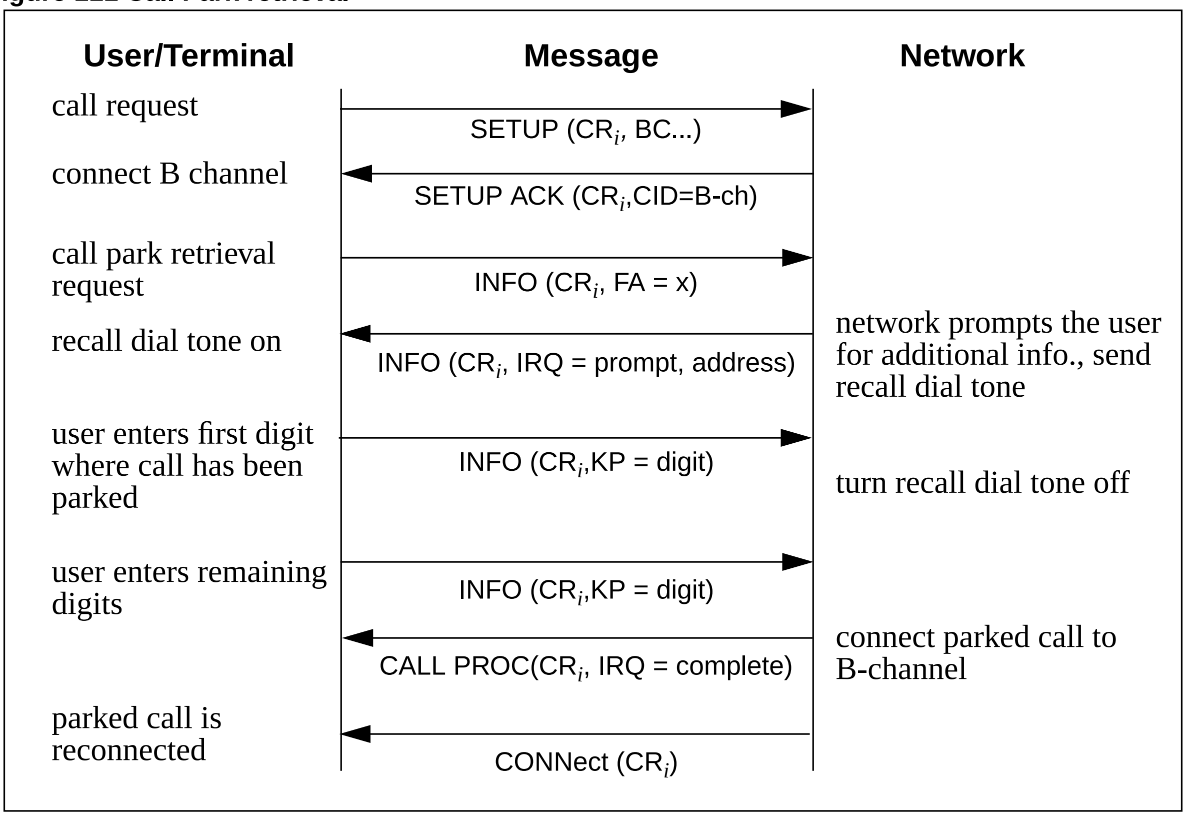
- Send an INFOrmation with a FA IE specifying the PRK FA to the network.

- If the request is accepted, the network returns an INFOrmation with a FI IE specifying the PRK FI with a status “active”. The call is actually parked when it is cleared by the network, and the requesting user’s FA shows a status of “idle”.
- The PRK timer is started; it recalls the requesting user if it times out. The call is now considered to be in the PRK held state.
- PRK provides additional capabilities such as listening to music while parked.
- If the parked party exits while in the held state, the feature is cancelled and the timer stopped.

6.36.3.2 Call Park Retrieve

A user at another terminal may retrieve a parked call using any of the generic procedures specified in TR–TSY–000847, sections 3.1.2 and 3.5.3.2.A. One of the allowable FKM sequences is shown in Figure 111, “Call Park retrieval”. Note that a FI IE is not sent by the network during PRK retrieval.

Figure 111 Call Park retrieval



6.36.3.3 Call Park Recall

- Once a call is parked and enters the “call park held” state, the timer starts.
- It stops when the call is unparked; that occurs when either the parked party disconnects, the call is retrieved, or the recall occurs.
- When the timer expires, the parking party is re-called.
- The recall is always presented to the DN against which the active call was originally parked.

- The recall procedure is the same as a basic incoming call. While the call is being offered through the recall procedure, it may still be retrieved from another terminal, thereby cancelling the recall. However, once the recall is answered, the call is automatically unparked and can no longer be accessed from another terminal.
- If the parking party is busy when the recall occurs, the timer is re-started and the parked party remains in the "call park held" state (that is, the call continues to be parked). This is true even when the parking terminal is assigned the CF feature, as the PRK recall is never Call Forwarded.

6.36.4 Feature interactions and limitations

- Calls can be parked by any terminal having this feature. They should only be unparked by terminals having a BC compatible with that of the parked call.
- A call must be active to be parked.
- Calls involving an operator position or an attendant console can not be parked.
- A conference call can not be parked.
- Only one call can be parked against a given DN. A terminal with multiple DNs can park multiple calls, one against each DN.
- Each customer group is assigned a maximum number of calls that may be parked simultaneously.
- The party attempting to retrieve a parked call must be in the same customer group as the party against which the call was parked.
- When the parking party is recalled, the Call Forwarding, Do Not Disturb, and Make Set Busy features have no effect on the recall. They remain applicable to other CAs on the terminal.
- The activation of PRK on a call does not affect RAG or ACB requests from other parties on either the parking or the parked party.
- If the user who parked the call rejects or does not answer the PRK recall, upon recall time-out, the network clears the entire call. If the DN of the user who parks the call is busy, the timer is re-started. The number of times it is re-started when the DN is busy can be provisioned.

6.37 Call Pickup (CPU)

6.37.1 Definition

Call Pickup (CPU) allows a terminal to answer incoming calls to another terminal within a pre-defined CPU group. CPU Group is provided on an individual terminal within a customer group. CPU may optionally be associated with only a subset of the DN appearances on the set. This feature is assigned at subscription time.

6.37.2 Feature activation

A call can be picked up by a second terminal using FKM, or DCA, as specified in procedures G3, see Section 6.14, “G3 - Feature Key Management (Call Initiation Phase)”, and G7, see Section 6.18, “G7 - Dial Management (Call Initiation Phase)”, respectively.

Figure 112, “Call pickup group activation”, illustrates one of the FKM sequences that may be used to invoke call pick up.

Figure 112 Call pickup group activation

Scenario: A user attempts to pick up an incoming call to another terminal, by initiating a call and activating the CPU activator #x, while in the Overlap Sending state.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC...) →	
connect B–ch	← SETUP ACK (CRn,CID=B-ch, SIG = tones on)	connect B –ch
call pickup request	INFO (CRn, FA=x) →	
	← INFO (CRn, SIG = tones off)	
display original called address	← CALL PROC (CRn, CDN=dialed number)	
connected to incoming call, display connected address	← CONNect (CRn, CN= conn number)	
call is picked up		

6.37.3 Feature interactions and limitations

- Calls may only be picked up by terminals with BCs compatible with the incoming call.

- Speed Calling may be used to dial the CPU Group access code.
- A user at a busy terminal can not pick up a call. The call must be terminated before using the CPU feature unless the terminal has another idle CA. In the later case, the terminal can put the current call on hold and pick up calls using the idle CA.
- Call pick-up retrievals are screened for BC compatibility.
- A terminal can only pick up calls within the defined CPU group.

6.38 Default Service

6.38.1 Definition

Default Service for Terminals, as defined by Bellcore in SR-3875 and GR-2815, allows a user or installer to access a minimum set of originating service capabilities. These capabilities include:

- installation testing/service troubleshooting (*i.e.* Basic Rate Verification, or BRIV, testing which includes OE verification and test line 108) and any special 7-digit number required for that testing. This 7-digit number is set up with specific translation.
- N11 (*i.e.* 611, 911)

The first capability may be provided by the Local Exchange Carrier (LEC) for maintenance equipment and personnel, while the second capability may be provided to end-users as a service, at the discretion of the LEC. These capabilities require the bearer capability to be speech or 3.1 kHz audio (*i.e.* VI call type) and access to one B-channel. The test equipment used for installation testing is typically non-initializing.

6.38.2 Procedures

To request Default Service, a terminal makes a call origination request per normal call origination procedures as specified by Section 5.7.1.1, “Call establishment at the originating interface”.

The call request is initiated by sending a SETUP message. No additional Information Elements are required to be included in the SETUP beyond those required for a normal basic call. Either En bloc or Overlap sending procedures may be used to establish the call.

The called address information provided by the terminal, as part of En bloc or Overlap sending, is a directory number which has been specially designated by the telco to provide access to the Default Service.

Upon successful call establishment by the terminal equipment, the DMS-100 will send a CONNect message and make a connection to the Default Service.

Error conditions, which may occur as part of the request for Default Service, are handled per ISDN call clearing procedures. See Section 5.7.1.3, “Call clearing”.

6.38.3 Feature operation and limitations

- Default Service is available to all ISDN lines (both NI-1 and NI-2 lines).
- Default Service is available to either a NIT, or a FIT which fails initialization and is able to operate as a NIT.
- Default Service does not change the maximum number of TEIs allowed on an interface. NI-1 lines are restricted to two SAPI 0 TEIs, while NI-2 lines may have up to eight SAPI 0 TEIs.
  - — If the maximum number of TEIs is already being used, then additional terminals that are added to the interface will not receive Default Service.
- If all terminals provisioned on an interface are FITs, or no terminals are provisioned at all, Default Service is still made available to a NIT plugged into the interface. This is provided the above TEI restrictions are met.
- A restricted translations dial plan is used for calls originating to the Default Service. This restricted dial plan is provisionable by the customer to provide access to special 3-digit and 7-digit numbers.
- Default Service is only available to voiceband information (VI) calls, using a bearer capability of either speech or 3.1 kHz audio.
  - — If none of the DNs assigned to a terminal are provisioned with the VI call type, Default Service is still available. In this case, the terminal may send a SETUP message and include the speech or 3.1 kHz audio bearer capability.
- Default Service is used as an originating-only service. It cannot be used to terminate calls to an ISDN interface.

6.39 Emergency Service Bureau (ESB)

6.39.1 Definition

Emergency Service Bureau (ESB) allows an ISDN user to report an emergency by dialing 911, 9911, or another number to reach an Emergency Service Bureau.

- Once active in an ESB call, a user cannot release the call.
- Attempts to clear the call, result in connection to the ESB being held.
- The ESB can recall the user that attempted to clear the call.
- When the ESB recalls the user, the call is offered to the interface using normal GR-268 call termination procedures.
- Any terminal that can respond to the termination request can answer the call.
- A user trying to initiate another call on the same terminal is automatically re-connected to the ESB.

6.39.2 Procedures

A user establishes a call to an ESB using the normal call establishment procedures described in GR-268.

- If a user sends a clearing message to the network, it follows normal clearing procedures as described in GR-268, except that the B-channel is not released. The connection is considered to be in a special held state.
- Subsequent attempts to establish a call from the same terminal result in an automatic connection to the ESB, that is, the network responds to a SETUP with a CALL PROCeeding and CONNect, regardless of any feature invocations.
- When in this special held state, the ESB can recall the user.
- The network broadcasts a SETUP to the interface with Channel Identification IE coded to the B-channel that the call was originally on, and the original BC.
- All terminals that can respond to the call based on its DN and CT may pursue the call.
- If contention is not allowed, the first terminal responding to the SETUP receives the call.
- If contention is allowed, the first terminal sending a CONNect receives the call.
- The other terminals pursuing the call receive a RELease COMplete having cause #26, “non-selected user clearing”.
- When the ESB re-rings an EKTS terminal, all those that have the DN and CA get a SETUP. Whatever terminals respond, get bridged into the call.
- When a terminal is connected to an ESB, attempts to establish a call on any DN and BC combinations are automatically connected by the network to the ESB call. The network ignores any KP or FA IE in the CAR.

6.39.3 Feature interactions and limitations

- A user is cannot hold an ESB call. The network rejects a HOLD with a HOLD REJect, having cause value #29, “facility rejected”.
- All calls to an ESB using CFU are disabled.
- PRK can not be activated while a call to an ESB is in progress.
- A call to an ESB cannot be included in a FC conference call. A user cannot make a FC conference call out of a call to an ESB unless they have FC Without Consultation Hold.
- EBO and SC are compatible with ESB.
- The attendant cannot release any call while it is active with the ESB.

6.40 Executive Busy Override (EBO)

6.40.1 Definition

Executive Busy Override allows access to a busy user. Upon receiving a busy indication, the calling user may choose to invoke EBO. Once invoked, the called user, and the party connected to the called user, enter a 3-way call connection.

6.40.2 Programming and feature activation

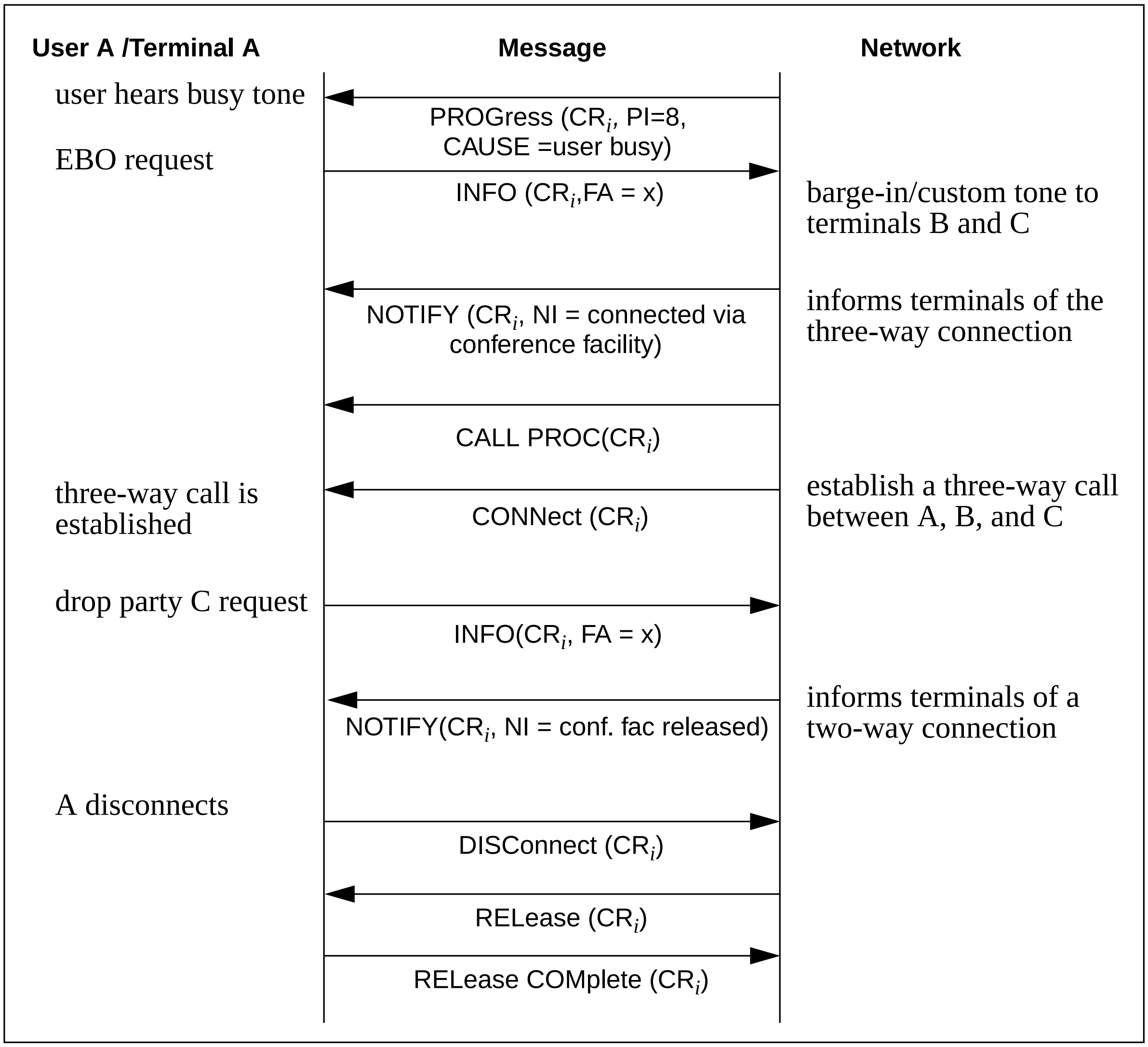
Not applicable.

6.40.3 Procedures

Consider the situation where parties B and C are in conversation and party A calls B.

- Upon receiving busy treatment, A may invoke this feature using the generic procedure described in *Section 3.5.3.2.B.1* of TR–TSY–000847, as shown in Figure 113, “Executive Busy Override procedures”.
- An INFOrmation is sent to the network with a FA IE containing the EBO FA.
- The network responds to party A with a NOTIFY with a NI IE specifying “connected via conference facility (controller)”.
- The network also sends NOTIFY(s) to the other parties (if they are ISDN) with the NI IE specifying “connected via conference facility (conferee)”.
- This NOTIFY contains the signal IE set to “barge-in tone”, and the DN of the controller, included in a Display IE.
- A three-way connection is now established with A as its controller.

Figure 113 Executive Busy Override procedures



As controller of the three-way connection, A, can either remain in the three-way connection, or drop C.

- To drop C, A again selects the EBO FA.
- Upon selection, the terminal sends an INFOrmation to the network with a FA IE corresponding to the EBO FA.
- The network responds with a NOTIFY, having a NI IE specifying “conference facility released”.
- Parties A and B remain connected, and C is disconnected.
- Party B also receives a NOTIFY (if it is ISDN) with a NI IE specifying “conference facility released”, and a Display IE containing the DN for A.
- NOTIFYs are sent if C initiates the clearing.
- A may alternatively remain in a three-way all, converse with B, and drop out.

- The leg of the call for A is cleared using normal clearing procedures described in GR-268, and B and C remain in a two-way call.
- Parties B and C, if ISDN, receive a NOTIFY with a NI IE specifying “conference facility released”, and a display IE containing the address of each other.
- If B disconnects during the three-way connection, the entire call is cleared, and A receives a DISConnect. There is no implicit transfer of the call between B and C to A.
- If feature execution is unsuccessful, A receives re-order tone.

6.40.4 Feature interactions and limitations

- When the calling station is forwarded from the called station because the called station is in the CFB mode, and the forwarded call is eventually connected to busy tone, the EBO can be applied to the originally called station.
- For successful activation of EBO, the EBO terminator must belong to the same customer group as the originator and must not be assigned the “EBO Exempted” option.
- EBO can barge into a call on a terminal with call waiting active on a previously-waiting call.
- It is not possible to barge into a non-VI call using EBO.
  — Attempts by a user to invoke EBO against an active CMD call are rejected. The party that invoked EBO, is given re-order treatment. If invoked per FKM procedures by an originating ISDN subscriber, the associated FI should be left as “Idle”.
- EBO is not permitted when
  — the called station is in a three-way conference/transfer mode
  — the calling station is forwarded from the called station because the called station is in the CFAC or CFD mode
  — the final destination of the calling station’s forwarded call is busy.
- EBO is not applicable when
  — the calling station is re-routed because of the flexible intercept feature
  — the called station is in the Do Not Disturb mode; the calling terminal is routed to the attendant.
- EBO cannot be assigned to a hunt group station.

6.41 Executive Busy Override Exempt (EBX)

6.41.1 Definition

Executive Busy Override Exempt is an option of EBO. EBX allows that the station cannot be barged into by another station using the EBO feature.

6.41.2 Feature activation

This feature is assigned at subscription time.

6.42 Feature Code Access

6.42.1 Definition

Feature Code Access (FCA) provides an alternate method of accessing features other than through the use of feature keys. This situation arises when a terminal has all of its keys assigned, but needs one more feature. To use any of the features through code access, the user must first be active on a DN.

The following features are available through DCA, using procedures G7, Section 6.18, “G7 - Dial Management (Call Initiation Phase)”, or G8, Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”, during call initiation:

- Speed Calling - long and short
- Speed Call user
- CF programming/activation
- CPU
- PRK retrieve
- Loudspeaker paging
- MSB

6.43 Flexible Calling (FC)

6.43.1 Definition

Flexible Calling (FC) is a set of capabilities allowing an ISDN user to establish and manage from 3 to 30 calls as part of a conference. This is made possible by the assignment of separate FAs for each of the conference sizes supported by FC (3-party, 6 up to 30-party - in increments of one). NI-2 terminals support the simultaneous assignment of two different sizes.

The FC feature is based on the capabilities defined by Bellcore specification TR-TSY-000858 Issue 1, Revision 3, *Flexible Calling for Managing Multiple Independent Calls*.

Flexible Calling (FC) is supported for NI-1 single B-channel devices, and for NI-2 terminals and 2B fully initializing and non-initializing terminal devices (2B FIT/NITs) with two simultaneous voice calls.

The following capabilities are provided with FC. The user can:

- designate a call to be a conference call
- hold, and subsequently retrieve, the conference call from hold
- bridge a call onto a conference call (a call bridged into the conference can be either incoming or outgoing)
- release the last call added to the conference call
- transfer a conference call
- initiate clearing of the entire conference.

This supplementary service uses three FAs for invoking various aspects of FC. They are used for:

- requesting a conference facility and bridging
- dropping the last member added to a conference and releasing the conference facility
- transferring the conference.

Here is a summary of the capabilities provided by FC. A detailed description is provided in subsequent subsections.

- A conference request can be made during call establishment or for an established call.
- Once the first call of the conference is established, add subsequent calls as follows:
  - — The controller requests new call origination, which autoholds the conference call. Once the new call is established, retrieve the conference call, causing the two calls to be bridged.
  - — The controller retrieves a held call, causing it to be bridged to the conference.

- — Alternatively, the controller can hold the conference call, initiate or retrieve a call, and retrieve the conference call to bridge the two calls together.
- The controller can send a drop request to have the network clear the last call bridged onto the conference when there are more than two members in the conference.
- If there are only two members in the conference, the network interprets a drop request as a request to terminate the call, and both parties (as well as the conference facilities) are released.
- If Flexible Calling Deactivate Conference Facility (DCC) is assigned to the controller, then the conference facility should be removed when the conference size is reduced to two parties (the controller and the conferee), or the controller makes an unsuccessful attempt to add a third party to a conference. This option is assigned to the Primary Directory Number (PDN) of a terminal. If assigned the option is always active and applies to the entire set.
- A transfer request from the controller causes the network to disconnect the controller from the conference, but to maintain the connection between the conferees.
- The controller can take down the entire conference.
- A conferee can disconnect from the conference.
- Conferees in a three-way conference can invoke a conference of their own, thereby establishing a three-way conference chain.

In general, the DMS–100 is compliant to Bellcore TR–TSY–000858, except that the codepoints for the Notification Indicator IE described in Section 3.3.1 on page 39 are used as indicated below.

- When a conference call changes from 2 to 3 members, as a result of bridging, the conferees receive a NOTIFY with NI IE specifying “connected via conference facility (conferee)”. Subsequent members bridged onto the conference also receive the message.
- When the number of parties on the conference reaches the maximum conference size (as specified by the conference FA used to invoke the conference), the network alerts the controller by sending a NOTIFY, with the NI IE coded to “conference bridge full”.
- If:
  - — the drop request was received while the conference bridge is full, and
  - — the controller is involved in a conference of more than three parties

  when a conferee is dropped from the conference call, the network, in addition to the standard TR–TSY–000858 behavior, sends the controller a NOTIFY with the NI IE coded to “conference bridge port available”.
- When a conference call drops down to two parties, the network sends the controller and remaining conferee a NOTIFY containing a NI IE specifying “two party call”. The connected number is sent in a Display IE.

- If the conference call is on hold and the controller sends an INFOrmation containing the call reference of a connected call, the network bridges the call onto the conference, as well as clearing both the conference call and the connected call to the controller.
- The user being transferred onto the conference call receives a NOTIFY, with NI IE specifying “connected via conference facility (conferee)”.
- If the user is being transferred onto a conference call with only one conferee, the user and the conferee both receive a NOTIFY with NI IE specifying “two party call” and the connected number in a Display IE containing the address of each other.

6.43.1.1 Terminology

- Established Call - for the purposes of the FC supplementary service, an ISDN call is considered established when one of the following requirements is met:
  - — for an originating ISDN user, the call on the originating user's interface is in either the “Outgoing Call Proceeding”, “Call Delivered”, or “Active” call state
  - — for a terminating ISDN user, the call on the interface is in the “Active” call state
- Conference call - any call to which conference capability is attached even though there may only be two parties involved
- Conference ID - the call reference of the call to which the conference facility is attached
- Controller - the user who requested the conferencing facility
- Conferee - a party in a conference other than the controller
- Add-on Member - a party in a conference other than the controller and the first conferee added to the conference
- Autohold - the automatic holding of an existing active call by the network; used only in FC and in EKTS DN Bridging.

6.43.2 Procedures

6.43.2.1 Invoking conference facility during call establishment

To invoke FC while originating a call, the controller uses the generic FKM procedures as part of call origination. For example, the controller includes the conference FA information either in the SETUP or as part of subsequent INFOrmation sent in response to the SETUP ACKnowledge. See Section 6.15, “G4 - Interactive Feature Key Management (Call Initiation Phase)”.

The following figures illustrate the various FKM procedures for invoking a conference during call establishment:

- Figure 114, “Conference request and all address info in SETUP message”, shows the procedures for a conference request in a SETUP with all address information.
- Figure 115, “Conference Request and no address information in SETUP”, shows the procedures for a conference request in a SETUP with no address information.
- Figure 116, “Conference Request and partial address information in SETUP”, shows the procedures for a conference request in a SETUP with partial address information.
- Figure 117, “Conference request using INFOrmation message”, shows the procedures for a conference request in an INFOrmation during call establishment.

Figure 114 Conference request and all address info in SETUP message

Scenario: A user invokes conference during call establishment by including both the conference FA #x and the CDN information in the SETUP message

USER/TERMINAL	MESSAGE	NETWORK
call request w/ conf request and address info	SETUP(CRn, BC,CID, FA=x, KP=digits) →	
conference facility allocated	← CALL PROC (CRn,CID, FI= x,active) Note	

Note: Normal call establishment occurs as described in Chapter 5.

Figure 115 Conference Request and no address information in SETUP

Scenario: A user invokes conference during call establishment by including the conference FA #x in the SETUP and no CDN information.

USER/TERMINAL	MESSAGE	NETWORK
call request and conference request	SETUP (CRn, BC,CID, FA=x) →	
connect B–ch	← SETUP ACK (CRn, CID, PI=#8, IRQ=prompt,addr, SIG=recall dial tone, FI=x,prompt)	connect B–ch, apply in–band recall dial tone and prompt for additional info
user enters first additional digit * if En Bloc then all digits	INFO (CRn, KP=digit*) →	
	← INFO(CRn, SIG=tones off)	Tones off
if necessary, user enters additional digits	INFO (CRn, KP=digit) → "	
conference facility allocated	← CALL PROC (CRn, CID, FI=x,active, IRQ=complete) Note	

Note: Normal call establishment occurs as described in Chapter 5.

Figure 116 Conference Request and partial address information in SETUP

Scenario: A user invokes conference during call establishment by including the conference FA #x in the SETUP and partial CDN information.

USER/TERMINAL	MESSAGE	NETWORK
call request w/ conf request and partial address	SETUP (CRn, BC,CID, FA=x KP=digits) →	
connect B–ch	SETUP ACK (CRn, CID, FI=x,prompt) ←	connect B–ch, prompt for additional info
user enters additional digits	INFO (CRn, KP=digit) → "	
conference facility allocated	CALL PROC (CRn,CID, FI=x,active) ← Note	

Note: Normal call establishment occurs as described in Chapter 5.

Figure 117 Conference request using INFOrmation message

Scenario: A user invokes conference during call establishment by including the conference FA #x in an INFOrmation during Overlap sending.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC,CID, ..)	
connect B–ch	SETUP ACK (CRn, CID, SIG=dial tone)	connect B–ch, turn on dial tone
user requests conference	INFO (CRn, FA=x)	
	INFO (SIG = tones off)	turn off dial tone
	INFO (CRn, PI=#8 IRQ=prompt, address, SIG=recall dial tone, FI= x,prompt)	apply in–band recall dial tone, prompt for additional info
user enters first additional digit * if En Bloc then all digits	INFO (CRn, KP=digit*)	
	INFO (SIG = tones off)	turn off recall dial tone
if necessary, user enters additional digits	INFO (CRn, KP=digit) "	
conference facility allocated	CALL PROC (CRn, CID, FI= x,active, IRQ=complete) Note	

Note: Normal call establishment occurs as described in Chapter 5.

6.43.2.1.1 Invoking conference facility for an established call

- Request that a conference facility be assigned to an established call by sending an INFOrmation to the network containing it's call reference. The message contains a FA IE with the conference FA.
- The network responds with an INFOrmation containing a FI IE having the conference FI with an active status. (For more details on FKM FA during an active call, see procedure G5, Section 6.16, "G5 - Feature Key Management (Call Progress/Active Phase)".)
- Figure 118, "Conference Request of established call (Success)", shows the procedures for conference invocation using the call reference of an established call.

Figure 118 Conference Request of established call (Success)

Scenario: A user invokes conference on a call already established on call reference #n by including the conference FA #x in an INFOrmation.

USER/TERMINAL	MESSAGE	NETWORK
user requests conference	INFO (CRn, FA=x) →	
	← INFO (CRn, FI=x,active)	allocate conference facility

Note: This capability cannot be invoked on a held call.

6.43.2.1.2 Error conditions

If a conference request that can not be granted, is received during call establishment, the network rejects the request and clears the call. The conditions for rejecting the conference request, and the associated cause that is returned in the first clearing message are:

- if conference facilities are not available, cause value #34, "circuit/channel congestion" is used
- if the BC of the call associated with the conference request is not speech or 3.1 kHz audio, network-specific cause value #51, "call type incompatible with service request" is used
- if the user that sent the conference request is already the controller of an existing conference, network-specific cause value #53, "service operation violated" is used
- if invalid or insufficient call establishment information is received from the user, a cause value is determined as specified in Chapter 5.

Figure 119, "Conference Request during call establishment (Failure)", shows the rejection of a call setup including a conference invocation.

Figure 119 Conference Request during call establishment (Failure)

Scenario: A user invokes conference when establishing a call by including the conference FA #x in the SETUP. The conference request is rejected.

USER/TERMINAL	MESSAGE	NETWORK
call request and conference request	SETUP(CRn, BC,CID,FA=x) ───────►	
		conference request rejected
	REL COM(CRn,CSE=circuit/ ◄─────── channel congestion)	

If conferencing was requested using the call reference of an established call in an INFOrmation, the network rejects the request with an INFOrmation containing the appropriate cause value. The conditions and associated cause values are:

- if a conference facility is not available, cause value #34, "circuit/channel congestion" is used
- if the BC of the call associated with the conference request is not speech or 3.1 kHz audio network-specific, cause value #51, "call type incompatible with service request" is used
- if the user that sent the conference request is the controller of an existing conference network-specific, cause value #53, "service operation violation" is used.

If the conference request is rejected, the call associated with the call reference identified in the INFOrmation proceeds as normal. Figure 120, "Conference Request of established call (Failure)", shows the rejection of a conference request because conference resources are not available.

Figure 120 Conference Request of established call (Failure)

Scenario: A user invokes conference on a call already established on call reference #n by including the conference FA #x in an INFOrmation. The conference request is rejected.

USER/TERMINAL	MESSAGE	NETWORK
conference request	INFO(CRn, FA=x) ──────►	
		conference request rejected
	INFO(CRn,CSE=circuit/ ◄────── channel congestion)	

6.43.2.2 Adding a call to a conference

Once the controller is active on a conference call, the controller can add subsequent calls to the conference. This can be done in one of two ways using the RETRieve:

- The controller can retrieve a held conference call onto a connected basic call.

  For example, if a SETUP is sent, the conference call is placed on autohold and the new call established. The conference can then be retrieved and the two calls are bridged (see Figure 121, “Bridging call to conference after answer (Success)”).

  Note: If the controller, with ISDN BRI line option Flexible Calling Deactivate Conference Facility (DCC) assigned, is connected to a conference call over a B-channel with only one conferee on the conference and sends a SETUP message that is rejected with a RELease COMplete message, then the conference call will be deactivated. The network will send to the controller a NOTIFY message with a notification indicator with the value of “conference facility released.” An INFOrmation message is also sent with a feature indicator and a status of “idle.”

- The controller can retrieve a held call onto an connected conference call.

  Note: The CID IE, if included in the SETUP or RETRieve, may contain either any channel, preferred B1“preferred B, exclusive B1, or exclusive B2. All of them are successful except if the existing call is on B1 (B2) and exclusive B2 (exclusive B1) is selected. In this case the call is rejected with a RELease from the network containing a cause value #44, “requested circuit/channel not available”.

Figure 121 Bridging call to conference after answer (Success)

Scenario: A user has conference facility assigned to a call on CR #n. The user then makes another call on CR #m and bridges the two calls.The conference call is autoheld during this procedure.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRm, BC,CID,.) →	
	HOLD (CRn) ←	autohold
call held	HOLD ACK (CRn) →	
	CALL PROC (CRm, CID) ←	
call active	CONNect (CRm) ←	
	CONN ACK (CRm) →	
user requests bridging	RETRieve (CRn, CID) →	
	DISC (CRm) ←	clear additional call
	RELease (CRm) →	
	REL COM (CRm) ←	
conference active	RETR ACK (CRn) ← (NI=conn_via_conf_ controller)	conference active, notify conferees

In either case, upon connecting the additional call to the conference, the network sends a DISConnect to the controller to clear the call reference of the additional call.

The calls can also be bridged before the additional call is answered. The controller sends a RETRieve to retrieve the conference call before receiving a CONNect for the additional call. Subsequent inband tones are applied to all members of the conference.

When a conference call changes from 2 to 3 members as a result of bridging, the conferees receive a NOTIFY with NI IE specifying “connected via conference facility (conferee)”. Subsequent members bridged onto the conference also receive the NOTIFY, to give the conferees an indication that they are members of a conference.

When the number of parties on the conference reaches the maximum size (as specified by the CONF FA used to invoke the conference), the network alerts the controller by sending a NOTIFY with the notification indication IE coded to “conference bridge full.”

6.43.2.2.1 Error conditions

The network rejects a RETRieve request to add a call onto a conference when any of the following conditions exist:

- A call on the conference has not yet reached an established state.
- The maximum number of users allowed on the conference was reached.
- The BC of the call to be added is not speech or 3.1 kHz audio.
- The autohold procedures fail.
- The call on hold is undergoing clearing.

Note: If a controller, with ISDN BRI line option Flexible Calling Deactivate Conference Facility DCC assigned, is connected to a conference call over a B-channel with only one conferee on the conference sends a RETrieve message that is rejected with a RETrieve REJect message, then the conference call will be deactivated. The network will send to the controller a NOTIFY message with a notification indicator with the value of “conference facility released.” An INFOrmation message is also sent with a feature indicator and a status of “idle.”

The network rejects the request with a RETRieve REJect with one of the following causes corresponding to the above error conditions, respectively:

- network-specific cause value #53, “service operation violated”
- network-specific cause value #53, “service operation violated”
- network-specific cause value #51, “call type incompatible with service request”
- network-specific cause value #53, “service operation violated”.

Figure 122 Bridging request (Failure)

Scenario: A user is the controller of a conference on CR#n. The controller also has another call on call reference #m. The controller requests the bridging of the two calls by retrieving the conference call. The bridging request is rejected because the maximum number of users was reached.

USER/TERMINAL	MESSAGE	NETWORK
bridge request	RETR (CRn, CID) →	
		bridging request rejected
	← RETR REJ (CRn,CID CSE=service operation violated)	

6.43.2.3 Holding/Retrieving a conference

The holding of a conference call behaves in the same way as a normal call. However, retrieval of a held conference call is treated somewhat differently.

If the terminal has no currently active call, a retrieve request causes the conference call to be retrieved. Upon retrieval, if the controller has the ISDN BRI line option Flexible Calling Deactivate Conference Facility (DCC) assigned and the retrieved conference has only two remaining parties (the controller and one conferee), the conference facility will be released.The network will send the controller a NOTIFY message with a notification indicator value of "conference facility released". An INFOrmation message is also sent with a feature indicator and a status of "idle".

If a call is currently active, a retrieve request causes the active call to be bridged onto the retrieved conference.

> ***Note:*** To swap between calls when one of the calls is a conference call, the user must hold the active call before retrieving the held call. This is illustrated in Figure 123, "Holding a conference and retrieving without bridging".

Figure 123 Holding a conference and retrieving without bridging

Scenario: A user has conference facility assigned to a call on CR#n. The user also has another call on CR#m. The user must hold the conference call before retrieving the other call if bridging is not desired.

USER/TERMINAL	MESSAGE	NETWORK
user holds conference call	HOLD (CRn) →	conference call held
	← HOLD ACK (CRn)	
user retrieves other call	RETR (CRm) →	call retrieved
	← RETR ACK (CRm)	

6.43.2.4 Dropping a call from the conference

To drop the last call added onto a conference, the controller sends the network an INFOrmation with the FA IE set to either the DROP or the CONF FA. The CONF FA is interpreted as a drop request:

- when sent within the context of an established conference, and
- when a DROP FA is not explicitly assigned to the controller.

The network then clears the last conferee added to the conference with cause value #16, "normal call clearing".

The network also sends the controller a NOTIFY with the NI IE coded to "conference bridge port available" if:

- the drop request was received while the conference bridge was full (for example, while the number of parties on the conference was equal to the maximum conference size), and
- the controller is involved in a conference of more than three parties.

Whenever a conference call drops down to two parties, the network sends the controller and remaining conferee a NOTIFY containing a NI IE specifying “two party call”, and a CN IE specifying the connected address (see Figure 124, “Dropping a call from a conference from three to two members”).

If the controller has ISDN BRI line option, Flexible Calling Deactivate Conference Facility (DCC) assigned and if there is only one party left in the call (in addition to the controller) following the drop request, the network releases the conference facilities and sends an additional NOTIFY message with a notification indicator value of “conference facility released”. An INFOrmation message is also sent with a feature indicator and a status of “idle”.

If there is only one party left in the call (in addition to the controller) when a drop request is received, the network releases the conference facilities and clears the call to both parties using cause #16, “normal call clearing”. In addition the clearing message sent to the controller also contains a FI IE with the conference FI and status “idle”.

Figure 124 Dropping a call from a conference from three to two members

Scenario: A user is the controller of a conference call with three conferees. The controller drops the last member added to the conference with the drop (or conference) FA #x.

USER/TERMINAL	MESSAGE	NETWORK
user issues drop request	INFO (CRn, FA=x) →	
	← NOTIFY (CRn,NI=two party call,CN=conn addr)	last member added cleared, notify conferee and controller
If user has DCC option assigned the NOTIFY & INFO messages are also exchanged	← NOTIFY (CRn; NI=Conference Facility Released)	
	← INFO (CRn; FI=conf,idle)	

6.43.2.5 Transferring a conference

- The controller can invoke transfer capability by sending the network an INFOrmation with a FA IE with the transfer FA.
- If the call reference of the INFOrmation is the conference ID, the network responds by initiating call clearing with:

— a DISConnect if the conference is connected, or

— a RELease if the conference is on hold with a FI IE with the conference FI and status “idle”.

The remaining conferees remain in the conference.

- If the conference call is on hold and the controller sends an INFOrmation containing the call reference of a connected call, the network bridges the call onto the conference, and clears both the conference call and the connected call to the controller.
- The user being transferred onto the conference call receives a NOTIFY with a NI IE specifying “connected via conference facility (conferee)”.
- If the user is being transferred onto a conference call with only one conferee, the user being transferred and the conferee both receive a NOTIFY with a NI IE specifying “two party call”, and a CN IE containing the address of each other.
- After the controller is released from the conference, the network maintains the conference facility until only two calls remain connected to the it, at which time the call is converted into a normal two-way connection.
- When only two members are left in the conference, they both receive a NOTIFY with a NI IE specifying “two party call”, and a Connected number IE containing the address of each other.

An example of transferring a connected conference call is illustrated in Figure 125, “Transferring a connected conference call”. Figure 126, “Transferring a call onto a held conference call”, illustrates the procedure when the controller issues the transfer while the conference call is on hold.

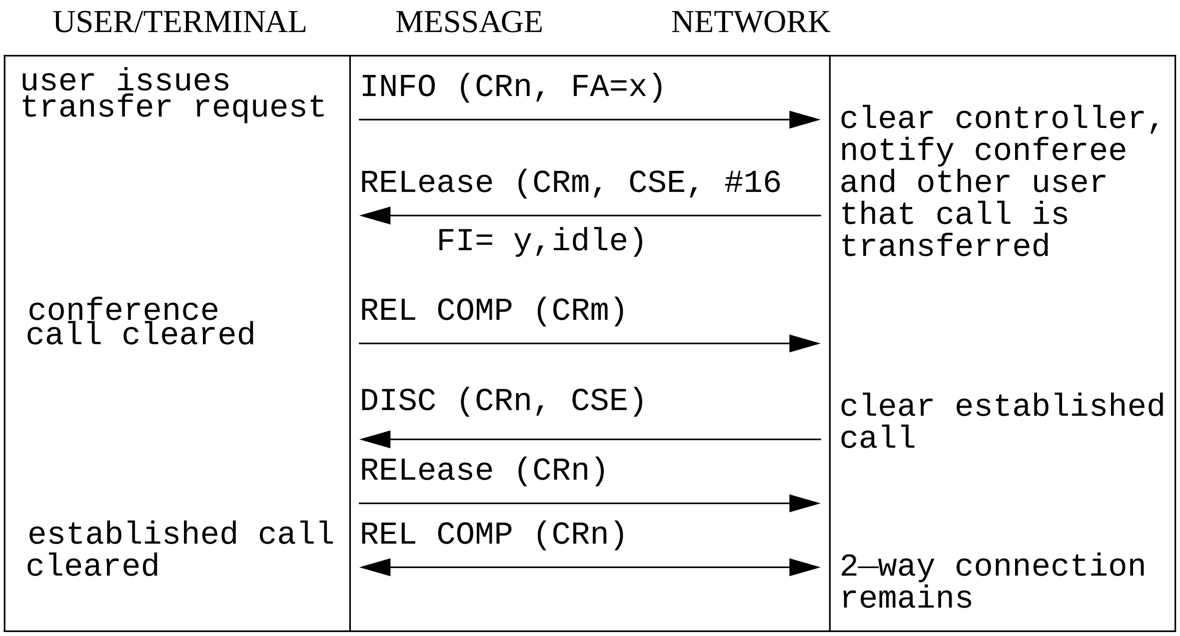
Figure 125 Transferring a connected conference call

Scenario: A user is the controller of a connected conference call with two conferees. The controller transfers the conference using the transfer FA #x. The conference FI is #y.

USER/TERMINAL	MESSAGE	NETWORK
	← INFO (CRn, FA=x)	user issues transfer request
clear controller, notify conferees that conference has been released	DISC (CRn, CSE, FI= y,idle) →	
	← RELease (CRn)	
	↔ REL COMP (CRn)	call cleared

Figure 126 Transferring a call onto a held conference call

Scenario: A user is the controller of a call on hold which has conference facilities attatched (for example, one conferee) on call reference #m. This user also has another call that is connected on call reference #n. The controller transfers the call onto the conference call using the transfer FA #x. The conference FI is #y.



6.43.2.5.1 Error conditions

The network rejects a transfer request unless all of the following conditions are met:

- all calls on the conference are identified by the Conference ID
- there are at least two established calls associated with the conference, and at least one is active
- the configuration of the conference call meets any customer group restrictions imposed on transfer
- at least one of the remaining conferees is:
  - — on an end-to-end ISDN connection to the controller
  - — a non-ISDN line served by the controller's switch
  - — on an incoming trunk to the controller's switch.

If any of the above conditions are not satisfied, the network rejects the transfer attempt by returning five seconds of inband reorder tone, and an INFOrmation containing network-specific cause #53, “service operation violated”. All calls associated with the controller remain in their current state.

6.43.2.6 Clearing the entire conference

To clear the entire conference, the controller sends a DISConnect to the network if the conference call is currently active. If it is currently on hold, the same result can be achieved with a RELease. In response, the network clears the entire conference (which includes all calls on the conference). The network includes the FI IE containing the conference FI with status “idle” in the first message that is sent in response to the user.

Note: The above scenario describes the normal conference clearing procedures only. In fact, any messaging that leads to the clearing of a basic call could be used to clear a conference call and its associated members.

6.43.2.7 Conferee releases from the conference

When a conferee sends a clearing message and drops out of a conference call with more than three members, the network clears the conferee with the clearing procedures defined in Chapter 5.

When a conferee sends a clearing message and drops out of a conference call with three members:

- the network clears the conferee with the normal clearing procedures defined in Chapter 5, and
- the controller, and the remaining conferee receive a NOTIFY containing a NI IE specifying “two party call”, and a CN IE.

In addition to the above when the controller has ISDN BRI option Flexible Calling Deactivate Conference Facility (DCC) assigned:

- the conference facility is released
- the network sends a NOTIFY message with notification indicator “conference facility released” to the controller and an INFOrmation message with feature indicator and a status of “idle” is also returned to the controller

If there are only two members left and the remaining conferee drops out, the conference facility is released and the call to both the controller and the conferee is cleared according to the procedures in Chapter 5. The clearing message to the controller contains a FI IE with the conference FI with status “idle”.

If one of the conferees on a conference of more than three parties sends the network a clearing message while the conference bridge is full (for example, while the number of parties on the conference equals the maximum conference size), the network:

- clears the conferee as defined in Chapter 5
- sends the controller a NOTIFY with the NI IE coded to “conference bridge port available”.

6.43.2.8 Feature Keys Management from NITs

NITs that support fixed FKM procedures (per SR-4288) may transfer a call, start, control, and/or drop a FC using the following fixed feature keys on the DMS-100.

- 62 = Drop
- 61 = Transfer
- 60 = Conference Size of three

6.43.2.9 3-Way Flexible Call (3WC) Chaining

Conferees in a three-way call conference who are assigned FC can establish their own conferences and create FC chains using the FC protocol described in this section. (Figure 127, “Establishing a 3-way flexible calling chain” demonstrates the configuration of chained conferences.)

Figure 127 Establishing a 3-way flexible calling chain

Scenario: A conferee in a 3 way conference (Party C) uses FC to create a conference chain between the original conference (on Bridge 1) and Party D on Bridge 2.

```
     BEFORE CHAIN       |            AFTER CHAIN
------------------------+-------------------------------------
                        |
        PARTY A         |       PARTY A        PARTY C
      (controller)      |     (controller)   (controller)
           |            |          |              |
           _            |          _              _
          / \           |         / \            / \
  PARTY  / 1 \  PARTY   |        / 1 \          / 2 \  PARTY
    B ── └─────┘── C    |    B ──└─────┘────────└─────┘── D
(conferee)   (conferee) |  (conferee)                (conferee)
```

A 3WC Chain has two limitations:

1 it can not be used to join two existing conference calls together

2 it can not be transferred to another conference.

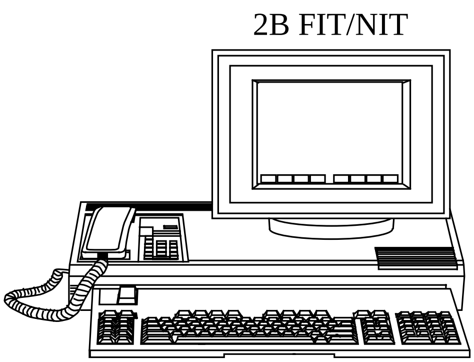
6.43.2.10 Flexible Calling on 2 B-channel terminals

This feature allows Flexible Calling (FC) activation on ISDN terminals which are capable of accessing two B channels (NI-2 Terminals and 2B FIT/NITs). These terminals are capable of establishing two simultaneous voice calls on a single Terminal Endpoint Identifier (TEI).

When a user has FC active on an NI-2 Terminal or a 2B FIT/NIT and desires to join two calls, the Channel Information Element (CIE) in the Q.931 RETrieve request, sent to the DMS, will be used to identify the particular B channel which is to be bridged.

The following diagram illustrates a situation which requires the DMS to examine the B channel information. In this example, the terminal has two active Voice Information (VI) calls with a conference on hold. When the retrieve request is received, the DMS will evaluate the channel information element to complete the request.

Figure 128 Example of a 2 B-Channel Terminal



CR X: Held conference, FC active

CR Y: Active VI call on channel B1

CR Z: Active VI call on channel B2

CR = Call Reference
VI = Voiceband Information (speech, 3.1kHz audio)

6.43.2.10.1 General operation

- FC is blocked for CMD calls.
- When there is only one active VI call, or a VI call on one B-channel, and a CMD call on the other, there is no difference in the FC service from operation on a 1 B-channel terminal.

6.43.2.10.2 Additional procedures for 2-B channel terminals

This section describes the DMS response to the Q.931 RETrieve message, within the context of the various call scenarios that may be found on NI-2 terminals or 2B FIT/NIT devices, when Flex Call is active.

> ***NOTE:***
> ***In the following examples in which bridging is allowed, it is assumed that the conference port is not full. When a conference port is full, a bridge request is always rejected. However, a full conference may be retrieved onto an idle B channel.***

6.43.2.11 Retrieve a held conference with two available B channels

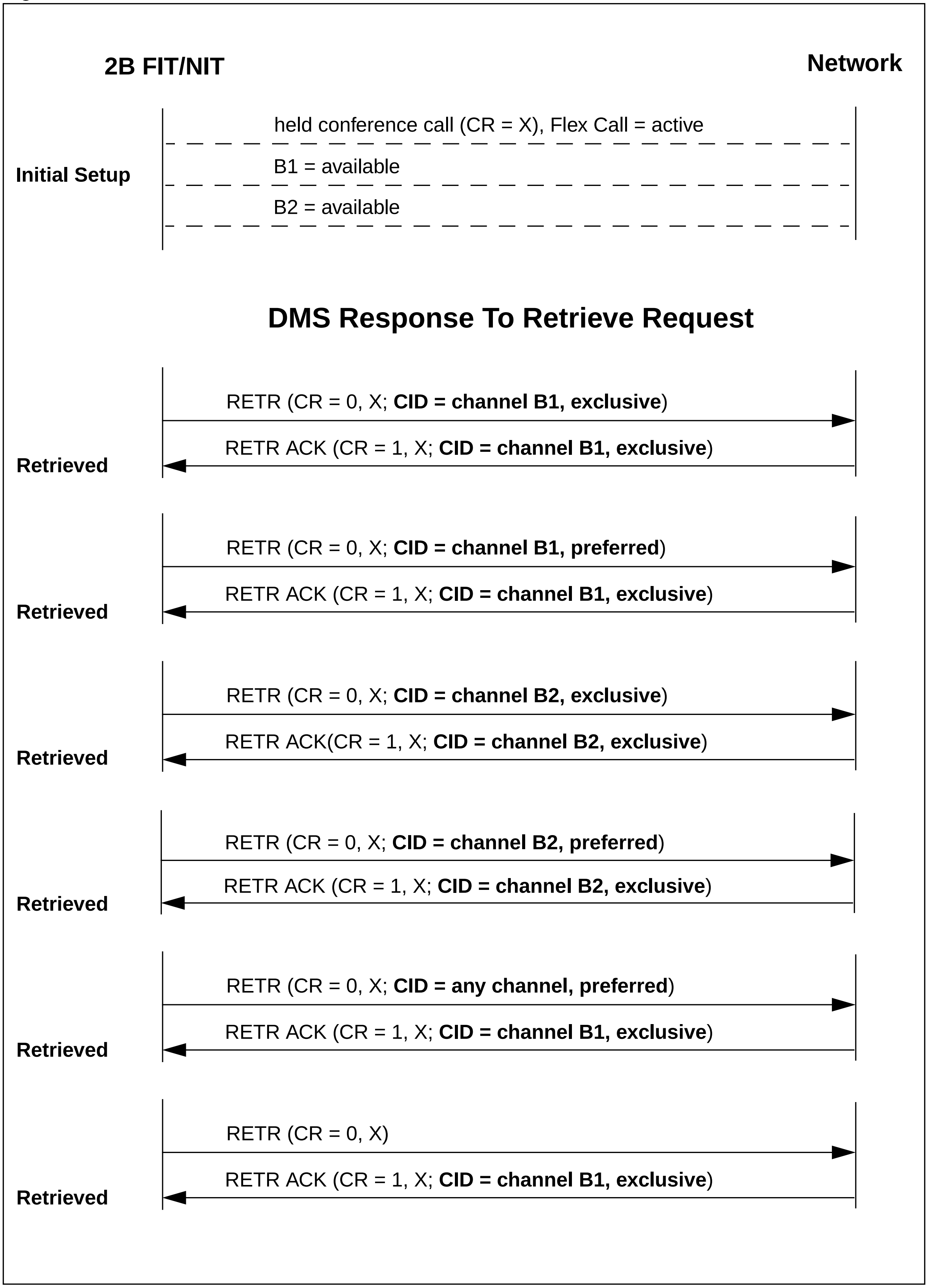
In this situation the conference is in a held state, both B channels are idle. When the DMS receives a RETrieve message it will examine the channel information element and respond accordingly.

DMS response:

1 If the retrieve request indicates either an exclusive or preferred B channel then, the call will be retrieved onto the indicated B channel. (TR858 section 3.1.1.1B)

2 If the retrieve request contains no B channel information, or indicates any B channel, then, the conference will be retrieved assuming any B channel is acceptable. (TR858 section 3.1.1.1B)

Figure 129 Retrieve a conference with two available B channels



6.43.2.12 Retrieve a held conference with one active VI call

In this situation the conference is held and there is an active VI call on one B channel, the other B channel is available.

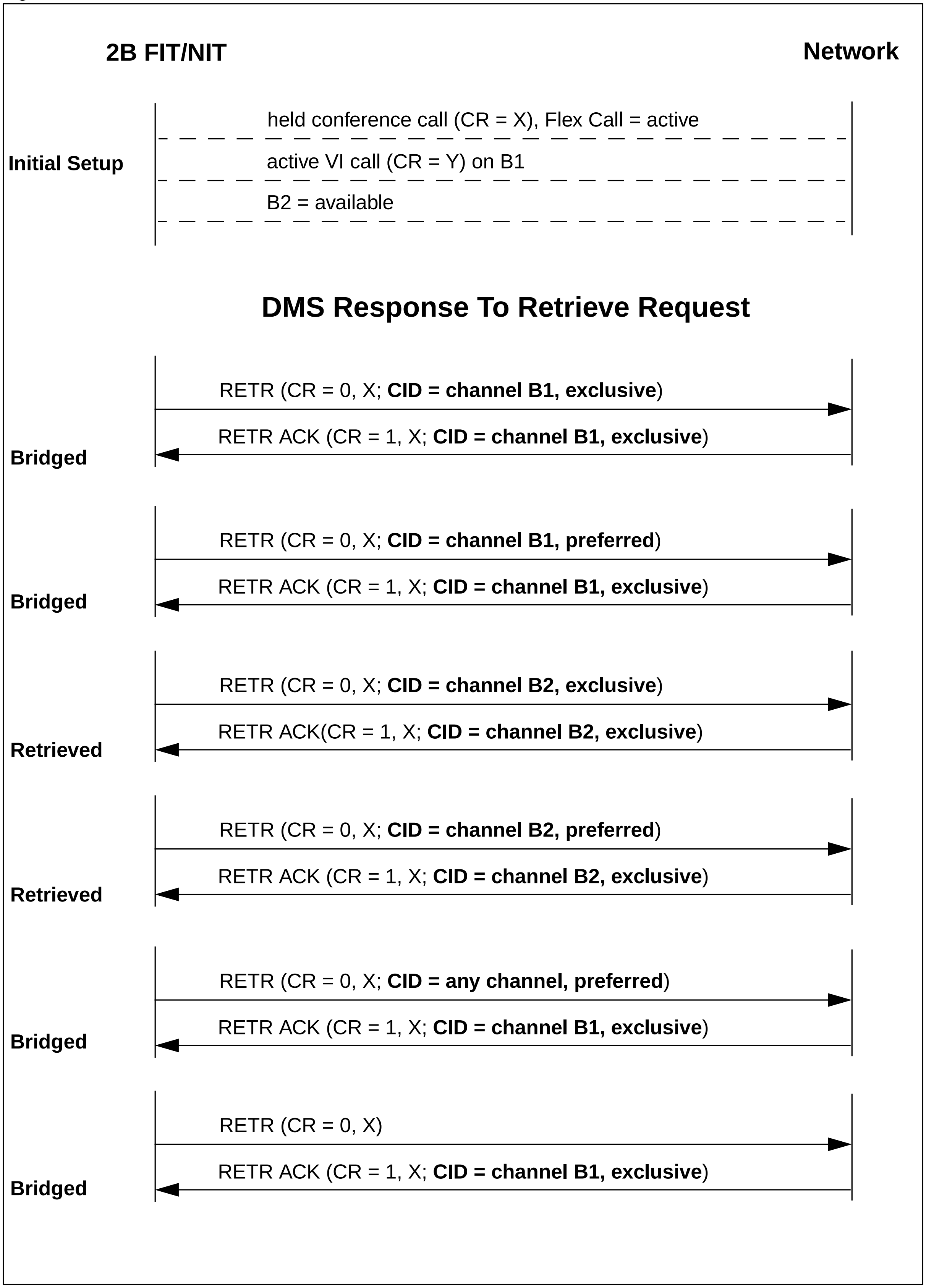
DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is the channel of the active VI call, then the conference is bridged with the active VI call. (TR858 Revision 3, section 3.1.1.2.3)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the conference is bridged with the active VI call (TR858 Revision 3, section 3.1.1.2.3)

3 If the retrieve request specifies an exclusive or preferred B channel, and the channel is the available B channel, then the held conference is retrieved onto the specified B channel. (TR858 Revision 3, section 3.1.1.2.3)

Figure 130 Retrieve a conference with one active VI call



6.43.2.13 Retrieve a held conference with two active VI calls

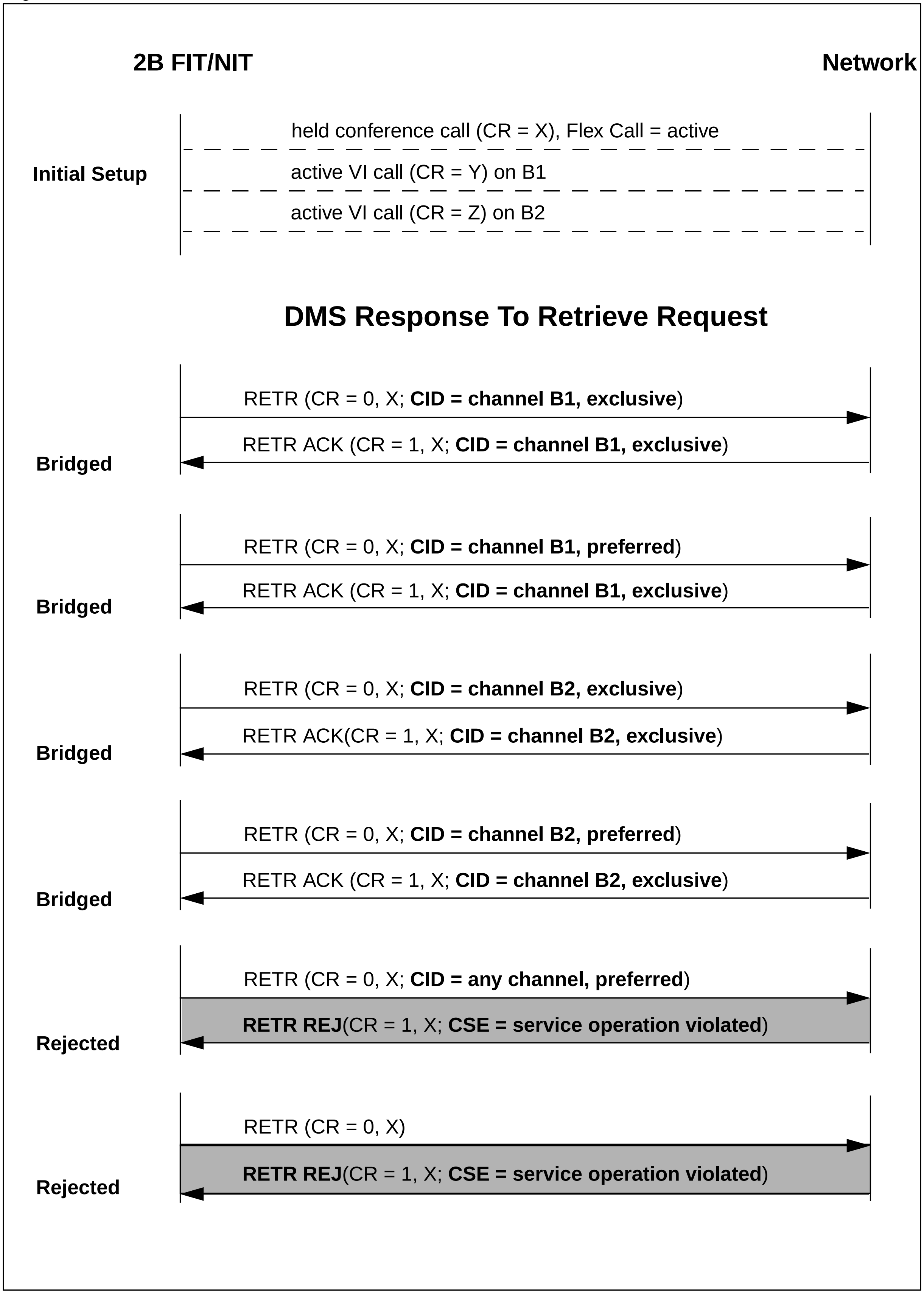
In this situation the conference is held and both B channels contain active VI calls.

DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel, then the conference is bridged with the specified B channel. (TR858 Revision 3, section 3.1.1.2.3)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the request is rejected with a reason of “service operation violated.” (TR858 Revision 3, sections 3.1.1.2.3 and 3.1.5Dc)

Figure 131 Retrieve a conference with two active VI calls



6.43.2.14 Retrieve a held conference with one active VI call and one active CMD call

In this setup, the conference is held, one B channel has an active VI call while the other B channel contains an active CMD call.

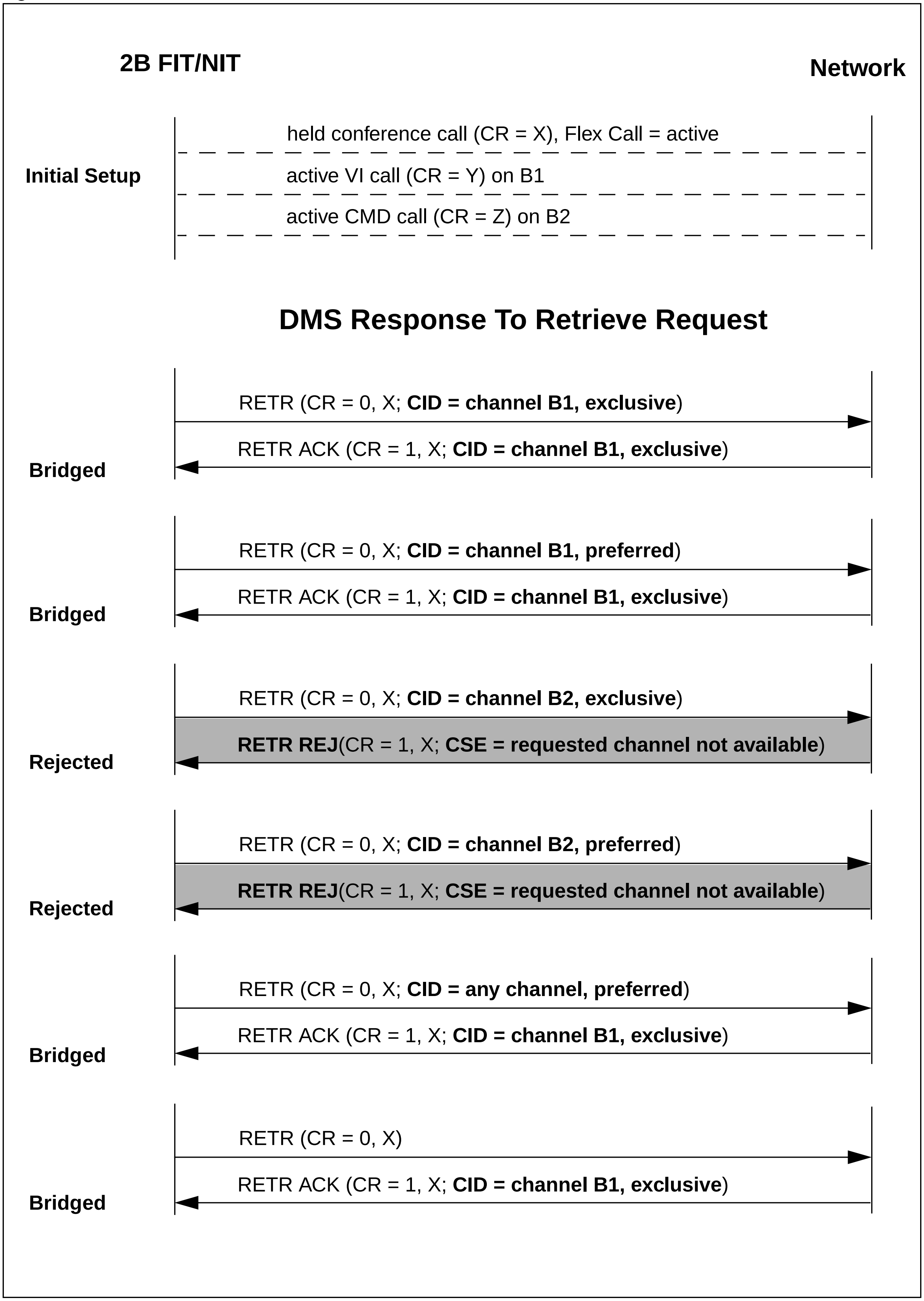
DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel with the channel of the active VI call, then the conference is bridged with the call. (TR858 Revision 3, section 3.1.1.2.3)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the DMS will bridge the conference with the active VI call. (TR858 Revision 3, section 3.1.1.2.3)

3 If the retrieve request specifies an exclusive or preferred B channel, and the channel identified is for the CMD call, then the request should be rejected. (TR858 Revision 3, section 3.1.1.2.3 and 3.1.5Dd)

Figure 132 Retrieve a conference with one active VI call and one active CMD call



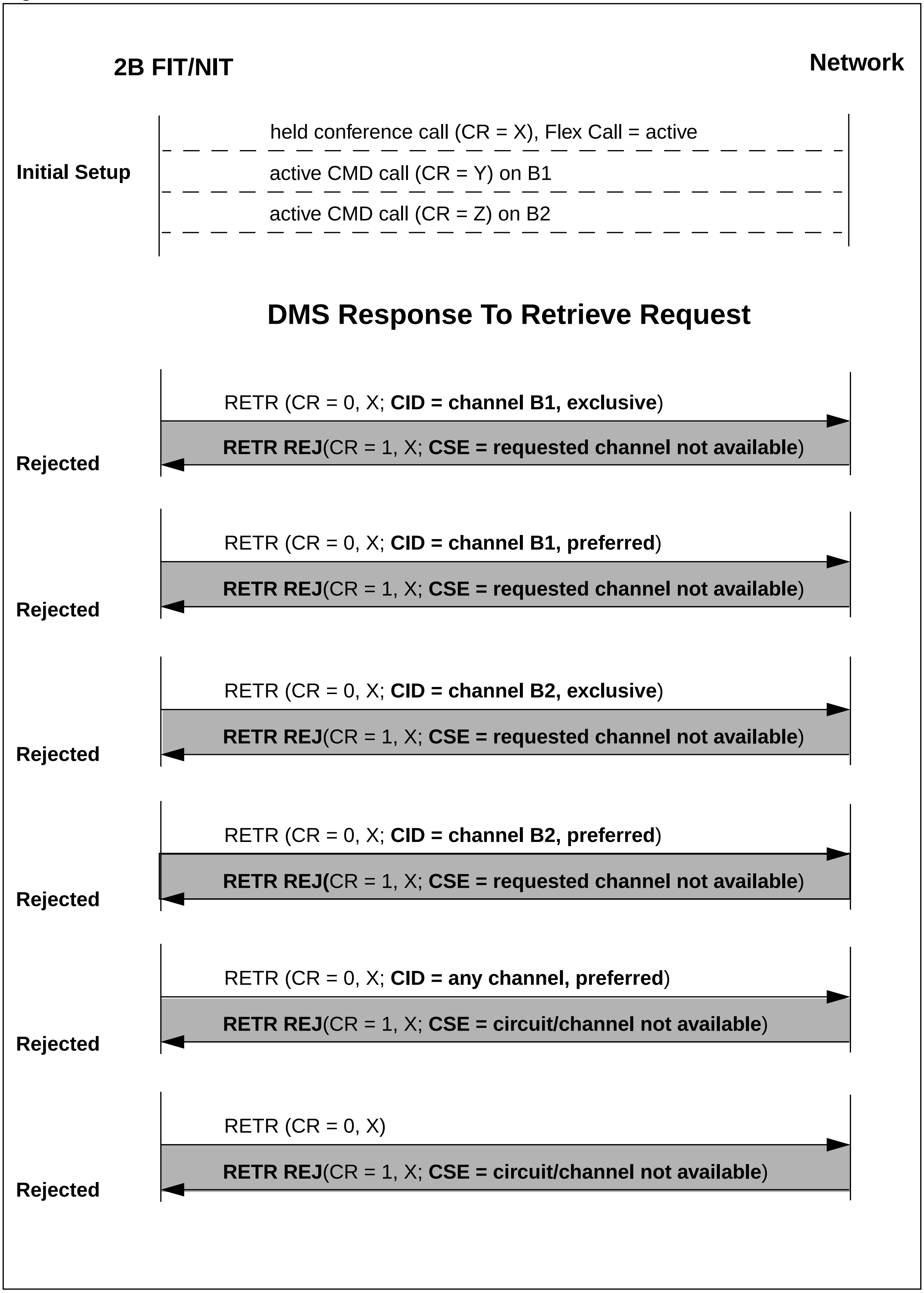
6.43.2.15 Retrieve a held conference with two active CMD calls.

The conference is held and both B channels contain active CMD calls.

DMS response:

1 The retrieve request is always rejected. (TR858 sections 3.1.1.1B and section 3.1.5D3e)

Figure 133 Retrieve a conference with two active CMD calls



6.43.2.16 Retrieve a held conference with one active CMD call

The conference is held and an active CMD call resides one of the B channels, the other channel is available.

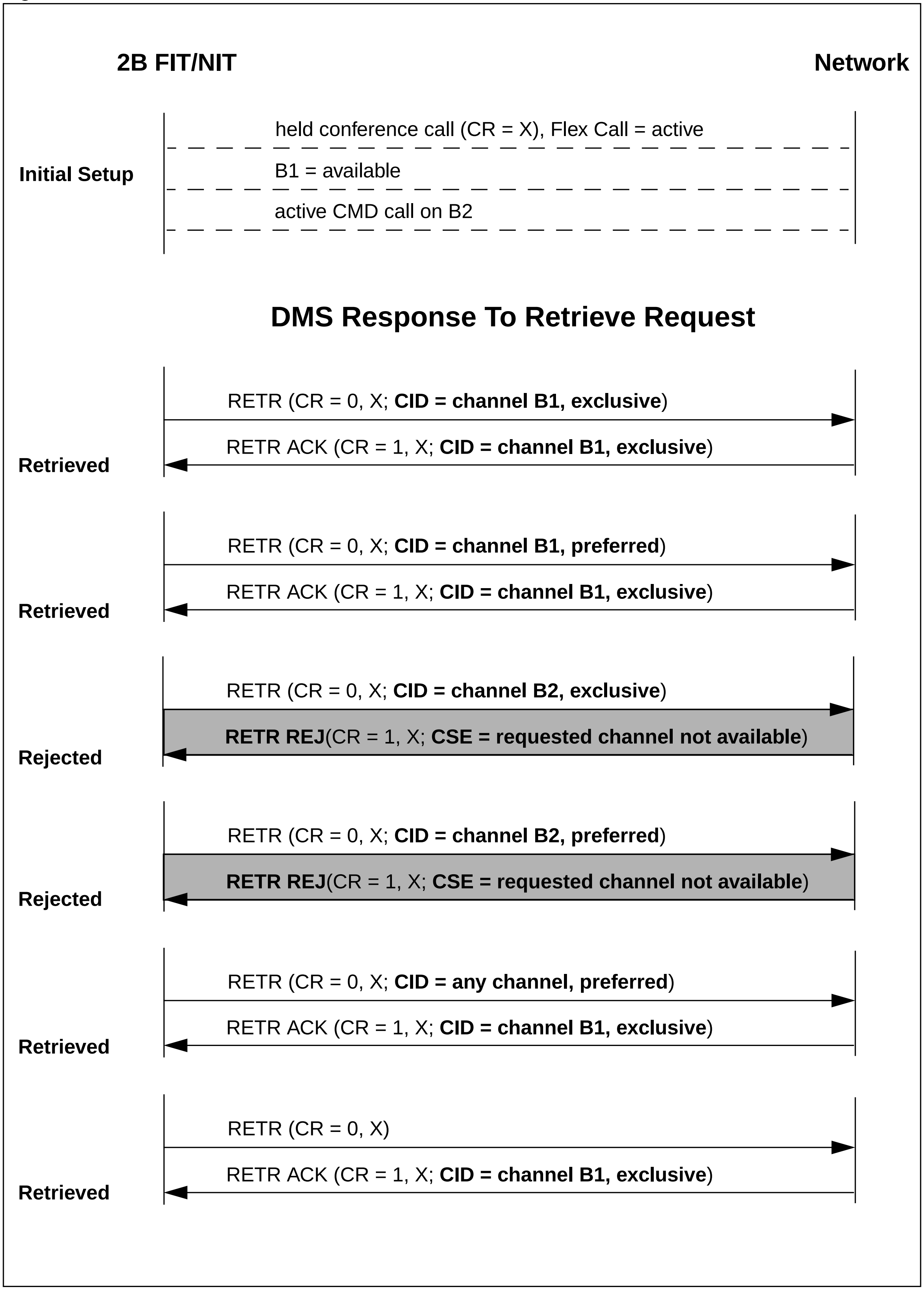
DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is the available channel, then the conference is retrieved onto the specified B channel. (TR858 Revision 3, section 3.1.1.2.3)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the conference is retrieved onto the available B channel. (TR858 section 3.1.1.1B)

3 If the retrieve request specifies an exclusive or preferred B channel, and the B channel is that of the CMD call, then the request is rejected. (TR858 Revision 3, sections 3.1.1.2.3 and 3.1.5Dd)

Figure 134 Retrieve a held conference with one active CMD call



6.43.2.17 Retrieve a held VI call with an active conference

In this situation a VI call is held and a conference is active on one B channel, the other B channel is available.

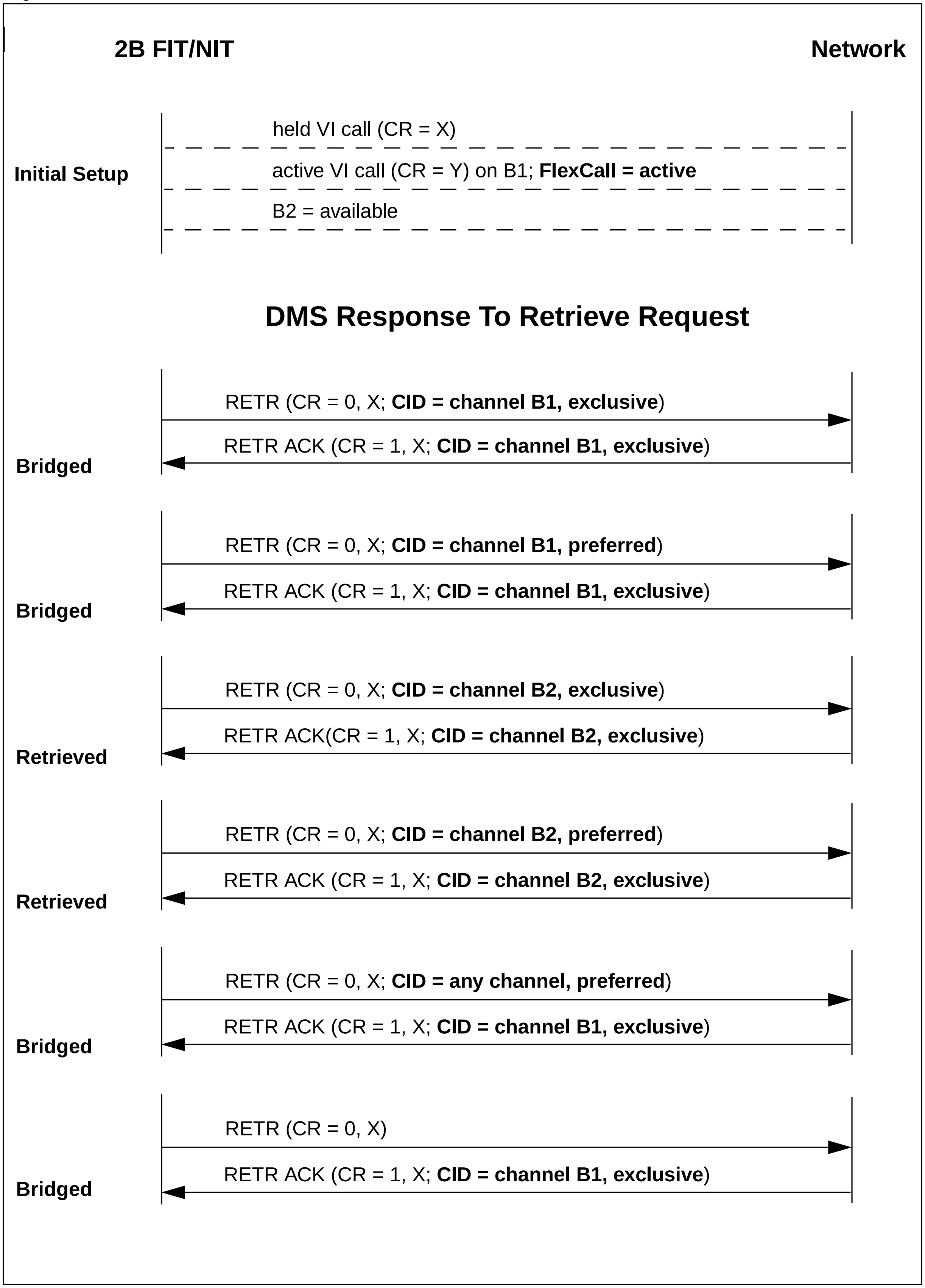
DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is the channel of the active conference, then the held VI call will be bridged with the conference. (TR858 Revision 3, section 3.1.1.2.2)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the VI call is bridged with the active conference. (TR858 Revision 3, section 3.1.1.2.2)

3 If the retrieve request specifies an exclusive or preferred B channel, and the channel is the available B channel, then the held VI call is retrieved onto the specified B channel. (TR858 Revision 3, section 3.1.1.2.2)

Figure 135 Retrieve a held VI call with an active conference



6.43.2.18 Retrieve a held VI call with an active conference and one active call

In this situation a VI call is held and a conference is active on one B channel. The other B channel contains either an active VI or CMD type call.

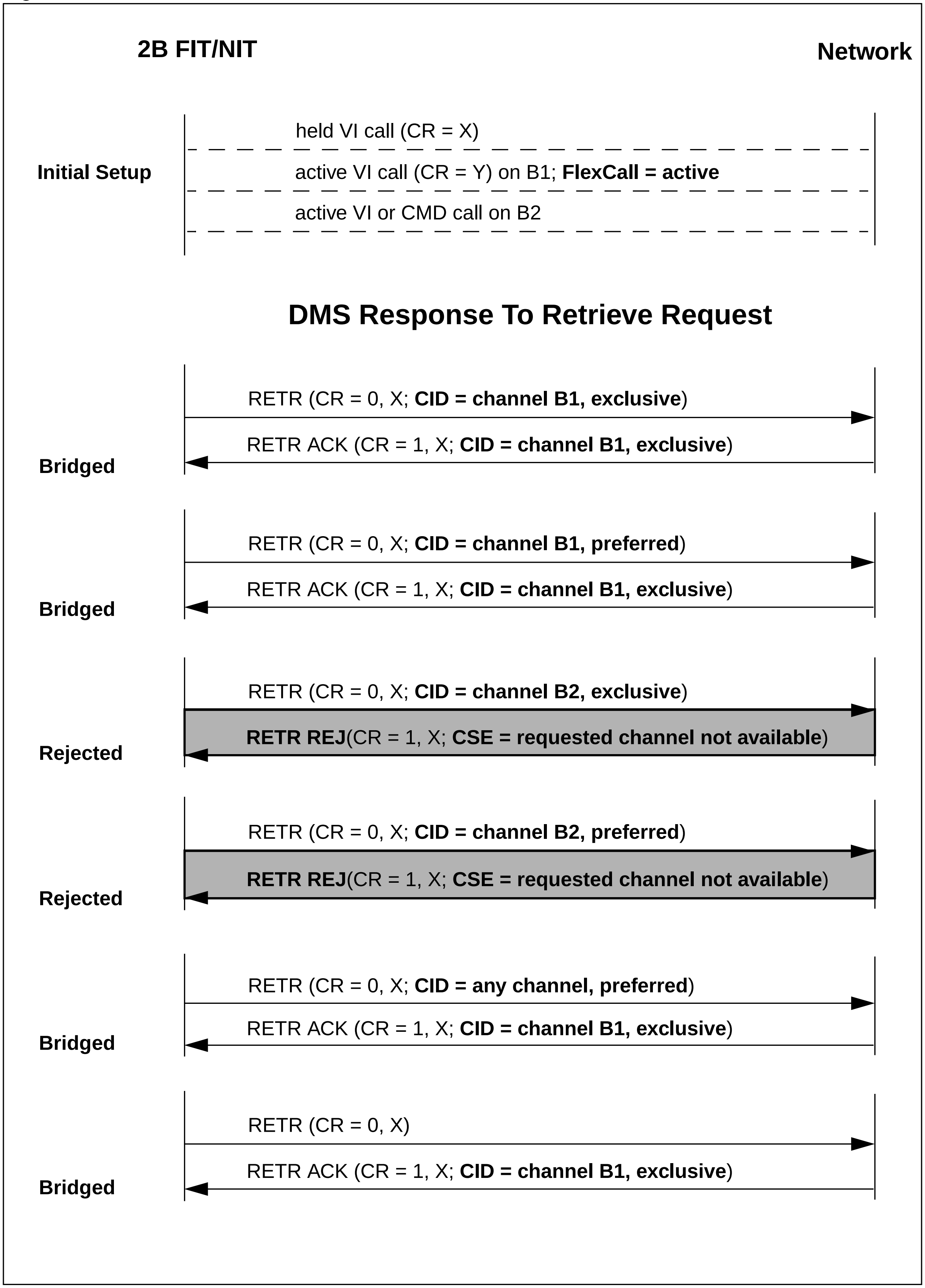
DMS response:

1 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is the channel of the active conference, then the held VI call is bridged with the conference. (TR858 Revision 3, section 3.1.1.2.2)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the VI call is bridged with the active conference. (TR858 Revision 3, section 3.1.1.2.2)

3 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is not the channel of the active conference, then the request is rejected. (TR858 Revision 3, section 3.1.1.2.2)

Figure 136 Retrieve a VI call with an active conference and on active call



6.43.2.19 Retrieve a held CMD call with an active conference

In this situation a CMD call is held and a conference is active on one B channel. The other B channel is available.

DMS response:

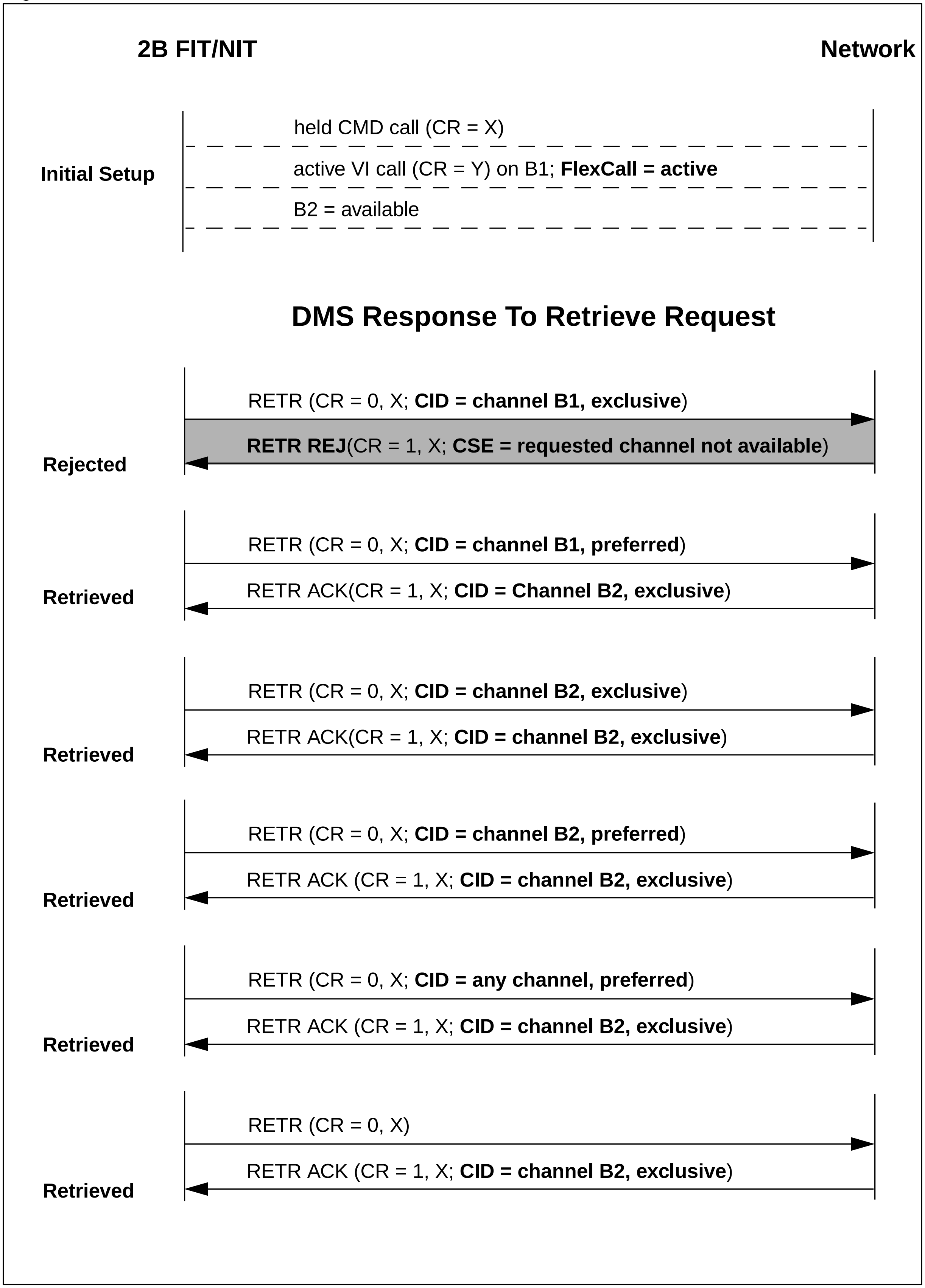
1 If the retrieve request specifies either an exclusive or preferred B channel, and the B channel is the available channel, then the CMD call is retrieved onto the specified B channel. (TR858 section 3.1.1.1B)

2 If the retrieve request contains no B channel information, or indicates any B channel, then the CMD call is retrieved onto the available B channel. (TR858 section 3.1.1.1B)

3 If the retrieve request specifies a preferred B channel for the channel which contains the conference, then the CMD call is retrieved onto the available B channel. (TR858 section 3.1.1.2.2, second paragraph)

4 If the retrieve request specifies an exclusive B channel, and the B channel is that of the conference, then the request is rejected. (TR858 section 3.1.1.1B)

Figure 137 Retrieve a held CMD call with an active conference



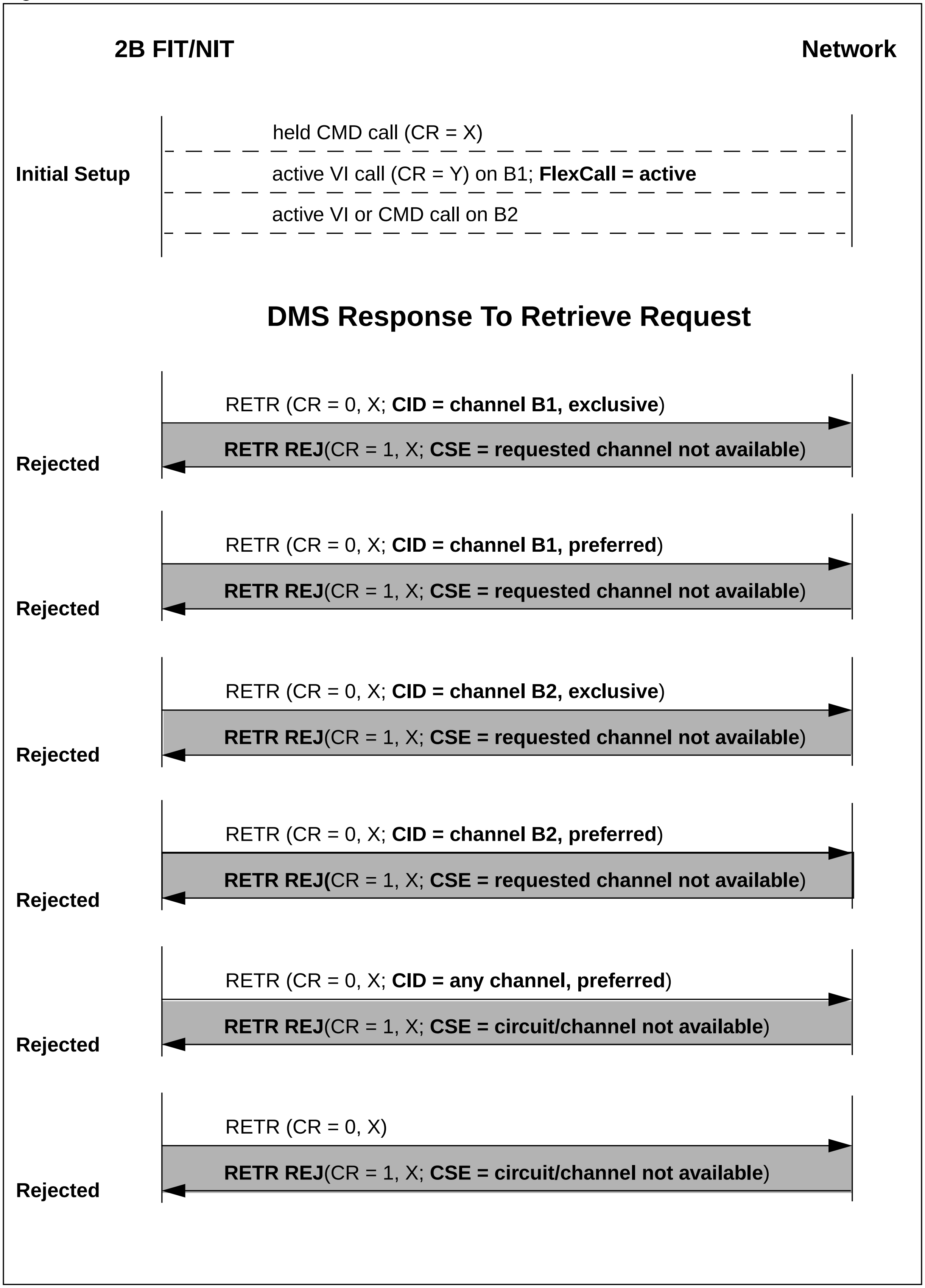
6.43.2.20 Retrieve a held CMD call with an active conference and one active call

In this situation a CMD call is held and a conference is active on one B channel. The other B channel contains either an active VI or CMD type call.

DMS response:

1 The retrieve request is always rejected. (TR858 sections 3.1.1.1B and 3.1.5D3e)

Figure 138 Retrieve a CMD call with an active conference and on active call



6.43.2.21 Handle SETUP with FC active and one available channel

In this situation an active Flex Call is on one channel and the other B channel is available.

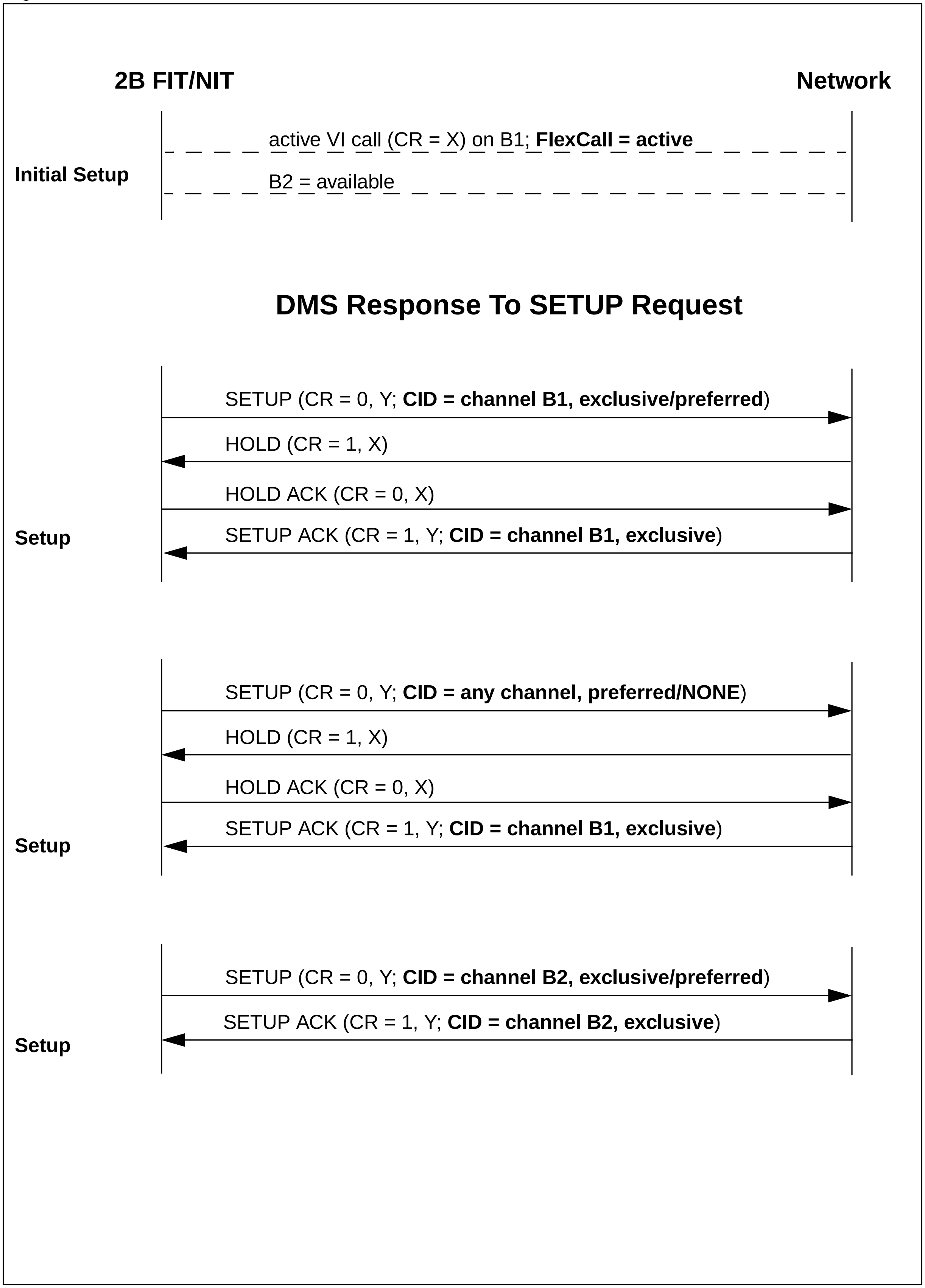
DMS response:

1 If the SETUP request specifies either an exclusive or preferred B channel, and the B channel is the channel with the active Flex Call, then consultation hold is applied to the FC call on the channel, and the new call is setup on the requested channel. (TR858 Revision 3, sections 2 and 3.1.1.2.2)

2 If the SETUP request contains no B channel information, or indicates any B channel, then the DMS assumes this is a request to bridge the call. Thus, consultation hold is applied to the FC and the new call is setup on the channel which was being used by the FC. (TR858 Revision 3, sections 2 and 3.1.1.2.2)

3 If the SETUP request specifies either an exclusive or preferred B channel, and the channel is for the available channel, then the new call is setup on the requested channel. (TR858 Revision 3, section 3.1.1.2.2)

Figure 139 Handle SETUP with FC active and one available channel



6.43.2.22 Handle SETUP with FC active and second channel in use

In this situation an active Flex Call is on one channel and the other B channel contains either an active VI or CMD call.

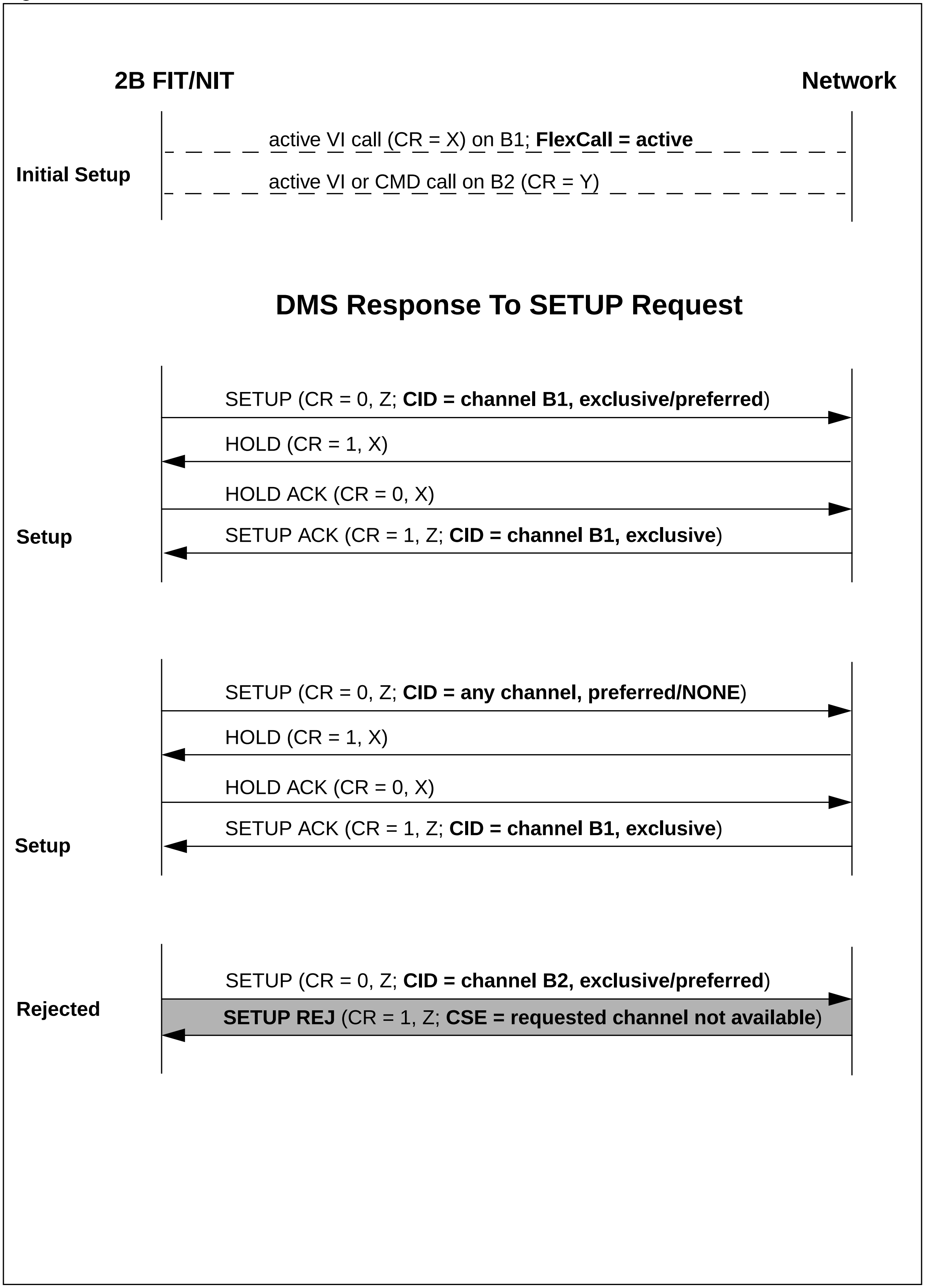
DMS response:

1 If the SETUP request specifies either an exclusive or preferred B channel, and the B channel is the channel with the active Flex Call, then consultation hold is applied to the FC call on the channel, and the new call is setup on the requested channel. (TR858 Revision 3, sections 2 and 3.1.1.2.2)

2 If the SETUP request contains no B channel information, or indicates any B channel, then the DMS assumes this is a request to bridge the call. Thus, consultation hold is applied to the FC and the new call is setup on the channel which was being used by the FC. (TR858 Revision 3, sections 2 and 3.1.1.2.2)

3 If the SETUP request specifies either an exclusive or preferred B channel, and the channel is for the channel with the active call, then the SETUP request is rejected. (TR858 Revision 3, section 3.1.1.2.2)

Figure 140 Handle SETUP with FC active and second channel in use



6.43.2.22.1 Call transfer

When there are two active calls on a 2 B-channel terminal, a request for call transfer, either explicit or implicit, is denied.

6.43.2.22.2 Call terminations

When a conference bridge is active, and associated with an existing VI call, whether Active or Held, subsequent terminating VI calls are offered as ACO procedures.

6.43.3 Feature interactions and limitations

6.43.3.1 Notation

For the purposes of this section, 500/2500 sets, MBS, and ISDN stimulus sets fall into the category of IBN lines. The controller is an ISDN functional terminal assigned the FC feature.

Throughout this section, the following terms are used:

- FC blocked agent - An agent which cannot be part of a FC. This implies one of two things:

1 The conference capability can not be attached to a call containing this agent (that is, attendant console, 911). If conference capability was attached during call establishment before routing, the controller receives treatment when the call terminates on an FC blocked agent.

2 Any additional call on the BRI interface containing this agent can not be bridged or transferred into the conference. Such an attempt is rejected with an appropriate RETRieve REJect or INFOrmation, containing network-specific cause value #53, “service operation violated”.

- FC blocked call - A call or call state incompatible with FC. This implies one of two things:

1 The conference capability can not be attached to a call in this state.

2 Any additional call on the BRI interface in this state can not be bridged or transferred onto the conference.

- Add-on call - The call last added to the conference using FC.

6.43.3.2 Basic IBN - attendant features

- Attendant Camp-on - If the attendant is camped-on to a call involving an ISDN functional terminal, that terminal is prevented from invoking FC.
- Attendant Transfer - If a call from an Attendant Console is routed to an ISDN set over a trunk (for example, the incoming agent is a trunk), the ISDN set user can invoke FC on the call.
- Busy Verify Line - An attendant can not barge in on a conference call established by the FC service, the call is routed to busy treatment.

- Busy Verify Trunk - If the trunk being busy-verified is involved in the FC conference call, the attendant call is routed to busy treatment.
- Attendant Message Waiting - The message center is a FC blocked agent. This applies also to calls which are forwarded to the message center.

6.43.3.3 Basic IBN - system features

- No Double Connect (NDC) - FC and NDC are incompatible. Service orders block the assigning of both these options to the same DN group on the ISDN functional terminal.
- 3WC Chaining - A call involved in a 3WC or 3WC chain is a FC blocked for FC 6WC but not for FC 3WC.

  When an ISDN user is a conferee in a 3WC/conference-six call, the network sends a NOTIFY with NI IE specifying “connected via conference facility (conferee)”. When the 3WC drops down to a two-way connection, a conferee receives a NOTIFY with NI IE specifying “conference facility released”, and a CN IE with the address of the other remaining party.
- Loudspeaker Paging and Line Termination (Enhanced) - The loudspeaker paging system can be accessed from the conference call and any additional call on the BRI interface. An attendant cannot use BUSY VERIFY for lines to pre-empt the paging equipment if the user is engaged in a conference call.
- Attendant Console - CMD Calls to an Attendant Console are blocked.

6.43.3.4 Basic IBN - station features

- Analog Call Hold - Any call held by analog call hold falls into the category of a FC blocked call. The conference or add-on call can not be held by Analog Call Hold.
- Permanent Hold - A call held by Permanent Hold falls into the category of FC blocked calls. Permanent Hold can not be activated on the conference or add-on call.
- Station Call Park - A parked call is considered a FC blocked call. A conferee cannot park either the conference or add-on call.
- Call Forward Don't Answer (CFD) - CFD is only applicable when invoking a 3-party FC conference.

6.43.3.5 IBN Enhanced Business Services - system features

EBO calls belong to the category of FC blocked calls. An EBO user can not barge into the conference or add-on call.

6.43.3.6 Business Set features

- EKTS Group Intercom - A controller who is a member of a GIC group may only transfer calls to other members in the group. Attempts to transfer a call to a party outside the group are rejected.
- Malicious Call Hold (MCH) - MCH cannot be invoked on the conference call. A conferee cannot invoke MCH on the calling user. In this situation, the flash is ignored if the called user is a 500/2500 set, or the called user

receives treatment if it is an MBS or ISDN stimulus set. Calls held by the MCH feature are FC blocked calls.

- EKTS shared DN - An EKTS user assigned FC can perform conference capabilities on an EKTS shared DN if that user (also the FC conference controller) is the only active member on the EKTS-shared DN call.

  If the EKTS user (also the FC conference controller) is not the only active member on the call, the following restrictions apply:

  — when the user attempts to invoke conference on an EKTS-shared DN, the network rejects the request in an INFOrmation containing cause value #29, “facility rejected”.

  — when the user attempts to bridge an EKTS-shared DN call and the FC conference call, the network rejects the request by sending a RETRieve REJect containing cause value #29, “facility rejected”.

  — when the user attempts to transfer together an EKTS-shared DN call and the FC conference call, the network rejects the request by sending an INFOrmation containing network specific cause value #53, “service operation violated”.

  A request to invoke conference on an EKTS-shared DN call that either MADN or EKTS held is rejected by the network by sending an INFOrmation containing network specific cause value #53 “service operation violation”.

  When a user is an FC controller on an EKTS-shared DN, other members of the EKTS group are not allowed to bridge into the call. Upon receipt of a bridge request from an associated member, the network rejects the request with an appropriate rejection message containing cause value #29 “facility rejected”.

  A user who is also an FC controller on an EKTS-shared DN call can place the call on hold and retrieve it. Associated EKTS members of the EKTS group may not retrieve the held call. No notification that the call was placed on hold or n retrieved is sent to the associated EKTS users.

  In general, notifications sent to remote parties for FC are withheld when the remote party is an EKTS bridged call. Notifications sent to remote parties for EKTS-shared DN calls are withheld when the remote party is an FC conference.

- Flexible Station Controlled Conference - A call involved in a flexible station controlled conference is an FC blocked call. The other party in the conference call or conferee can not invoke the flexible station controlled conference feature.

- ACD (Automatic Call Distribution) - An ACD agent is a FC blocked agent.

- IBN Preset Conferencing - A call involved in a preset conference is an FC blocked call.

6.43.3.7 IBN-ESB compatibility

For 911 service, the emergency service line and trunk are both FC blocked agents.

6.43.3.8 IBN Superset

- Call Waiting Originating/Dial Call Waiting - A station with call waiting originating can not impose call waiting on the controller, or any of the two conferees, after bridging. The calling station continues to receive busy treatment in this case.

  Call waiting can not be imposed using Dial Call Waiting by a station on any party involved in a conference call set up through the FC service. In this case, the calling party receives busy treatment.

- Directed Call Pickup with Barge-in (DCBI) - allows an IBN station to answer a call ringing any other line within the same customer group and served by the same DMS switch.

  If the called station already answered the call by the time the activating station completed the pick-up sequence, the activating station may barge into it.

  A call barged into using the DCBI feature is an FC blocked call.

- Directed Call Park - A call on the BRI interface parked by the directed PRK feature is an FC blocked call. A user can bridge or transfer any call retrieved using the directed PRK feature into the conference as if that call were established through normal termination procedures.

6.43.3.9 Miscellaneous

- Operator Trunks - FC can not be invoked for calls using operator trunks. A call involving an operator trunk on the BRI functional interface can either be held manually or through the autohold procedures. Thus, the ISDN hold capability temporarily disables the operator hold control feature.

6.44 Hold and Retrieve

6.44.1 Definition

Hold and Retrieve is a functional version of hold, using Q.931 functional messages for activation.

Figure 141 Hold service activation

Scenario: A user is active on call reference #n and invokes the Hold service by sending a HOLD to the network. The network responds with a HOLD ACKnowledge to denote that the request was successfully completed.

USER/TERMINAL	MESSAGE	NETWORK
	Call in progress/active	
hold request	HOLD (CRn) ——▶	hold request valid
call held	◀—— HOLD ACK (CRn)	

Note: Channel reservation may be specified as a network option

Hold and Retrieve service allows a user to interrupt communication on an existing call/connection, and then subsequently, if desired, re-establish communication.

A B-channel may or may not be reserved after the communication is interrupted to allow the origination or possible termination of other calls. Reservation is provided by the network as a user option. If reserved, two different types of reservation are possible:

1 for a given terminal that placed the call on hold

2 for a subscription time user defined set of terminals.

Specify the type of reservation at subscription time.

6.44.2 Procedures for Hold

Procedures for both user-initiated Hold and Network Autohold are described in Section 6.44.2.3, “User holding a call”, and Section 6.44.2.5, “Autohold procedures”, respectively. The preferred approach for terminals is to use the user-initiated hold procedures. The unsuccessful application of this feature results in a response containing the failure details.

Note: The network does not attempt to reserve the channel released for the terminal that invoked the Hold.

6.44.2.1 Connection states

Hold acts on the connection associated with the call. The associated state changes therefore relate to the state of the connection; for example, no B-channel associated with the call. These are referred to below as Connection Manager states.

The Connection Manager auxiliary state machine, is a state machine tracking the state of a connection at the interface on a per connection (call) reference basis.

6.44.2.2 Initiator/Receiver side states (CMn)

- Null (CM0) - Default condition; an access channel is associated with the call.
- Hold Request (CM1) - A Hold request was initiated or received.
- Connection Held (CM2) - The connection is on hold, for example, the access channel was disconnected from the end-to-end connection.

6.44.2.3 User holding a call

- The user may explicitly hold any established call by sending a HOLD to the network, as shown in Section 6.44.2.5, “Autohold procedures”. An established call is either an outgoing call that progressed passed Call Proceeding (for example, after receiving CALL PROCeeding from the network), or an incoming call that received a CONNect ACKnowledge from the network. At this time, the user disconnects the B-channel.
- If the hold request is valid, the network releases the B-channel at the interface and sends a HOLD ACKnowledge. If the held user was receiving CALL ALERTing, a Signal IE containing signal #63 is included in this message. Upon receiving the HOLD ACKnowledge, the user releases the B-channel, but maintains the call reference value.
- If the hold invocation was not successful, the network returns a HOLD REJect, with an appropriate cause, and user then re-connects the B-channel.
- As a subscription option, the network may send a notification to the held party, indicating the call was placed on hold.

6.44.2.4 Channel reservation

The following rules concerning reservation against a channel apply:

- If the held call(s) are cleared for any reason, the network continues to reserve a B-channel until there no more held calls with reservations associated with that user.
- When a call is retrieved, any reservations against a channel associated with that call are cleared, independent of which channel is used to retrieve the call.
- When a call is cleared, any reservation against a channel associated with that call is cleared.
- When all reservations are cleared, all channels become available for use by either the network or user.
- When any reservation is outstanding for a given user, and they are not using the channel for an active call, the network considers that channel as “not free” for that user, for subsequent incoming calls.

6.44.2.5 Autohold procedures

- The network may also autohold an existing call by sending the user a HOLD, as shown in Section 6.44.2.5, “Autohold procedures”. After sending the HOLD, the network disconnects from the B-channel at the user-network interface, and starts hold request timer T360 (default 4 s).
- Autohold procedures are only available for the FC and EKTS DN Bridging supplementary services.
- Explicit HOLD procedures are used in all other cases.
- If a HOLD ACKnowledge is received from the user before expiry of T360,[1] the network cancels T360 and reserves the B-channel for use by the user on the interface.
- If the user sent the network a HOLD REJect, the network cancels T360 and re-connects the B-channel. If the Cause IE is missing in the HOLD REJect, the network processes the HOLD REJect as if the Cause IE were included. The actions that follow depend on the event that initiated the autohold request:

  1 If the hold request was a result of a retrieve request from the user, the network rejects it by sending a RETRieve REJect.

  2 If the hold request was initiated as a result of a CAR from the user, the network rejects the CAR by sending a RELease COMplete, as described in Chapter 5.

  3 If the hold request was initiated as a result of a connect request from the user during additional call offering, the network clears the additional call to the user by sending a RELease, and following the call clearing procedures defined in Chapter 5.

  4 If the hold request was initiated as a result of a FA request from the user, the network reverts to the condition before the feature request was received.

  In cases 1, 2, and 3, the network sends a cause value #34, “no circuit/channel available”.

  If the hold request T360 expires before the user sends any response, the actions taken are the same as if a HOLD REJect was received, as described above.

1. Currently the network does not wait for the user to acknowledge the autohold request.

Figure 142 Autohold procedures

Scenario: A user is active on call reference #n and attempts to originate a new call on call reference #m by sending a CAR to the network. The network autoholds the active call by sending a HOLD.

USER/TERMINAL	MESSAGE	NETWORK
	active call on CRn ←——→	
call request	SETUP (CRm, BC, ...) ——→	
autohold	HOLD (CRn) ←——	autohold active call
call held	HOLD ACK (CRn) ——→	
	CALL PROC (CRm) ←—— (as in basic call)	

6.44.3 Procedures for retrieve

- Retrieve provides the ability to re-establish a previously-held call.
- Invoke Retrieve by sending a RETRieve to the network, specifying the call reference of the held call, as shown in Figure 143, “Retrieve Request procedure”.
- The user may or may not include a CID IE in the RETRieve. Users are encouraged not to use CID set to ‘exclusive B1’ or ‘exclusive B2’, because it may result in the retrieve being rejected if the channel is not available.

  The channel may become unavailable in the following scenario:

  – A user holds a call on channel B1, the network reserves a B-channel for the held call.

  – A second user on the same ISDN access sets up a call on B-channel.

  – The user then attempts to retrieve the held call exclusively on B1.

  – The retrieve is rejected because the channel is already in use.
- If the Retrieve is successful, the network connects the held call to a B-channel, and sends a RETRieve ACKnowledge containing the Channel identification IE specifying the B-channel to which the terminal connects.
- If the held call was receiving CALL ALERTing, a Signal IE with signal, #1 is included in the message. The user then connects to the specified B-channel.
- If the Retrieve was not successful, the network returns a RETRieve REJect, with an appropriate cause. The call remains held.

Figure 143 Retrieve Request procedure

Scenario: A user wants to re-establish a previously held call by sending a RETRieve to the network. The network responds with a RETRieve ACKnowledge specifying the B-channel to which to connect.

USER/TERMINAL	MESSAGE	NETWORK
	(held call on CRn)	
retrieve request	RETR (CRn) →	
connect B–ch	← RETR ACK (CRn, CID = connected B-channel)	

6.44.3.1 Requirements for terminal supporting multiple ISDN Basic Rate User Network Interface Specification appearances

NI-2 ISDN terminals must allow more that one Flexible Calling (FC) size to be provisioned against them. The DMS allows two different sizes of FC to be provisioned on a terminal (for example, FC3 and FC6). The FC appearances are not limited to FC3 and FC6, they could be between FC6 - FC30.

- Any FC user can expand a call, or combine two calls to form a conference call. ISDN FC provides a common set of conferencing services independent of the subscribed conference size.
- The user can subscribe to two different size conference services on a terminal. The size of the conference is specified during service activation.
- Although a user can subscribe to both small and large conference capabilities, they can control only one conference.
- They can however, be a part of multiple conferences. They can hold a call or conference and talk to parties on other CAs. This allows users to move between multiple calls or conferences on a terminal.

6.44.3.2 Requirements for allowing ISDN Basic Rate User Network Interface Specification to transfer to, or conference an attendant

Attendants are required when callers can not dial or reach a party.

- Because of this, FC users, whether using FC3, FC6, or greater, require the ability to call an Attendant, and transfer the call to that Attendant.
- Any FC conference made up of three parties (one of them being the Attendant), can be transferred. If the Attendant is busy, and the call goes to a Queue, the call can still be transferred into the queue. If the FC has more than three parties in the conference when the Attendant is rung, the Attendant can be added to the conference. If the Attendant is added into the conference while ringing, the conference will continue to receive ringing from the Attendant Queue.

- This ringing call can be dropped from the conference using “Drop Last”, if applicable[1].
- If the conference’s controller drops out of a conference having three or more parties, the conference continues as long as one of the remaining parties can pass the transfer supervision criteria.
- This conference is in a “float” condition and is not controlled by anyone. Therefore, if one of the remaining parties is alerted, the conferees hear the ringing. Because there is no controller, no one can drop the ringing party from the conference.
- ISDN FC3 users can call an Attendant and conference that agent into a three-party call. The controller of the call can transfer the other party to the Attendant or Attendant Queue, thus freeing the controller.
- For ISDN FC6 or greater, users with a conference of one other party can call an Attendant, and conference all the parties. If desired, the controller can, at this point, transfer the other party to the Attendant or Attendant Queue.
- For ISDN FC6 or greater, users with a conference of more than one other party can call an Attendant and conference that agent or Attendant Queue into the call. The FC user can drop the Attendant or Attendant Queue by doing a “Drop Last”.
- If a FC6 or greater user is controlling a conference with an Attendant connected, and the controller disconnects, the conference should continue as long as one of the remaining conferees can pass the transfer supervision criteria.
- ISDN terminals with “Explicit Transfer” can transfer a non-conference call to the Attendant or an Attendant Queue.

6.44.4 Transfer

The TRANSFER subscriber may transfer a conference call either *implicitly* or *explicitly*. However, transferring parties from one call to parties on another call is valid only for *explicit* invocation.

If a subscriber has been provisioned with Implicit TRANSFER, after he/she established a bridged Flex Conference call, the subscriber may transfer the conference. That is, when the subscriber disconnects from the conference, the remaining conferees will remain connected to the conference circuit.[2] If Implicit TRANSFER is not provisioned, all the call legs on the conference will be taken down when the controller exits the call.

To use Explicit TRANSFER to transfer a conference, the subscriber will activate his/her TRANSFER key once, identifying the conference call.

1. Only the last party added may be dropped. On conference of greater than three parties, each time the drop key is hit a party will be dropped. Parties are dropped in the reverse order that they were added.

2. If only two conferees remain on the conference when the controller exits, the conference circuit will be released and the conferees will remain connected in a two way call.

However, to Explicitly TRANSFER together two independent calls, the subscriber must identify both calls by activating the transfer feature key twice, once for each call.

6.44.4.1 Call Processing

Flexible Calling TRANSFER supports the following types of transfers:

1 Conference transfers, where remaining conferees continue to be connected to each other after the controller exits. (Implicit or explicit invocation.)

2 Call-to-Call transfers, where a party from one call is transferred to a party from another call. Neither call requires a conference to be active. (Explicit invocation only.)

3 Call-to-Conference transfers, where a party from one call is transferred into an active conference call. (Explicit invocation only.)

6.44.4.2 Explicit Transfer allows ISDN users to transfer two calls together without invoking FC

The explicit transfer request can be sent within a message containing a call reference value not associated with an existing conference, the switch places the call (identified within the transfer request) on hold.

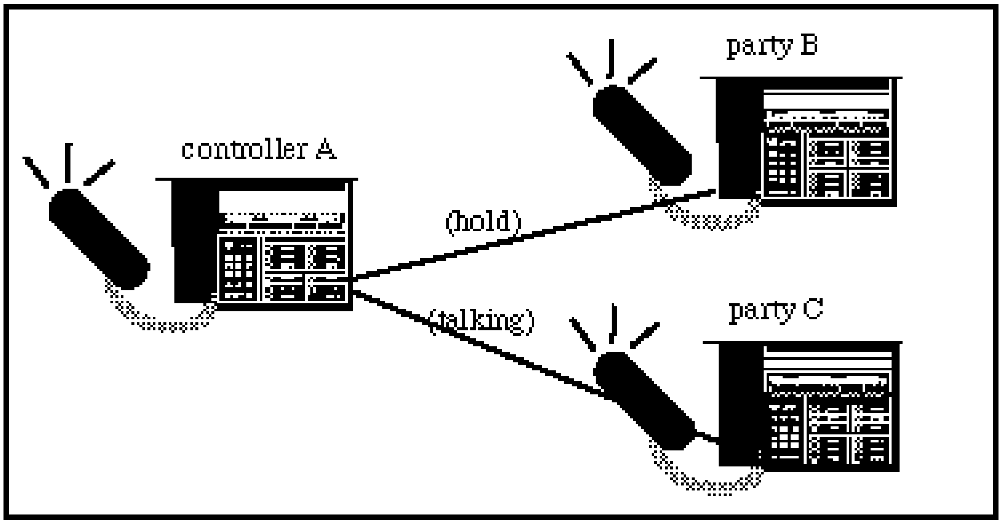
Only FC subscriber with the Explicit Transfer feature may transfer a party from one call to a party on another call with out activating FC. To Explicitly Transfer together two independent calls, the subscriber must identify both calls by activating the transfer feature key twice, once for each call. The DMS supports this Call-to-Call transfer using the following scenario.

1 Controller A has a 2-Party call established with Party B.

2 Controller A hits the TRANSFER feature key while talking to Party B. Party B is tagged for future transfer and is put on hold.

3 Controller A establishes a second call with Party C.

Figure 144 Call-to-Call Transfer after first TRANSfer message

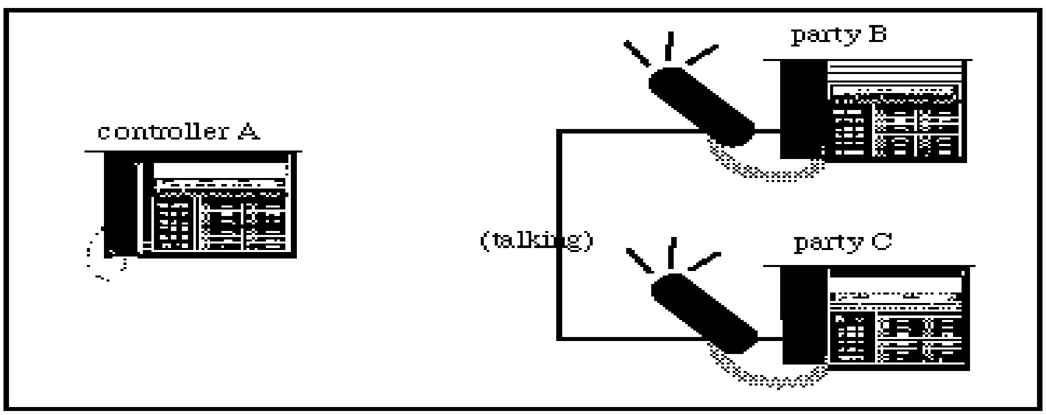


4 Controller A hits the TRANSFER feature key while talking to Party C.

5 Party C is transferred to Party B. Both parties remain connected to each other.

6 Controller A is released from both calls and both call references are cleared from Controller A’s terminal.

Figure 145 After second TRANSfer Message



Explicit Transfer can be done from FC3 or FC6 or greater terminals.

- The second transfer request is received in an INFOrmation containing the call reference value of a speech or 3.1 kHz audio call.
- At least one of the calls has been answered. If the other has not, it is an outgoing call (from the controller), that has at least reached the point where an ALERTing or PROgress was sent to the controller, and neither call is undergoing call clearing, the conference is taken down.
- In addition, at least one of the calls is an end-to-end ISDN call, a non-ISDN line served by the switch providing FC, or on an incoming trunk to the switch.
- Meet all of the DMS transfer restrictions (for example, CTINT, CTOUT, and so forth). If the second transfer request is received in an INFOrmation

containing a conference ID, the switch should determine if the following conditions exist:

- Explicit transfer may be done, regardless of the FC size assigned to the terminal.

6.44.4.3 Explicit Transfer as a controller of a conference

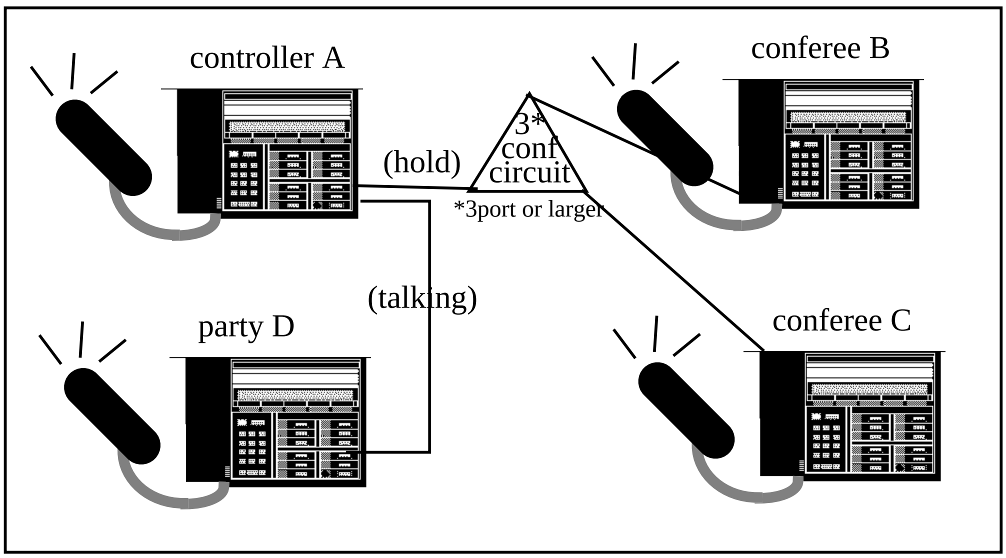
When a FC user is controlling a conference greater than 2 parties, that controller may transfer and leave the parties in the conference talking (that is, floating the conference).A conference that is floating does not have a controller and is taken down when the last party with answer supervision leaves the conference or the conference size becomes smaller than three.

To TRANSFER a two-party call to a conference, the conference can contain up to the maximum number of conferees for the circuit (but at least one conferee and the controller) prior to the transfer request. Also, all Flex Call conference sizes are supported.

1 Controller A has a 3 (or larger) conference established with Conferee B and Conferee C. The conference is on hold.

2 Controller A has a second call established with Party D.

Figure 146 Before Call-to-Conference TRANSFER



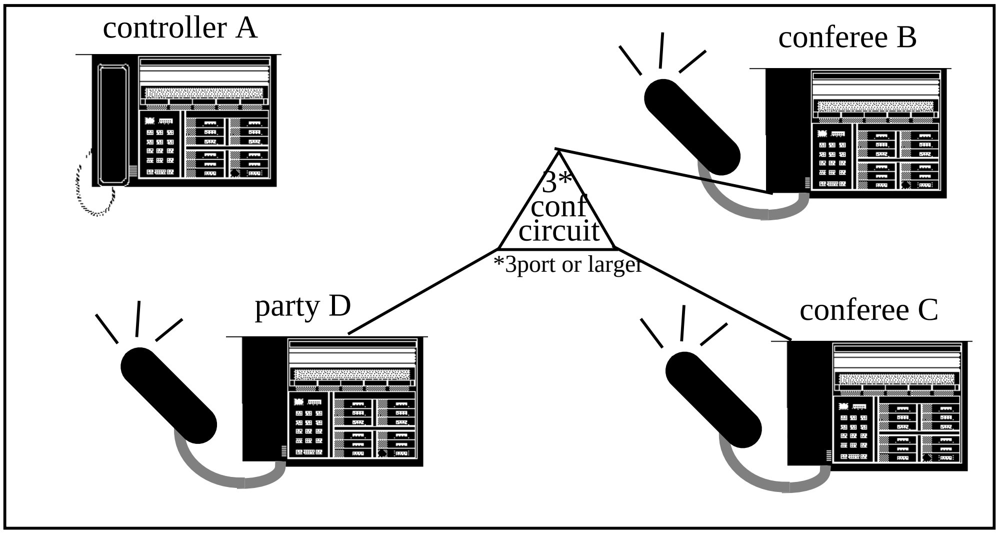
3 Controller A hits the TRANSFER feature key while talking to Party D. Party D is tagged for future transfer and is put on hold.

4 Controller A retrieves the conference and hits the TRANSFER feature key.

5 Party D is bridged into the conference with Conferee B and Conferee C.

6 Controller A is released from the conference. Controller A’s reference to the conference call and the call to Party D are cleared.

Figure 147 After Call-to-Conference TRANSFER



6.44.5 Transfer descriptions

This section illustrates the system view of the new and modified transfer scenarios covered by this activity:

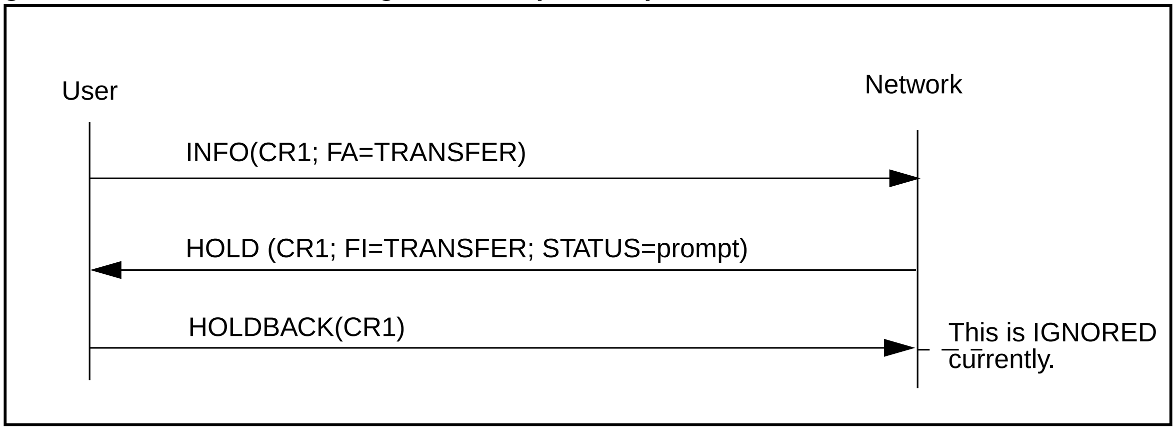
- Call-to-Conference Transfer, where
  - — One conferee and the controller are active on the conference (a.k.a., pre-bridged conference)
  - — More than one conferee and the controller are active on the conference (a.k.a., bridged conference);
- Call-to-Call Transfer
- Transfer attempt to an Invalid Call Reference (i.e., data call)
- First Transfer Message

For both the Call-to-Conference and Call-to-Call scenarios the Message Sequence for the first Transfer message is identical.

If the first transfer message is sent to a call reference that is not on hold, the message is acknowledge with a HOLD message and disconnect the call from the bearer channel[1]. Bellcore requirements state that the terminal should respond to this HOLD message with a HOLD_ACK message within a specified amount of time, but this timer is not supported and consequently the HOLD_ACK is ignored by DMS.

1. The DMS reserves the B-channel for the user who placed the call on hold. It does not however support Bearer Channel Reservation Release.

Figure 148 First Transfer Message to active (not held) call

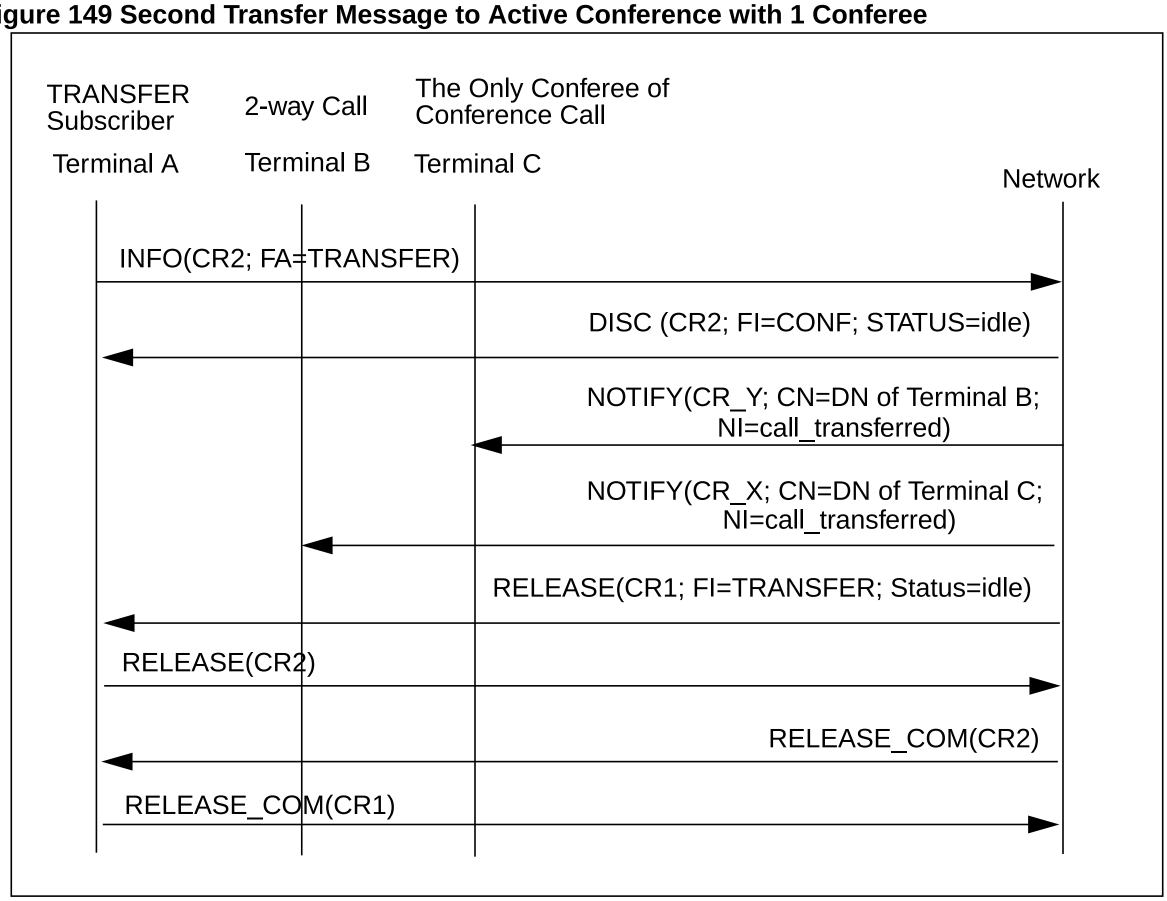


If that call is already on hold, the DMS will acknowledge with an INFO message. In either case, the acknowledgment should contain a Feature Indicator coded to 'TRANSFER' and Status coded to 'prompt'.

6.44.5.1 Call-to-Conference Transfer (pre-bridged)

When the second transfer request is sent to a conference, the controller is cleared from the conference and the remote party on the call associated with the first Transfer message is connected in its place. In this case, the resulting conference contains only two people so the conference bridge is released and the transferred parties remain in a two-way call.

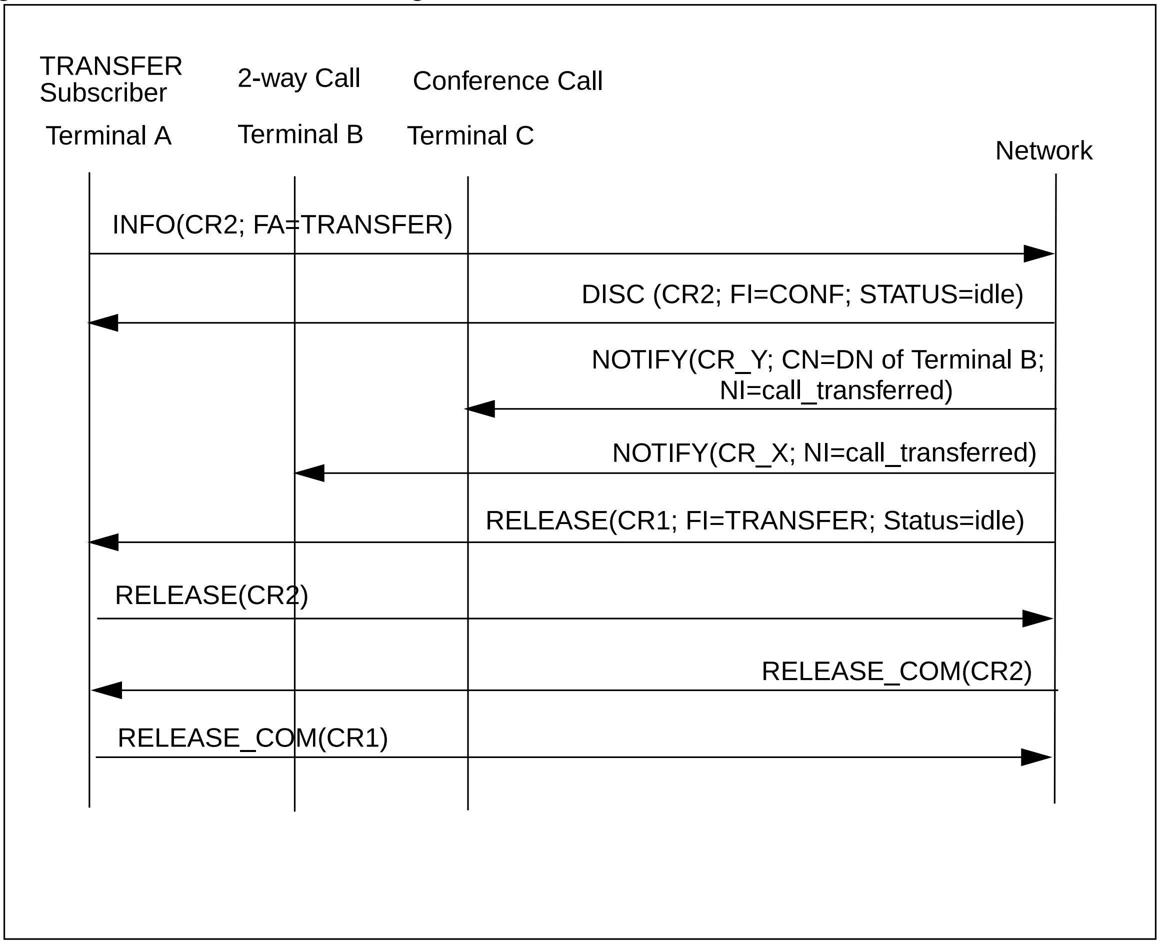
Figure 149 Second Transfer Message to Active Conference with 1 Conferee



6.44.5.2 Call-to-Conference Transfer (bridged)

If the second Transfer message is sent to a conference with more than one conferee the message sequence chart changes slightly. The conference bridge is not cleared, since the transferred parties will remain connected in a conference call.

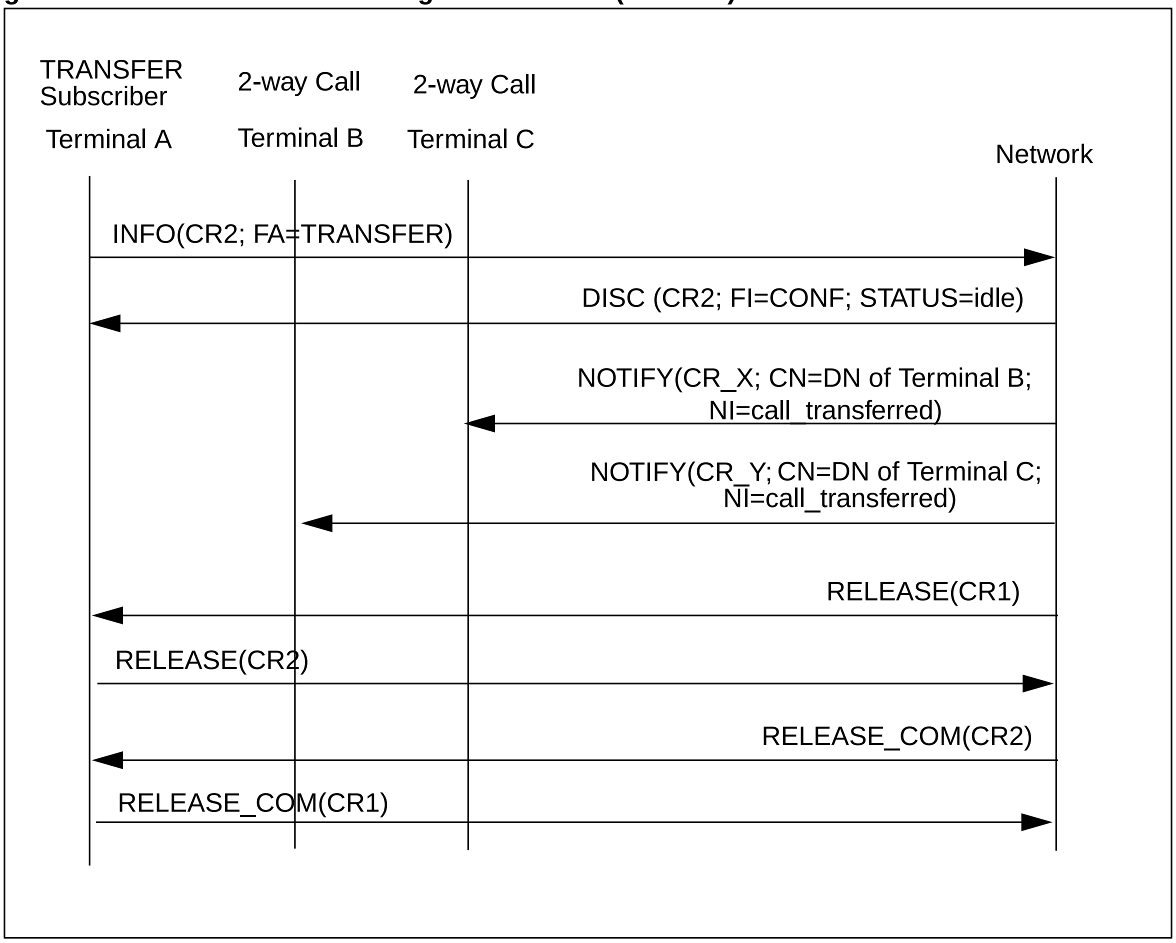
Figure 150 Second Transfer Message to Active Conference with More than 1 Conferee



6.44.5.3 Call-to-Call Transfer

If the second Transfer message is sent to a non-conference call, both calls are connected together and released from the controller. The release sequences for this are based on whether the call being cleared was connected to a bearer channel or on hold. The figure below shows the sequence when the second transfer is sent to an active call.

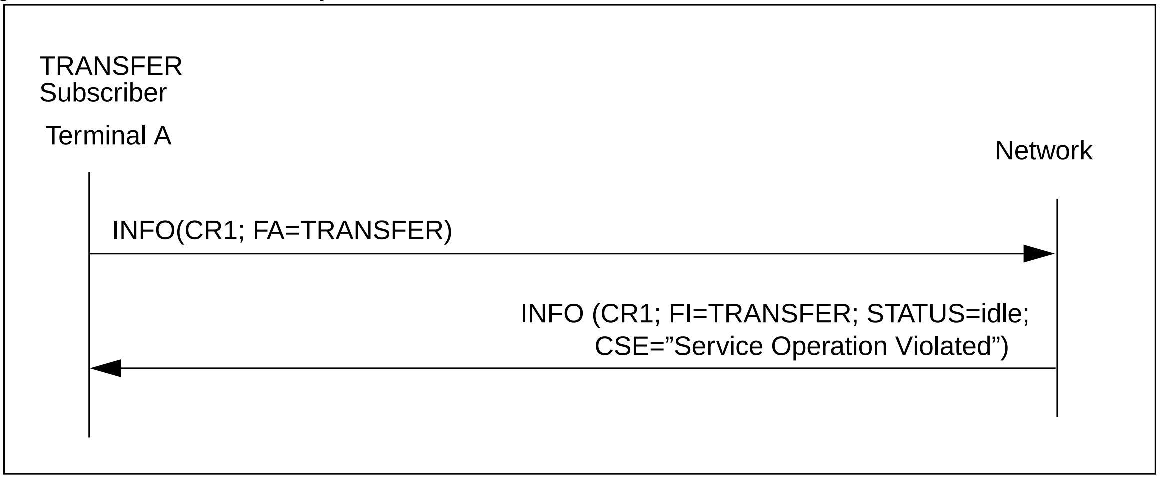
Figure 151 Second Transfer Message to an Active (not held) Call



6.44.5.4 Transfer of an Invalid Call Reference

When a transfer attempt fails because of something detected by the XPM[1], the notification of this failure is sent to the CM with an error event. This allows the CM to update the OMs relating to transfer attempts and transfer failures.

Figure 152 First transfer request failure



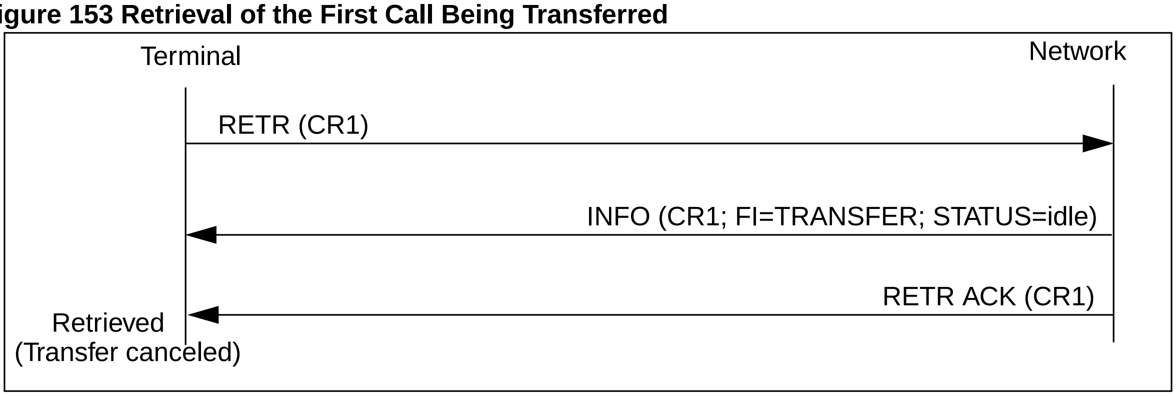
6.44.5.5 Retrieval of the First Call Being Transferred

After the first transfer message was sent to the first 2-way call, the user might later want to retrieve it from on-hold instead of transferring it. The reasons for doing so could be:

- The user changed his/her mind.
- The previously active conference or 2-way call, to which the user intended to transfer the first 2-way call, has been disconnected.
- The user tried to make another 2-way call, but failed.

In this situation, the Retrieve request is acknowledged and the original Transfer is canceled.

Figure 153 Retrieval of the First Call Being Transferred



1. i.e. the bearer capability is not Speech or 3.1KHz Audio.

6.44.5.6 Interactions

1 Explicit Transfer can transfer a non-conference call to the Attendant or into an Attendant Queue. (Refer to Feature AF6592 “FlexCall Interaction with Attendant Console”)

2 If an business subscriber party wants an attendant they can dial code (0 or *0) to get an attendant and then transfer that party to the attendant.

3 When FC is assigned with ACO, the switch should allow the ISDN user (or controller) to hold an existing call to connect to a waiting call, that is, a call offered as an ACO call. Once the call is answered, Transfer should be allowed as though the call had been offered using normal call treatment.

4 The switch should not allow a user to hold the connection to the packet-handler function of the switch.

5 The switch should allow a call established through one of the Call Pickup features to be eligible for transfer.

6 An IBN line or ISDN functional terminal will be prevented from picking up any unanswered call involved in the FC conference. However, it is permitted to pick up any additional call on the BRI interface before it answers and is transferred. The controller may invoke call pickup to establish the conference call or an additional call from another DN/BC pair.

7 CACH service uses call appearances and is based on the key set service. If a party is found through this method, that party can be added to a conference. This party may be transferred to another party through FC or explicit transfer.

8 When a party is found by via Hunt (either Analog Hunt or Key Set Short Hunt), that party can be transferred to another party.

9 ISDN calls will allow a subscriber to transfer a party to a 911 operator if the Office Parameter allowing it (see FSD for name of this parm) is set to yes. Existing FC/ 911 interactions will continue to be met.

10 EBO is a feature which allows the calling station to barge in on a call. Conferences and calls marked as Transfer-pending cannot be barged in on.

11 A call where either party has the NDC [No Double Connect] option is categorized as an FC blocked call. Since FC is a set option and NDC is a DN option, these should not be blocked in service order. Instead, it will be blocked on the invocation of the FC service.

12 MCH [Malicious Call Hold] can be invoked either by key or code access. For code access, the business set must have the 3WC or call transfer feature assigned. FC presently can not be assigned the MCH feature.

6.45 Hunting

6.45.1 Definition

Hunting enables a call to be routed to another station if a busy condition is encountered. Hunting is based on “call reference busy” only. A definition of “call reference busy” is provided in Section 6.6.1, “Busy conditions,” on page 364. Hunting increases the likelihood of a call being completed.

- Directory Number Hunting (DNH) - Each line in this hunt group has its own unique DN. Access the hunt group by dialing any number in the group, however the number of lines hunted depends on the hunting option (Circular or Sequential).
  - Circular Hunting - hunts all lines in the hunting group regardless of the starting point.
  - Sequential Hunting - starts at the number dialed and ends at the last number in the group.
- Distributed Line Hunting (DLH) - supported on functional sets. The hunting capability requires delivery of an EID for correct functionality. EKTS is required for DLH. EKTS facilitates the delivery of the EID, making it possible for terminals on the interface to respond correctly to the hunt termination. Only a pilot DN is associated with this hunt group. Hunting starts after the first idle line found by the previous hunt and continues until the starting point is reached. DLH is assigned to large hunt groups requiring an equal distribution of calls.
- Multi-Line Hunting (MLH) - only a pilot DN is associated with this hunt group. Hunting is sequential.
- Multi Line Hunting for 2 B-channels Terminals - on an 2 B-channel terminal, a single DN may not be a member of any hunt group. Single DN and Hunt are incompatible. Other DNs on the terminal that are not shared and have a CRBL of 1, can be members of a Hunt group.
  - NITs are incompatible with MLH and DLH. This applies to all DNs on the set.
  - Non-Shared DNs may subscribe to DN Hunt.
  - MLH is supported on functional sets. Hunting requires delivery of an EID. Due to current limitations, EKTS is required for MLH. EKTS facilitates the delivery of the EID, making it possible for the terminals on the interface to respond correctly to the hunt termination. The channel ID provided in the SETUP on call termination is coded as “no channel indicated”.

The following options are available to hunt groups:

- Line overflow to a route - when all lines in a hunt group are busy, it enables hunting to continue to a specified route.
- Line overflow to a DN - when all lines in a hunt group are busy, it enables hunting to continue to a specified DN, which can also be part of another hunt group.

6.45.2 Feature activation

Hunting is subscribed to by the end user on a TSP basis. Incoming calls to a hunt group follow normal call termination procedures.

6.45.3 Feature interactions and limitations

The ACO feature is not compatible with Hunting.

DLH and MLH are supported on functional sets. Hunting requires delivery of an EID for correct functionality.

EKTS is a requirement for DLH/MLH

It is not possible to split the Voiceband Information (VI) and Circuit-Mode Data (CMD) appearances of a shared DN across different hunt groups. The circuit-mode call type appearances must belong to the same hunt group.

FC Transfer is not allowed if interacting with EKTS DN Bridging.

The FC controller is not allowed to clear the FC conference if interacting with EKTS DN Bridging. If no other EKTS members are EKTS DN Bridged, then the FC controller is allowed to either transfer or clear the FC conference.

The role of the FC controller is not allowed to be assumed (or transferred) to other EKTS members within the EKTS DN Bridge.

6.46 Last Number Redial (LNR, LNRA)

6.46.1 Definition

The Last Number Redial (LNR) feature enables a subscriber to re-dial the last called number by selecting a single key rather than dialing the entire number.

There are two variations of the last number redial feature.

1 Last Number Redial (LNR) - permits the last number dialed to be re-dialed using a single key instead of the whole number. Every time a number is dialed, it is stored as the LNR for that DN.

2 Last Number Associated with Set (LNRA) - permits the user to re-dial the last number dialed from the set using one key. It is associated with the entire set, rather than a specific DN.

6.46.2 Programming and feature activation

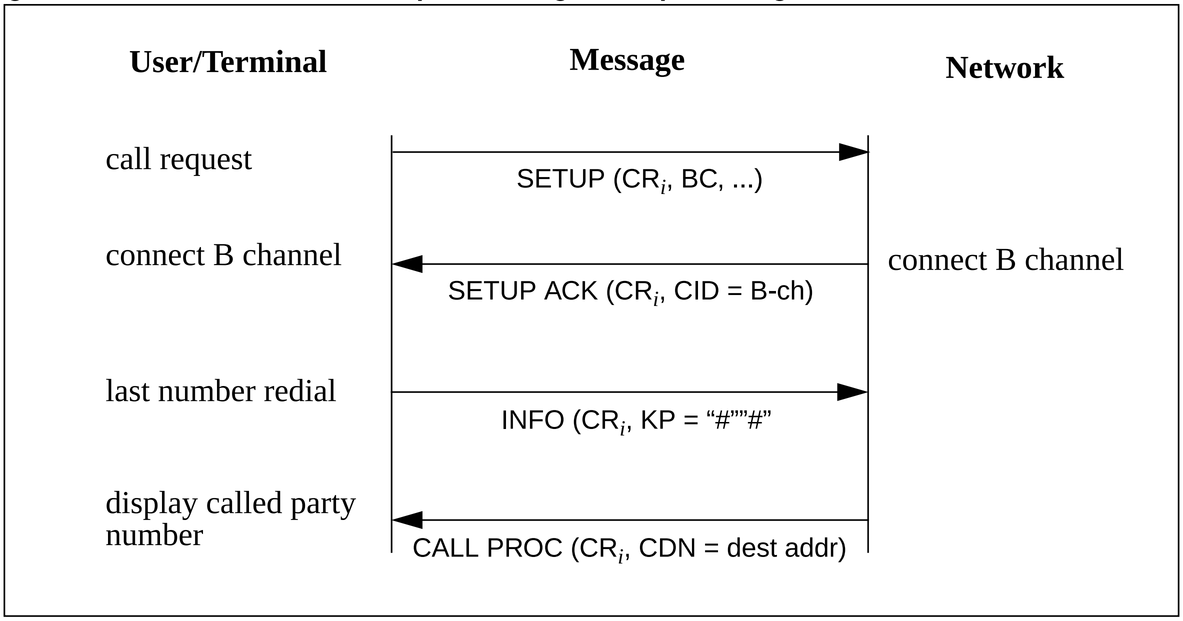
- No programming is associated with either LNR or LNRA.
- The feature may be requested using either En bloc or Overlap sending.
  - For En bloc sending, the second # is not required to complete the LNR request
  - For Overlap sending, after issuing a call request, activate the feature by selecting the octothorpe key (#) twice, or the octothorpe key once, and waiting for the interdigit timer to expire.

6.46.3 Procedures

- When activating this feature, the user may, in the SETUP, include a KP IE containing a “#”. The network interprets this as a LNR request, and routes the call to the last destination dialed.
- If the last dialed number is valid, the network sends a CALL PROCeeding to the user. It contains a Channel Identification IE and a CDN IE identifying the destination address.
- If a valid LNR request is received during Overlap sending, the network sends a CALL PROCeeding containing a CDN IE identifying the destination address.

Figure 154, “Last Number Redial request during Overlap Sending” illustrates LNR activation user Overlap sending.

Figure 154 Last Number Redial request during Overlap Sending



6.47 Loudspeaker Paging and Line Termination

6.47.1 Definition

Loudspeaker Paging and Line Termination is equivalent to Loudspeaker and Radio Paging Access except that it terminates on a line rather than a trunk. Some paging equipment requires Dual Tone Multi-Frequency digits to be outpulsed. If required, DTMF is provided by the terminal and not by the network.

6.48 Loudspeaker and Radio Paging Access

6.48.1 Definition

Loudspeaker and Radio Paging Access allows stations and attendants to access customer provided loudspeaker paging equipment to summon a particular party by using loudspeakers located throughout the customer's premises.

Access is provided for the following paging system configurations:

- Single zone per paging system. Single paging system.
- Multiple zone per paging system. Single paging system.
- Single zone per paging system. Multiple paging systems.
- Multiple zone per paging system. Multiple paging systems.

6.48.2 Feature activation

The above configurations are accessed by issuing a CAR, and dialing an appropriate access code, one for each paging system followed by a zone code, which corresponds to a particular paging zone within that paging system. The network analyses the access code but not the zone code, since the latter is entirely dependent on how the customer's paging equipment is set up.

The access code and the zone code can be sent En bloc in the SETUP or can be sent in the Overlap sending state by sending one or more INFOrmation(s) with a KP IE to the network.

6.48.3 Feature Interactions and Limitations

- The access to paging facility is controlled by Network Class of Service (NCOS), the Terminating Restriction Code (TRC), and the Denied Incoming (DIN) line option.
- An attendant can force release a calling party from a loudspeaker.
- It is the customer's responsibility to ensure that the electrical and procedural interfaces between the network and the paging equipment is correct.
- No hunting is allowed for a loudspeaker paging line.
- A call terminating on a loudspeaker paging line can not be call forwarded.
- Queuing is not allowed on a loudspeaker paging line. If a user dials a paging access code and the equipment is already in use, busy treatment is received and the user must re-try the call.

6.49 Meet-Me Conference

Meet-Me Conference provides a six-party conference bridge and DN for conferees to dial at a specified time to hold a conference.

6.49.1 Feature activation

The conference originator calls the attendant to arrange for a DN for a conference bridge. At the specified time all the conferees dial the conference bridge DN and are connected on the bridge. The ISDN functional terminal is unaware that the call is a conference call, only that it is a call to a specific number (the conference bridge).

6.49.2 Feature limitations

Since DCA is not supported, while the call is progressing or active, the ISDN terminal cannot either lock or unlock a Meet-Me conference or redial the attendant.

6.50 Meet-Me Conference (large)

6.50.1 Definition

Meet-Me Conference (large) extends the maximum number of conferees from six to thirty. This is done by adding conference bridges. The feature is activated in the same way as with the Meet-Me Conference.

6.51 Night Service -Trunk Answer From Any Station (TAFAS)

6.51.1 Definition

Night Service - Trunk Answer From Any Station (TAFAS) provides handling of calls when the attendant is absent. TAFAS allows any station to pick up the call when TAFAS alerting device sounds.

6.51.2 Feature activation and limitations

This feature is subscribed to on a customer group basis. To answer a call, use procedure G8 (see, Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)”, initiate a call, receive dial tone, and dial an access code. The audible signals are silenced and the answering station is connected to the calling party. The answering station may complete the call by transferring it.

Figure 155 Trunk Answer From Any Station (TAFAS)

Scenario: A user attempts to pick up an incoming call by initiating a call and dialing an access code, while in the Overlap Sending state.

USER/TERMINAL	MESSAGE	NETWORK
call request	SETUP (CRn, BC...) ⟶	
connect B–ch	SETUP ACK (CRn, CID=B–ch) ⟵	connect B–ch
enter access code	INFO (CRn, KP=access code) ⟶	
	CALL PROC (CRn) ⟵	
	:	
connected to incoming call, display connected address	CONNect (CRn, CN= conn number) ⟵	
call established		

6.52 Preset Conference

- Preset Conference allows a Meridian services station, a trunk, or an attendant console to establish a preset conference of up to 25 people.
- Dialing a DN invokes establishing conference to all parties.
- Preset Conference invokes a simultaneous ringing of the pre-selected conferees, who were selected in advance and are called through the use of a data table.

6.52.1 Feature activation and limitations

The ISDN implementation and limitations are described in Section 6.43, “Flexible Calling (FC)”.

6.53 Release (RLS)

6.53.1 Definition

Release (RLS) allows a user to abandon a feature programming sequence. They can then originate or receive other calls.

6.53.2 Feature activation

Activate this feature by sending the network an INFOrmation with a FA IE corresponding to the Release FA. The network abandons any active programming sequence. There is no FI associated with this feature.

6.53.3 Feature interactions and limitations

A terminal invoking this feature must be equipped with a FA assigned as a Release activator.

The interactions with 3WC, n-Way Conference and Programming are described in the same sections as quoted above under ‘Usage’.

Note: When a 3WC originator selects the Release FA to attempt Call Transfer, the other parties are disconnected if neither of them are within the ISDN.

6.54 Subscriber Line Usage (SLU)

6.54.1 Definition

Subscriber Line Usage (SLU) is an Operational Measurement (OM) report used to measure usage of individual lines. The statistics provided are: Originating peg counts, Terminating peg counts, and Usage.

- The peg counts are incremented on each origination or termination attempt respectively.
- The usage is calculated from a periodic scan of the state of the line.
- The usage counter is incremented on each scan during which the line is CP busy.
- This scan period defaults to 100 s., but can be set to any multiple of 10 s.
- For ISDN, the lines must be assigned for measurement by DN, not line equipment number.

6.55 Attendant Console (AC) Interworking

6.55.1 Definition

Attendant Console (AC) Interworking enhances AC interworking with ISDN users in several new ways. Users receive explicit notification when an attendant enters or leaves a call. The network attempts to re-connect a user to the attendant if the user releases while connected to an attendant, and new feature interactions are introduced.

Additional notifications and network procedures for ISDN users when an AC enters or leaves a call with that user are summarized below:

- when a user originates a call to an AC
- when a user terminates (receives) a call from an AC
- when a user attempts to hold or prematurely clear an AC controlled call
- when an AC signals or clears a user in an AC controlled call
- when an AC extends and then releases (for example, transfers) or holds an AC extended call
- when an AC is brought into an existing basic call.

AC Interworking supports the following feature interactions between an AC and an ISDN user:

- an AC to camp a non-intra-group user onto a busy intra-group DN
- an AC to activate and deactivate DND on a user's DN
- an AC to activate Busy Verify Line and Busy Verify Trunk.

In addition, this feature allows the following interactions between an AC and an ISDN user for the listed, existing supplementary services:

- parking a call by the AC against a user's DN (see Section 6.36, “Call Park”)
- controlling a user's MWT indication from the AC (see Section 6.58, “Message Waiting and Call Request”, and
- delivering the Name and Reason for AC calls (see Section 6.56.2, “Name and Reason Display”).

6.55.2 Procedures

In the following procedures, a set of “AC controlled” states are used to assist in the description of the interactions between a user and an AC. With the exception of entering and leaving an AC controlled condition, there is no requirement for a terminal to track these states. The terminal should be aware of entering and leaving the AC controlled condition so that it prevents a user from clearing while the call is AC controlled. This feature makes use of the procedure G10, see Section 6.21, “G10 - Network Notification of Events”.

6.55.2.1 Call origination to an AC

- In the same manner that a user establishes a call to an ESB (see Section 6.39, “Emergency Service Bureau (ESB)”), a user establishes an intragroup call to an AC using the normal call establishment procedures as defined in Chapter 5.

- In addition, the network includes in the CONNect, a NI IE specifying that the call is “connected to Attendant Console”.
- The call is now in an “AC controlled - active” state. The terminal should prevent the user from clearing while the call is AC controlled. An example series of interactions between an originating user and an AC is shown in Figure 156, “Attendant Origination with a user”.

Figure 156 Attendant Origination with a user

USER/TERMINAL	MESSAGE	NETWORK
User requests a call to AC	SETUP (CRn, ...) →	
	← CALL PROC (CRn, ...)	
	← ALERTING (CRn, ...)	
	← CONNECT (CRn, NI=conn to AC, DT, ...)	AC answers call
User active with AC	CONN ACK (CRn, ...) →	
		AC extends call
		Destination answers
User held by AC	← NOTIFY (CRn, NI=call info/event, CN, ...)	AC holds call
User active with AC	← NOTIFY (CRn, NI=call info/event, DT, ...)	AC retrieves call
User active with Destination	← NOTIFY (CRn,NI=no longer conn to AC, CN, ...)	AC releases call (transfer, for example)

Example Interactions of an Originating ISDN User With an AC: The Display Text (DT) IE carries the CLLI of the AC as a name. The Connected number (CN) IE holds the DN of the destination party.

6.55.2.1.1 AC controlled calls - user initiated actions

- While in the “AC controlled - active or extended” state, the user can hold the call to the AC using the procedures identified in Section 6.44.2, “Procedures for Hold”. The call is now in the “AC controlled - user held” state.
- If a user does send a clearing message to the network while in the “AC controlled - active” state, the network interprets this as an error condition and returns a RELease COMplete with cause value 95, “invalid message, unspecified”, and places the call into an “AC controlled - user cleared” state.
- Attempts to establish a call, while in the “AC controlled - user cleared” state from the same DN/BC pair, result in an automatic connection to the AC, that is, the network responds to a SETUP with a CALL PROCeeding and a CONNect containing a NI IE specifying “connected to Attendant Console”, regardless of any feature invocations.
- Attempts to establish a call on the same DN but on a different BC in this state are rejected by the network with a RELease COMplete having cause value #29, “facility rejected”.
- If however, a user establishes a call on a different DN while in this state, it is allowed to proceed using the normal call establishment procedures as defined in Chapter 5.

6.55.2.2 Call termination from an AC

- An AC requests or extends a call to an intra-group user using the normal call establishment procedures as defined in Chapter 5.
- In addition, the network includes in the CONNect ACKnowledge sent to the user, a NI IE specifying “connected to an Attendant Console”.The call is now in an “AC controlled - active or extended” state.
- Independently of how the user becomes AC controlled, the terminal should prevent the user from clearing while the call is AC controlled.
- An example series of interactions between a destination user and an AC is shown in Figure 157, "Origination with AC," on page 542. The Display Text (DT) IE carries the Common Language Logical Identifier (CLLI) of the AC as a name, with no reason. The Call party number IE (CGN) carries the DN of the source user. The Connected number IE (CN) holds the DN of the source user.

Figure 157 Origination with AC

USER/TERMINAL	MESSAGE	NETWORK
	SETUP (CRn, FIE, ...) ←	AC extends call
	ALERTING (CRn, ...) →	
	NOTIFY (CRn, NI=call ← diverted, CGN, ...)	AC releases call
	NOTIFY (CRn, NI=call ← info/event, DT, ...)	AC is recalled
User answers call	CONNECT (CRn, ...) →	
User active with AC	CONN ACK (CRn, NI=conn ← to AC, DT, ...)	
User active with Source	NOTIFY (CRn,NI=no longer ← conn to AC, CN, ...)	AC releases call (for example, transfer)

Example Interactions With a Destination ISDN User: The Display Text (DT) IE carries the CLLI of the AC as a name, with no reason. The CGN IE carries the DN of the source user. The CN IE holds the DN of the source user.

6.55.2.2.1 AC controlled calls - AC initiated actions

- If an AC signals the user, while the call is in the “AC controlled - active or extended” state, the network sends the user an in-band “Ringing Off-Hook” tone.
- If the call is in the “AC controlled - user held” state, the network sends a NOTIFY with a NI IE specifying “retrieve held call”. If the call is in the “AC con trolled - user cleared” state, the network broadcasts a SETUP to the user.
- If the user accepts the call, normal call establishment procedures are followed, as defined in Chapter 5, except that the CONNect ACKnowledge sent to the user contains a NI IE specifying “connected to Attendant Console”.
- The call is then returned to the “AC controlled - active or extended” state

- If the user rejects this call establishment attempt, the network repeats it every two seconds until, either the user accepts the call, or the AC releases the user.
- When AC initiated action causes the call to be cleared, the network follows the normal call clearing procedures as defined in Chapter 5.
- While in the “AC controlled - active state” the AC can extend the call of the “source” user to a “destination” user. If the AC releases (for example, transfers) the extended call before the destination user answers, the network sends a notification to both the source and destination users.
- The source user receives a NOTIFY with a NI IE specifying that the call is “no longer connected to Attendant Console”, and a Redirection number IE containing the address of the destination user.
- The source is now no longer AC controlled, and is free to clear the call.
- A destination user receives a NOTIFY with a NI IE specifying “call diverted”, and the CGN IE containing the address of the source user.
- If the AC is extending a call for a non intra-group user and encounters a busy destination, the AC can activate camp on.
- The source user receives a NOTIFY with a NI IE specifying “call information/event”, and a RNN IE with the number of the camped-on party.
- When a destination user answers an extended call, the call enters the “AC controlled - active or extended” state.
- If the AC releases (for example, transfers) the call in this state, the source and destination user both receive a NOTIFY with a NI IE specifying that the call is “no longer connected to Attendant Console”, and the Connected number IE containing the other user's address.
- Both the source and the destination user are now no longer AC controlled and are free to clear the call.

While in the “AC controlled - active or extended” state, the AC can hold the extended call.

- In this situation the network sends a NOTIFY to source and destination users with a NI IE specifying that a “call information/event” occurred, and the Connected number IE contains the address of the other user.
- The call remains AC controlled. When the AC retrieves the extended call, the network sends a NOTIFY to source and destination users with a N IE specifying “call information/event”, and the CLLI of the AC using the feature Name and Reason Display.

An AC can be brought into an existing basic call in a number of different ways, for example:

- the AC answers an AC recall for an extended or camped on call

- the AC barges into a call as a result of verifying a busy line or trunk
- the AC is connected to a conference bridge as a conferee and then transferred, by the controller, to the other conferee.

When an AC is brought into an existing basic call the following notifications are sent, using procedure G10, see Section 6.21, “G10 - Network Notification of Events”.

- Source and destination intra-group users active on an existing basic call receive a NOTIFY with a NI IE specifying “call connected to Attendant Console”. The call is now in an “AC controlled - active or extended state” and is under AC control.
- Destination intra-group users being alerted receive a NOTIFY with a NI IE specifying “call information event” and the CLLI of the AC using the feature Name and Reason Display.
- Source non intra-group users camped on to a DN receive a NOTIFY with a NI IE specifying “call information/event”, and the CLLI of the AC using the feature Name and Reason Display.

6.55.3 Feature interactions and limitations

6.55.3.1 Name and Reason Display

Name and Reason Display delivers the CLLI of the AC to both source and destination ISDN users. Use procedure G10, refer to Section 6.21, “G10 - Network Notification of Events”, for Name and Reason Display when the NI IE specifies “connected to Attendant Console”, and as indicated in the procedures when it specifies “call information/event”.

- Camp On - The AC can only camp on to a DN that is CRB.
- Busy Verify Line - The AC only sees busy on a DN that is CRB. The AC is only allowed to barge in to an active speech or 3.1 kHz audio call.
- Busy Verify Trunk - The AC is only allowed to barge in to an active speech or 3.1 kHz audio call.
- Circuit Data Mode Calls - CMD Calls to an AC are blocked.

6.56 Display procedures

6.56.1 ISDN Display Service

No difference in service offering is made based on CT or because of 2 B-channel access. CPE is expected to manage the sharing of display area for calls on different B-channels.

6.56.2 Name and Reason Display

6.56.2.1 Definition

- Name and Reason Display service provides supplementary information to a subscribing user. Name text, associated with each type of party involved in a call, supplements the party's number.
- Similarly, Reason text supplements IEs that describe the progress or status of a call or supplementary service. In addition to Name text, address information corresponding to the name party may also be provided.
- Name text, if subscribed to by an ISDN user, is delivered to the called party for call originations, and the calling party's name is delivered to the user for call terminations.
- Name text for all types of parties (calling party, called party, redirecting party, redirection party, and connected party) is delivered when it is available. If Name text for a party is not available, default text is substituted (for example, “OUTSIDE CALL”).
- If a user has not subscribed to Name and Reason Display, then, provided the user subscribed to the particular number delivery, the address of the parties (calling party, redirecting party, redirection party, and connected party) involved in the call are delivered in the DTIE when the address information is available.
- Reason text supplements information, such as NI and Progress indicator IEs, which may already be present in other IEs. Use of the network-provided Reason text frees the terminal from having to translate indicators relating to supplementary services operations (for example, CPU) into appropriate text for display.

6.56.3 Procedures

If available, Name and Reason text is delivered to the user, for all originating and terminating calls, using procedure G11, see Section 6.22, “G11 - Call-Related notification of feature information”. If the text is available when the network offers a terminating call to the user, the information is included in the SETUP. In all other cases, for both originating and terminating calls, the text follows in a subsequent INFOrmation or other message. The Name and Reason text is sent in the DT IE as specified Section 5.5.6.2, “Display Text information element”.

The following subset of optional tags are used by this feature:

- Reason
- Called Address (CDA)

- Called Party Name (CDNM)
- Calling Address (CGA)
- Calling Party Name (CGNM)
- Connected Party Name (CONM)
- Redirecting Name (RGNM)
- Redirection Name (RNNM)
- Redirecting Number (RGN)
- Redirection Number (RNN)
- Connected Number (CON).

6.56.3.1 Reason Text

Reason text can be programmed on a customer group basis, or can be allowed to default. Table 175, “Default reasons” lists the reasons which are supported and the default text with which they are associated.

Table 175 Default reasons

Default text	Reason
CONFERENCE	Conferences: multi-party call, such as FC
FORWARD	Call Forward, all types: display for the calling party
CALL FWD	CFAC: display for the called party
BUSY FWD	CFB: display for the called party
NO ANS FWD	CFD: display for the called party

Of the mandatory tags, Skip and Blank, only Blank is currently used with this service.

- The DT IE is formatted in groups of 20 “character spaces”, with the first 40 characters containing as much Address, Name and Reason information as possible.
- Any remaining information is contained in the next 40 characters of the DT IE.
- The information is formatted such that terminals with a minimum display size of 2X20 characters can post meaningful information without necessarily comprehending the optional display tags.
- All information is tagged, thus allowing terminals which comprehend the optional display tags to manage the presentation of display information.

6.56.3.2 Name/Address

- If the information is available and Name and Reason Display is subscribed to, name text is delivered to the user for all calls.
- Name text and/or address information for each party involved in the call may be delivered.
- Identification of the party name/address is by use of the DT IE display tags.

- Refer to Section 5.5.6.2, “Display Text information element” for description of the DT IE.
- If a party is outside the customer group or customer group family, the name text delivered is “OUTSIDE CALL”, or substitute text can be programmed on a customer group basis.

6.56.4 Feature interactions and limitations

Name and Reason Display is currently provided for the following supplementary services, in addition to basic call, for users in the same customer group or customer group family.

- Attendant Console (AC) Interworking
- Automatic Dial (AUD)
- Automatic Line (AUL)
- Call Forward All Calls (CFAC)
- Call Forward Busy (CFB)
- Call Forward Don't Answer (CFD)
- Directory Number Hunt (DNH)
- Electronic Key Telephone Service - Group Intercom (GIC)
- Electronic Key Telephone Service Shared DN
- Flexible Calling (FC)
- Last Number Redial (LNR)
- Make Set Busy (MSB)
- Message Waiting (MWT) and Call Request (CAR)
- Ring Again (RAG)
- Speed Calling: Short (SCS), Long (SCL).

While there is no restriction on the contents or language for name and reason text, only ASCII characters may be used. Thus, accented characters are not available.

Name and Reason is only sent to the user if it is available.

6.57 Make Set Busy (MSB)

6.57.1 Definition

Make Set Busy (MSB) allows a terminal to be made busy to incoming calls. While this feature is active on a set:

- All incoming calls to DN appearances affected by the feature receive either busy tone or some other treatment (tone or announcement).
- For intragroup calls blocked by MSB, the calling party always receives busy tone.
- The made busy set receives no indications, either audible or visible, that calls are attempting to terminate on it.
- It is still free to originate calls from any of its DN appearances.
- Feature programming is also possible.

When the feature is supported, two variations of MSB are available on the ISDN set. One, MSB All Calls, enables the user to make the set appear busy to all types of incoming calls, both internal and external to the customer group. The other, MSB intragroup, only affects intragroup calls.

6.57.2 Procedures

This feature is activated/deactivated using either FKM or DCA procedures.

- Feature activation - Using the generic non-call-related FKM procedures for FA (G1) (see Section 6.12, “G1 - Feature Key Management (Non-call related)”, invoke MSB by sending an INFOrmation with the FA IE specifying the MSB FA, as shown in Figure 159, “MSB Dial Code Activation”. The network responds with an INFOrmation with the FI IE specifying that MSB FI has the status “active”.
- Feature deactivation - To deactivate the feature, the user again sends an INFOrmation with the FA IE specifying the MSB FA. The network responds with an INFOrmation with the FI IE specifying the MSB FI having the status “idle”.

Using FKM procedures, MSB may be activated or deactivated during or outside a call at any time. However, invocation of MSB in the middle of a feature programming sequence (that is, CF or SC) is ignored by the network.

Figure 158 MSB FKM Activation/Deactivation

Scenario: The terminal is idle. The MSB activator #x is used to make all call appearances on the terminal appear busy to all incoming calls. Subsequently, the user deactivates this feature.

USER A/TERMINAL A	MESSAGE	NETWORK
MSB request	INFO (CRd, FA=x) →	
MSB activated	← INFO (CRd, FI=x,active)	accept MSB request
MSB in effect (user may still originate calls)		
MSB cancel request	INFO (CRd, FA=x) →	
MSB deactivated	← INFO (CRd, FI=x,idle)	cancel MSB

Using any one of the generic dial access procedures for FA/deactivation during call initiation (G7, Section 6.18, “G7 - Dial Management (Call Initiation Phase)”), the user activates/deactivates MSB by sending:

- the entire MSB access code in a SETUP, or
- a partial MSB access code in a SETUP, followed by INFOrmation(s) to complete the code, or
- in response to a SETUP ACKnowledge, the MSB Access code in a single or series of INFOrmation(s)

When the network determines it has received the entire MSB activation/deactivation dial access code, it returns in-band confirmation tone to the user and clears the call. As an example of MSB activation using dial access code, see Figure 159, “MSB Dial Code Activation”

Figure 159 MSB Dial Code Activation

Scenario: The terminal is idle. The user includes a partial access code in the SETUP when activating MSB.

USER A/TERMINAL A	MESSAGE	NETWORK
Call request w/ partial MSB code in KP	SETUP (CRn, BC, KP) →	
	SETUP ACK (CRn,CID=B-ch) ←	Connect B–ch
User completes access code digit(s)	INFO (CRn, KP=digit) → " "	Interdigital timing Accept feature request
MSB activated	INFO (CRn, FI) ←	
	PROG (CRn, PI=#8, SIG=confrm. tone) ←	Confirmation tone
	PROG (CRn, PI) ←	
	DISC (CSE=normal, SIG=tones off) ←	Initiate call clearing. Remove Confirm tone.
	RELease →	
	RELease COMplete ←	

6.57.3 Feature interactions and limitations

MSB works on a service profile as long as the DNs on that service profile are not shared with other functional service profiles on the same interface.

6.57.3.1 EKTS group intercom and intercom

MSB does not affect Intercom calls. They are still allowed to terminate on terminals even after MSB is activated.

6.57.3.2 EKTS shared DN

For basic EKTS group members, activation of MSB only causes audible alerting to be suppressed. EKTS calls may still be answered while MSB is active on the set.

6.57.3.3 Executive Busy Override

Attempts by incoming calls to activate EBO receive re-order tone and are not completed.

6.57.3.4 Call Forward

CF interacts with MSB in the following manner:

- Calls to CAs on which the CFU and/or Intragroup variations are activated are forwarded regardless of whether or not the terminal has been made busy.
- Calls to CAs assigned the CFB and/or CFD variations are forwarded.

6.57.3.5 Attendant originated or extended calls

Attempts by the attendant to originate or extend a call to a CA on a terminal in the made busy state are blocked if the terminal is assigned the MSB All Calls feature.

If the MSB Intragroup feature is assigned to a set, an attendant call is always delivered to the terminal, provided an idle CA is available. This interaction occurs whether or not MSB is active on that set.

6.57.3.6 Do Not Disturb

MSB takes precedence over attendant-activated DND, such that treatments specified for MSB apply when both it and DND are activated on a given line.

Furthermore, if both MSB and DND are active on a given terminal and MSB is deactivated, DND is also deactivated.

Attempts by the attendant to activate/deactivate DND on a terminal in the made busy state result in the network sending a ‘Disallowed’ indication to the attendant's display.

6.57.3.7 Operator verification

Busy Verification overrides MSB. An attendant applying Busy Verify on a terminal in the made busy state is unaware of MSB.

6.57.3.8 Attendant Camp-On

Attendant Camp-On is not possible on terminals in the made busy state. Attempts to activate this feature result in the network sending an ‘MSB Active’ indication to the attendant's display.

6.58 Message Waiting and Call Request

These features are available to initializing and non-initializing terminals.

6.58.1 Definitions

6.58.1.1 Call Request

This feature allows a terminal subscriber to leave a Call Request (CAR) indication on the called party's terminal, when the calling party encounters no answer or busy indication. A feature indicator (audible and/or visual message waiting, as described in Section 6.58.1.3, “Types of Indicators”) is used for the Call Request indication.

Both the Call Request and Call Request retrieve features are implemented such that neither the requestor nor the requestee is required to enter any directory number information. The requestor does not specify the requestee's directory number while leaving a call request and the requestee does not specify the requestor's directory number when trying to make contact.

To activate Call Request, the requestor must be active on the primary directory number (PDN).

6.58.1.2 Message Waiting

When a user's audible and/or visual message waiting (MWT) indicator is on, there are messages waiting or call requests pending. Messages are retrieved by calling the message desk attendant or using the activator associated with the visual message waiting indicator. Call Requests are retrieved by using the activator associated with the visual message waiting indicator, or by dial access code.

Multiple messages and call requests can be queued for the same user. When all messages and call requests have been retrieved, the network deactivates the message waiting indicator.

6.58.1.3 Types of Indicators

The user may receive Audible Message Waiting Indicator (AMWI), Visual Message Waiting Indicator or both, depending on subscription parameters.

6.58.1.3.1 Audible Message Waiting Indicator

The feature allows an ISDN user to hear an audible indication (interrupted dial tone) that messages or call requests are waiting. This flexibility of choice provides a way to receive an indicator when the user’s CPE does not have visual indicator capabilities.The AMWI will be provided both in-band and also indicated out-of-band by way of the signal information element (IE) in the D-channel signaling. Terminals provisioned with AMWI will receive interrupted dial tone at any call origination if a message is waiting. AMWI is continuous until either a key is depressed or treatment occurs. If a message is waiting and the user dials a feature activation code that normally returns AMWI, the user will receive interrupted dial tone twice, once for the message waiting indication and again for the feature activation response. The AMWI is accessed upon call origination until there are no messages pending.

6.58.1.3.2 Visual Message Waiting Indicator

The Visual Message Waiting Indicator is the feature indicator associated with the message waiting feature key.

6.58.2 Procedures

6.58.2.1 Non-Initializing Terminals

Non-initalizing terminals (NITS) may work with the MWT or CAR features on the DMS-100 by using the Bellcore specified feature activator and indicator value of “63”.

6.58.2.2 Leaving a Message

When a direct or redirected call is made to the message center, which can be automated or attendant-assisted, the message center records the message and activates either the audible and/or visual message waiting indicator of the called user, as described in Section 6.58.2.5, “Message Waiting Indicator Activation-Terminating Side”.

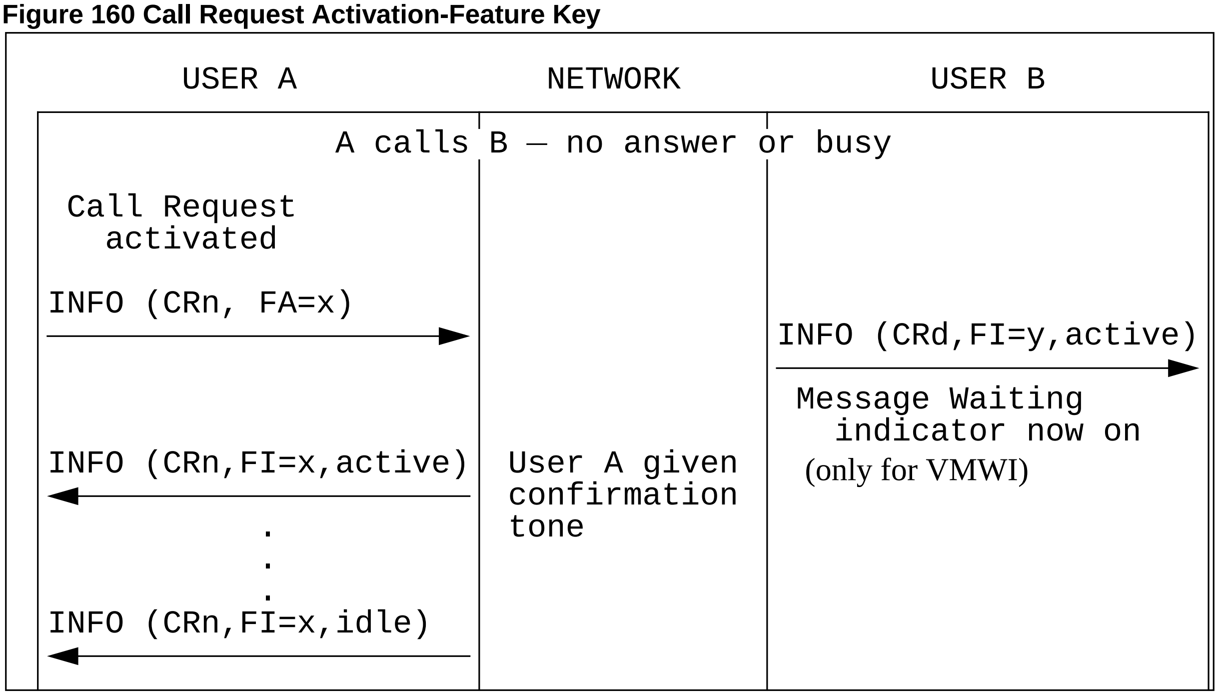
6.58.2.3 Call Request Activation-Feature Key

When a called station is busy or there is no answer, the caller activates Call Request using the assigned activator. The caller informs the network that Call Request is being activated, using generic procedure G5. (See Section 6.16, “G5 - Feature Key Management (Call Progress/Active Phase)”, for additional information about generic procedure G5). The user sends the network an INFOrmation message containing a Feature activation information element with the identifier of the Call Request Activation feature.

When the Call Request activation is accepted, even if a new queue entry was not created, the caller receives in-band confirmation tone, and the Call Request activation indicator is given confirmation, using generic procedure G5. An INFOrmation message is sent to the caller containing a Feature indication information element with the Call Request activation indicator with status “active”, when confirmation tone is applied. The indicator is deactivated with an identical message, but with status “idle”, when the call is released.

The network will activate the called user’s message waiting indicator as described in Section 6.58.2.5, “Message Waiting Indicator Activation-Terminating Side”

Figure 160 Call Request Activation-Feature Key



6.58.2.4 Call Request Activation-Dial Access

The Call Request feature may be activated when the calling station (station A) encounters no answer or busy indication, when calling terminal B. To leave B a call request, A and B must have Call Request capabilities and A must have Three-Way Calling (3WC) activator. The following procedures should be followed:

- Station A will send an INFOrmation message to the network with Feature activation information element corresponding to 3WC activator, as shown in Figure 161, "Call Request activation-Dial Access," on page 555.
- The network will return a HOLD message to autohold the call.
- Station A will respond with a HOLD ACKnowledge message.
- The network will then send an INFOrmation message with Progress indicator information element corresponding to “dialing”, Signal information element corresponding to “special dial tone” and Feature indication information element corresponding to the 3WC indicator pattern 17 “active”.
- A will send an INFOrmation message to the network with Keypad information element corresponding to the Call Request Activate (CRA) access code.
- The network will return an INFOrmation message with Signal information element corresponding to “tones off”.
- The network will then send an INFOrmation message with a Feature indication information element corresponding to 3WC indicator pattern 16 “idle” and Signal information element corresponding to “confirm tone”, indicating that a call request is queued.
- When the confirm tone ceases, A will receive an INFOrmation message with Signal information element corresponding to “tones-off”.
- A will clear the call by sending a DISConnect message to the network and the call will be cleared in accordance to the procedures defined in Chapter 5 of this specification.

The network will activate terminal B’s message waiting indicator as described in Section 6.58.2.5, “Message Waiting Indicator Activation-Terminating Side”.

Figure 161 Call Request activation-Dial Access

Scenario:User A calls user B but receives busy tone. User A leaves user B a call request.

USER A/TERMINAL A	MESSAGE	NETWORK
USER HEARS BUSY TONE	(call on CRn)	
message waiting initiation req. (x = 3WC)	INFO (CRn, FA=x) →	
	HOLD (CRn) ←	autohold
	HOLD ACK (CRn) →	
special dial tone on	INFO (CRd, PI=dialing ← SIG=SDT FI=x,17)	
user enters access code for call request	INFO (CRn, → KP=access code)	
spec dial tone off	INFO (CRd,SIG=tones off) ←	
confirm tone on	INFO (CRd, ← SIG=confirm tone, FI=x,16)	accept call request confirm tone on
		activate message waiting indc on user B’s terminal
confirm tone off	INFO (CRd,SIG=tones off) ←	confirm tone off
message waiting completion request	DISConnect (CRn) →	
	RELease (CRn) ←	
release B —ch	RELease COMplete (CRn) →	release B —ch

Note: When user A activates this feature while user B is busy. The network sends INFO (FI=z,17) to user B's terminal, where indicator #z is the Message Waiting indicator.

6.58.2.5 Message Waiting Indicator Activation-Terminating Side

6.58.2.5.1 Terminals with VMWI or both VMWI/AMWI Assigned

The network, if the Call Request activation is accepted and the called station's VMWI/AMWI is not already on, turns on the called station's VMWI/AMWI using generic procedure G9. (Refer to Section 6.20, “G9 - Network notification of Feature Information” for additional information about generic procedure G9). The network sends the called user an INFOrmation message containing a Feature indication information element with Message Waiting feature indicator with status “active”. The called station knows that there is a message waiting because of the indicator. If there is already a queue entry for the same caller, a new queue entry is not created.

6.58.2.5.2 Terminals with only AMWI Assigned

No INFOrmation message sent to terminal. Indication occurs at call origination as described in Section 6.58.1.3.1, “Audible Message Waiting Indicator”.

6.58.2.6 Retrieval of Messages and Call Requests-Feature Key

When a user sees that the message waiting indicator is on or hears a interrupted dial tone during call origination, there are messages, call requests, or both waiting for that user. Typically, a user would subscribe to either the Message Waiting or Call Request feature so there would be no ambiguity. In the case where a user subscribes to both, messages and call requests share the same queue.

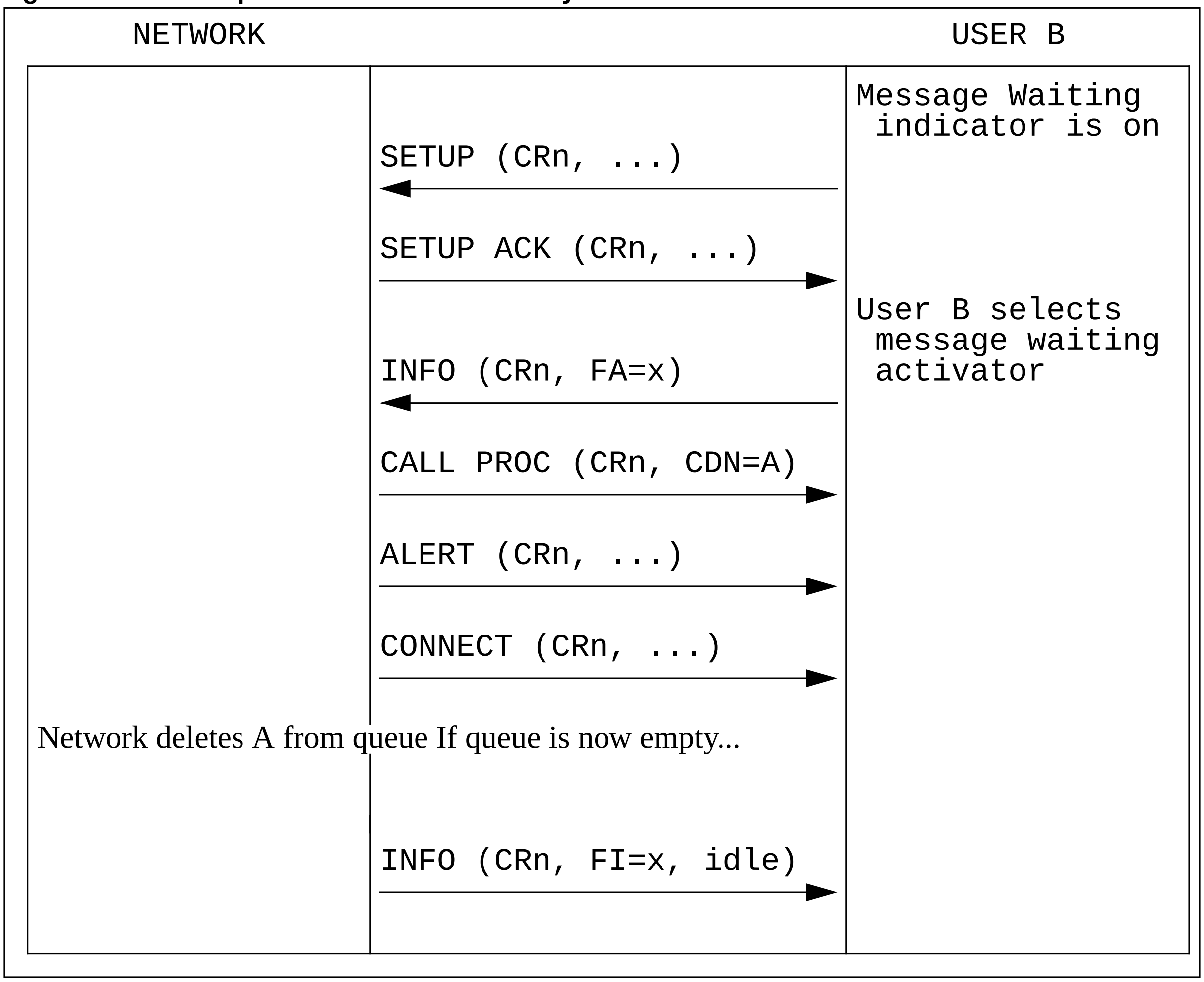
The user must have VMWI or both VMWI/AMWI (i.e. not just interrupted dial tone) in order to retrieve messages and call request with the feature key. The user may only use the message waiting feature key when active on the PDN.

The user can retrieve a message or call request using any one of the sequences specified in generic procedure G3. Figure 162, "Call Request Retrieval-Feature Key," on page 557, illustrates one of these sequences. The first idle requestor, searching from the top of the queue, is retrieved by selecting a DN and then the activator associated with the message waiting indicator. If there are no idle requestors, the network gives the user in-band reorder tone. If a requestor associated with a queue entry has been locked out or is no longer a valid user, that queue entry is deleted. If an idle requestor is found, the network sends the user a CALL PROCeeding message containing the number of the user who left the call request in the Called party number information element. If the called party answers, that call request is deleted from the queue. If the queue is now empty, the audible and/or visual message waiting indicator is deactivated by the network, using generic procedure G6. If there is no answer, that call request is placed at the bottom of the queue.

Messages left at a message center can be retrieved in the same manner as for call requests, as described above. In this case a call is initiated to the message center when the user selects the activator associated with the message waiting indicator. The procedures are identical to those for Call Request retrieval.

Messages left at a message center can also be retrieved by making a call to the message center. In this case, the queue entry is managed directly by the message center. That is, the message center (or message center attendant) informs the network when all messages have been read. The network then removes the queue entry. If there are no more call requests or messages (possibly from another message center), the network deactivates the user's message waiting indicator, using generic procedure G6, if the call is still active, otherwise generic procedure G10 is used.

Figure 162 Call Request Retrieval-Feature Key



6.58.2.7 Call Request Retrieval-Dial Access

To retrieve the call, the procedures below should be followed:

- B will originate an outgoing call by sending a SETUP message to the network, as shown in Figure 163, "Call Request Retrieval-Dial Access," on page 558
- the network will respond with a SETUP ACKnowledge message
- Terminal B will send an INFOrmation message with Keypad information element corresponding to the Call Request Retrieve access code
- After the access code sending is complete, the network will send a CALL PROCeeding message. The call will proceed as described in Chapter 5 of this interface specification.

When terminal A answers, the call is established. Terminal B will receive an INFOrmation message with Feature indication information element corresponding to the Message Waiting indicator pattern 16, “idle”.

If A is busy or does not answer, the call request will remain queued. Both of the message waiting indicators patterns will not change.

Multiple call requests can be queued for a terminal. Call request retrieval will be served in the order they arrived.

Figure 163 Call Request Retrieval-Dial Access

Scenario:User B has received a call request from user A, and the message waiting indicator #x on user B's terminal shows pattern 17. User B originates a call and dials the call request retrieve access code to return the call.

USER B/TERMINAL B	MESSAGE	NETWORK
Message waiting indc. #x active	INFO (CRd, FI=x,17) ←	
call request	SETUP (CRn, BC,...) →	
connect B–ch	SETUP ACK (CRn, CID=B–ch) ←	connect B–ch
User enters first digit of access code	INFO (CRn, KP=access code) →	
User enters remaining access code	INFO (KP=digit) → "	establish call to user A
	CALL PROC (CRn, CDN=dest addr) ←	
ringback on	ALERTing (CRn) ←	far end alerting ringback on
display connected address	CONNect (CRn) ←	call established
Message waiting indc. #x idle	INFO (CRd, FI=x,16) ←	(except if user B only has AMWI)

6.58.2.8 Call Request Cancellation-Dial Access

The requestor (terminal A) may cancel a call request by sending an INFOrmation message with Keypad information element corresponding to the

Call Requestor Deactivate Specific code and the address of the requestee terminal B.

When the requestee (terminal B) sends an INFOrmation message with Keypad information element corresponding to the Call Requestee Deactive All code, all call requests queued for this terminal are dequeued. Subsequently, this deactivates both the VMWI and AMWI.

6.58.3 Feature Interactions and Limitations

Calls are redirected to a message center by means of one of the Call Forwarding services, CFAC, CFB, or CFD. Please refer to the sections which describe these features to understand their operation and their interactions with other features.

In an EKTS Shared DN group, both the audible and visual message waiting indicator only applies to the primary member of the group.

Even if the user who activated Call Request has Do Not Disturb (either activated by the attendant or by service order) or Call Forwarding active, Call Request retrieval will allow a call setup to the original requestor's station.

If user A calls user B, the call is forwarded to user C, and user A does a Call Request activation, the audible and/or visual message waiting indicator of user B is activated, not user C’s indicator.

If a user has the Call Request Exempt option (activated by service order), other users can not activate call requests on that user.

Message Waiting and Call Request are allowed features for members of a Directory Number Hunt group (DNH).

6.58.3.1 Call Request Activation-Feature Key

The following additional limitations apply to feature key activation of Call Request:

- The originating terminal has Message Waiting
- The originating terminal has the call request option
- The terminating terminal has the call request option
- The terminating terminal is busy or does not answer
- The customer group has the call request option
- The originating and terminating terminals belong to the same customer group family
- The terminating terminal does not have the call request exempt option
- The originator is not the same or in the same MADN group as the terminator.

If any of the above conditions are not satisfied, the originator will receive an error indication, via an INFOrmation message with Signal information element corresponding to “reorder tone”.

A terminal can only have one call request against another terminal.

A terminal can make multiple call requests (to different terminals).

Call request retrieves are done in the order of their arrival.

6.58.3.2 Call Request Activation-Dial Access

The following additional limitations apply to dial access activation of Call Request:

- The originating terminal has Message Waiting
- The originating terminal has Three-Way Calling
- The originating terminal has the call request option
- The terminating terminal has the call request option
- The terminating terminal is busy or does not answer
- The customer group has the call request option
- The originating and terminating terminals belong to the same customer group family
- Three-Way Calling is not in effect
- The terminating terminal does not have the call request exempt option
- The originator is not the same or in the same MADN group as the terminator.

If any of the above conditions are not satisfied, the originator will receive an error indication, via an INFOrmation message with Signal information element corresponding to “reorder tone”.

A terminal can only have one call request against another terminal.

A terminal can make multiple call requests (to different terminals).

Call request retrieves are done in the order of their arrival.

6.59 Ring Again (RAG)

Ring Again will be supported on the National ISDN-1 BRI Interfaces only, Automatic Call Back is supported for NI-2 BRI Interfaces.

6.60 Definition

Ring Again is NTI's version of Automatic Call Back (ACB). For differences between the two service offerings, the reader should consult TR-855. The Ring Again feature allows a user encountering a busy destination the option of being notified when the busy number becomes idle. If the notification is accepted by the user the network will automatically re-attempt the call.

The feature may be divided into three major components:

- the Feature Activation, which enables a user to request that a busy destination be monitored until it becomes free.
- the Call Offer Notification, which enables a user to be notified when the once busy destination becomes free.
- the Recall Answer, which initiates the network to automatically re-dial the once busy destination.

6.60.1 Feature Activation/Deactivation

Feature key access is used to provide access to this feature. The ISDN implementation of Ring Again will use the Call Reference Busy Limit and, if Additional Call Offering (ACO) is assigned to the called party, the Notification Busy Limit to determine whether the called user is busy. To activate the feature, the user selects the RAG feature activator when encountering a busy station. The RAG indicator turn on to indicate that the feature is active. Once the called DN is free, the calling party will be notified by a RAG tone a flashing of the feature indicator. The user then selects an id call appearance and selects the RAG feature activator to re-initiate the call. If the user does not select the RAG feature activator before the RAG recall time-out value is reached, the RAG request is cancelled. The user can cancel RAG at any time by selecting the RAG feature activator.

6.60.2 Procedures

It is assumed that Terminal A is assigned the Ring Again feature and Terminal A has attempted a call to Terminal B which is assigned ACO. Terminal B is both Call Reference and Notification Busy. As shown in to Procedures on page 561, Terminal A may invoke Ring Again by sending the network an INFOrmation message with the Feature activation information element corresponding to the Ring Again feature activator, as per the generic feature access procedure G5.

If Ring Again can be successfully activated, the terminal will receive an INFOrmation message with Feature indication information element corresponding to the Ring Again feature indicator with status "active". The call will then be cleared and the user is free to originate other calls.

If the Ring Again request was rejected, Terminal A will continue to receive busy tone.

If Terminal A already has a Ring Again request pending for a destination then this request must be cancelled by selecting the Ring Again activator before another Ring Again request will be accepted.

6.60.3 Call Offer Notification

The network will notify user A once destination B is no longer busy by sending a NOTIFY message encoded as follows:

- The Call Reference IE contains the null call reference
- + The Bearer Capability IE matches the call type of the original calling party
- + The Calling Party IE contains Party B's number
- + The Called Party IE contains Party A's number
- The Signal IE contains Alerting-On Pattern 2, “requested call
- The Feature Indicator IE is set to “prompt”
- The Notification IE contains “monitored user idle.”
- + Not included in the NOTIFY message at this time.

Note: The Ring Again feature indicator can never be busy, so A is ALWAYS notified when B becomes idle even when the terminal has all of its DNs/call references in use.

Terminal A has X seconds to respond to the call offer notification, where X is data filled at network assignment time on a customer group basis (X = 8 to 32 seconds).

Call offer notification does not inhibit Terminal B from initiating another call. Terminal A will continue to receive the call offer notification if this occurs.

If the network Ring Again timer expires before A answers then call offer notification will stop and the Ring Again request will be cancelled. The network will send an INFOrmation message with a Feature indication information element with the RAG feature indicator status “idle”. If A responds after time-out, A may follow the basic outgoing call procedures to access Terminal B.

6.60.4 Recall Answer

While the call offer notification is still active (i.e. the Ring Again feature indicator shows status “prompt”), user A may accept the call offer notification by originating a new call and using Feature Key Management (FK to request Ring Again activation (i.e. by sending the network a SETUP message followed by an INFOrmation message that contain the Ring Again feature activator, as shown in the generic feature access procedure G3).

This action causes the network to attempt to establish a connection between the requesting and remote terminals. A successful attempt will result in the network sending an INFOrmation message with a Feature indication information element specifying the Ring Again feature indicator with status “idle”.

There are four possible cases that can occur before the user of Terminal A selects the Ring Again activator

1 If A sends a SETUP while receiving call offer notification but not follow that SETUP with an INFOrmation message containing the Ring Again feature activator (e.g. Party A sends a SETUP and then begins dialing), the network assumes that A is ignoring the offer notification and treats the SETUP as an attempt to initiate a separate call.

2 If A sends a SETUP while receiving call offer notification but the Bearer Capability (BC) specified in that SETUP does not match the BC of the original call to B (i.e. the BC of the call on which RAG was invoked), the network treats the SETUP as an attempt to initiate a separate call.

3 If B initiates an outgoing call in the meantime, A will again receive busy indication. A must reinitiate the service if they want to RAG on B again.

4 If B has activated either Call Forward All Calls, Make Set Busy or Do Not Disturb then the Ring Again request will be cancelled.

5 RAG and NRAG cannot be invoked against a CMD call.

6.60.5 Cancellation

Terminal A can cancel the Ring Again request by sending an INFOrmation message with Feature activation information element corresponding to the Ring Again feature activator. The network returns an INFOrmation message with Feature Indicator information element specifying the Ring Again feature indicate status “idle”.

Cancellation is permitted at any time or state EXCEPT during the call offer notification.

6.60.6 Network Ring Again

If the called user is served by a different switch than the calling user then RAG can be activated if:

- The calling and called users are in the same customer group.
- The call was made via an ISUP trunk.
- There exists a CCS7 link between the originating and terminating switches.

If the above requirements are met, RAG can be activated and follows the procedures described above. The only difference is that the calling user will receive an INFOrmation message with a Feature indication information element containing the RAG feature indicator with status “pending” while the network determines if the RAG request can be performed. The procedures for acceptance or rejection are described above.

6.60.7 Feature Interactions and Limitations

If any of the following are true then a Ring Again activation request will not be successful:

1 Terminal B has been made busy to new calls while another Terminal C is being notified that B is now idle (C had activated a Ring Again request against B earlier).

2 Terminal B has either the Make Set Busy or Do Not Disturb features active.

3 The call was forwarded via CFU, CFI, or CFD at any point.

4 Terminal B is not in the same customer group as A and A's customer group does not have the CBQ option.

5 Terminal B already has 8 Ring Again requests activated against it.

***Note:* A terminal can be equipped with one and only one Ring Again feature activation key.**

In the following scenarios assume that A is a terminal with the Ring Again activation capability and B is a busy terminal that Terminal A is calling or has called.

6.60.7.1 Call Forwarding

- If B has activated CFU, CFI or CFD, when A calls B, CFU, CFI, or CFD will be applicable. There is no interaction with Ring Again. This also applies if the Call Forward flag is set for B indicating that a Call Forward is already in progress. If the terminal to which B is forward to is busy then Terminal A will not be allowed to activate Ring Again.
- If CFB is applicable to B, and B is busy, then A will follow the CFB feature on the original call. If the remote terminal (C or D etc.) is also busy and A selects the Ring Again activator, Ring Again will be activated against the base Terminal B, and B will be re-rung if A answers the call offer notification.

Suppose A has activated Ring Again on B, and B becomes available.

- If A has CFU or CFI activated, A's line will still be given call offer notification. The Ring Again request will not follow the CFU or CFI feature.
- If A has CFD and does not answer before the CFD timer expires (but the call offer recall has not timed out) the call will not be forwarded. Only the Call Offer timer applies.
- A is busy and has the Call Forward Busy feature. The Ring Again request remains pending until both A and B are idle. Call offer notification does not follow CFB.
- If B activates CFU or CFI between the time that A activates Ring Again request against B and A answers the corresponding call offer notification, then A will receive reorder tone, and the request will be canceled.
- If B has the CFD feature and A answers the call offer recall, B will be rung, but if B does not answer before the CFD timer expires then the call will be forwarded just like an ordinary call.

6.60.7.2 Call Pickup

- Call offer notifications cannot be picked up via the Call Pickup feature.
- Once B is notified of the call, (after A has accepted the Call Offer notification) the call to B can be picked up via the Call Pickup feature.

6.60.7.3 Call Waiting/Attendant Camp-On

If B already has a call waiting, A will receive busy, and can activate Ring Again. If B becomes available, the call waiting will be served first. At this point another incoming call may be call waited. Finally when there are no more calls waiting, the Ring Again request will be served. The same prioritizing takes place for Attendant Camp-On.

6.60.7.4 Three-Way Calling

Terminal A cannot delete a pending request against a party which is part of a three-way call.

6.60.7.5 Make Set Busy/Do Not Disturb

- If A has MSB or DND active, the call offer notification will not be blocked.
- If B has MSB or DND active, then A is NOT allowed to activate the Ring Again against B.
- If B has MSB or DND activated when A answers a call offer notification, then the Ring Again request will be canceled.

6.60.7.6 Hunt Groups

Terminal A can activate a Ring Again request for a DN in a DNH, MLH, DLH group.

6.60.7.7 EKTS Shared DN

Ring Again will allow any EKTS group member to instigate Ring Again and only that member will receive the call offer notification for that request. Only one Ring Again request is allowed per EKTS member.

Ring Again can be activated against a basic EKTS group when any member is busy.

Figure 164 Ring Again Procedures

Scenario: The user initiates an outgoing call but receives a busy tone indicating destination busy. The user then uses the Ring Again activator #x to request the network to notify him and establish a connection when the destination is no longer busy.

USER/TERMINAL	MESSAGE	NETWORK
user hears busy tone	call in progress on CRn ↔	called end busy
RAG request	INFO (CRn, FA=x) →	
busy tone off RAG activated	INFO (CRn, FI=x,active) ←	
	RELease (CRn) ←	
release GR	RELease COMplete (CRn) →	
RAG recall	NOTIFY (CRd, SIG=alert ← patn 2, FI=x, prompt, NI=monitored pty idle)	called end free
call request	SETUP (CRm, BC...) →	
connect B–ch	SETUP ACK (CRm, ← CID=B–ch)	connect B–ch
RAG answer request	INFO (CRm, FA=x) →	
RAG deactivated	INFO (CRm, FI=x,idle) ←	
display destination addr call established	CALL PROC (CRm ← CDN=dest addr) (as in basic call)	establish call to previously busy destination

6.61 Screen List Editing (SLE)

6.61.1 Definition

Screen List Editing (SLE) allows terminals to edit screening lists associated with Call Screening services, that include:

- Selective Call Rejection (SCRJ)
- Selective Call Acceptance (SCA)
- Selective Call Forwarding (SCF)
- Customer Originated Trace (COT).

For each call screening feature, the switch maintains a list of DNs identifying incoming calls for special treatment that the subscriber can create and modify. The subscriber can also activate and deactivate the service that uses the associated screening list.

SLE provides the interface to the subscriber for carrying out these activities. CLASS SLE is assignable to Single DNs.

6.61.2 Procedures

Access SLE by dialing an access code, as described in Section 3.1.2 of TR–NWT–000847 and supported by procedure 8, Interactive Dial Access (Call Initiation Phase). Access SLE by dialing an access code, Respond to the voice prompts by sending digits over the B-channel, requiring no ISDN terminal specific procedures. A call proceeding message is returned, followed by an INFO (IRQ = prompt), prompting the user/terminal to return D-channel keypad in response to in-band audio prompts.

6.61.3 Feature description

A brief description of each feature assignable to ISDN sets by the SLE service follows:

- Selective Call Forwarding (SCF) - allows a subscriber to define a special list of DNs and a destination DN. Incoming calls from the subscriber's list of DNs are forwarded to the destination DN.
- Selective Call Rejection (SCRJ) - allows a subscriber to define a list of DNs, such that incoming calls from those DNs are prevented from terminating to the subscriber.
- Selective Call Acceptance (SCA) - allows the subscriber to define a list of DNs such that only calls that are on the list of DNs are allowed to terminate to the subscriber’s line. All other calls (that is, those numbers not on the DN list), do not terminate on the subscriber's line.
- Customer Originated Trace (COT) - allows a subscriber to activate a trace of the last incoming call. The trace results in an output report generated for the operating company to use. This report, which is not available to the subscriber, provides information regarding the last (presumably malicious) call.

6.62 Speed Call (SC)

6.62.1 Definition

Speed Call (SC) allows a subscriber to store frequently-dialed strings against access codes, and to make calls to these numbers using only the corresponding abbreviated access code. The desired string can be a DN, authorization code, account code, or feature access code, and can include an asterisk or octothorpe.

To store the string, a short list and a long list are provided. A short list (SCS) consists of a maximum of 10 stored strings. A long list (SCL) is one that consists of a maximum or either 30, 50, or 70 stored strings, depending on which version of long list is used.

There are two flavors of speed call lists, Personal and Group:

- Personal lists - stored against a DN/CT. The user assigns and changes numbers against these lists.
- Group lists - accessed by a number of terminals within a business group, but only one controlling station in the group can alter its contents. They are accessed by a two-digit code.

6.62.2 Programming and feature activation

The SCS or SCL can be programmed using either generic procedure G1 in Section 6.12, “G1 - Feature Key Management (Non-call related)” or the dial access procedures in TR–TSY–000847, Section 3.1.2. For the dial access procedures, indicate the end of the dialing/digit sequence using an octothorpe (#).

- For FKM, the terminal must either be inactive, or have a call on hold.
- The user first selects the FA, followed immediately by the SC number to be stored.
- At completion of programming, the SC FI shows the status “idle”.
- While in the programming mode, any out of context input aborts the session, and the old number is retained.
- Any successful programming attempt overwrites the old SC number stored against the access code.

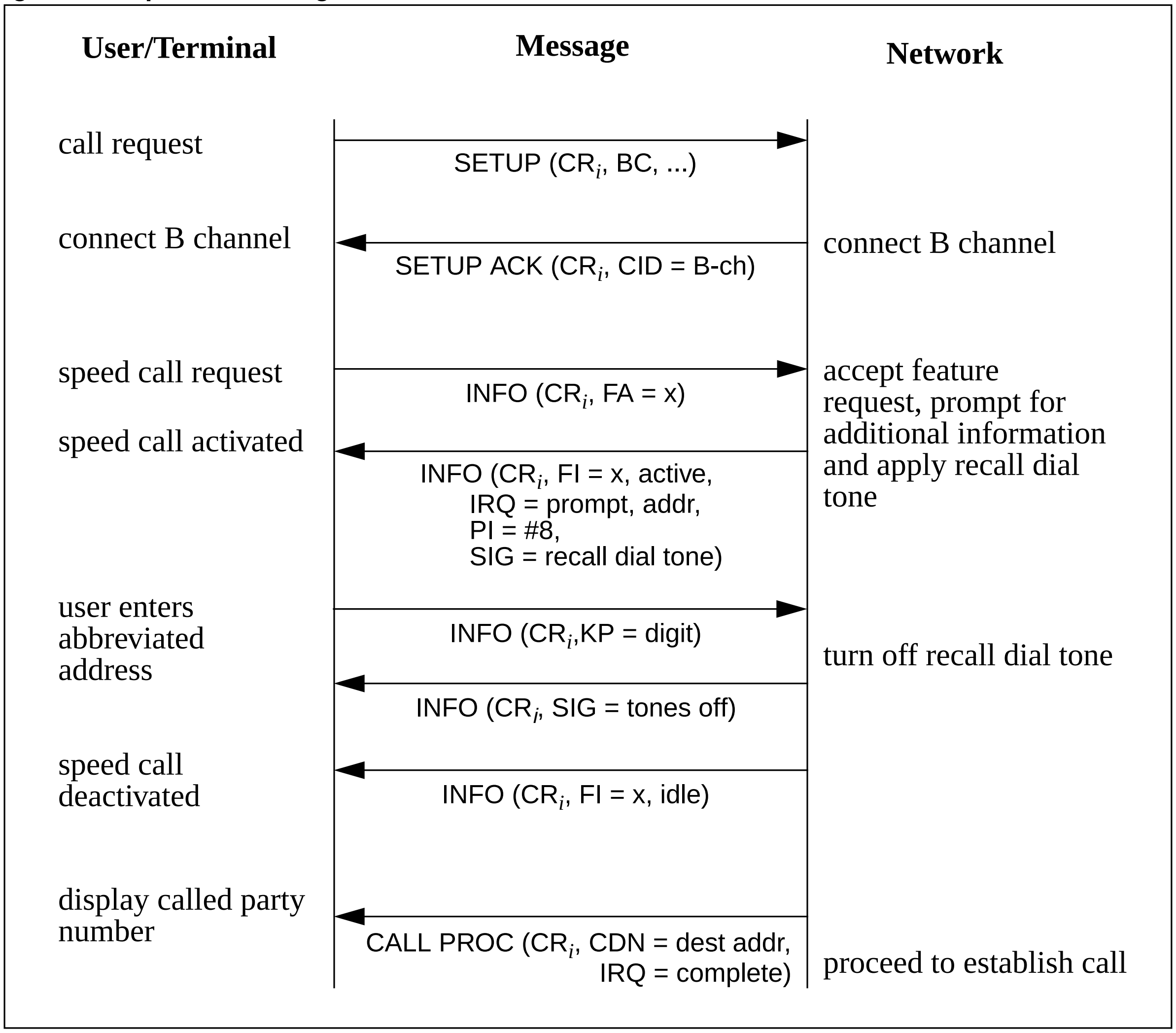
6.62.3 Procedures

Invoke SC usage using either FKM or DCA generic procedures, as specified in TR–TSY–000847 Sections 3.5.3.2 and 3.1.2, respectively. Figure 165, “Speed Call usage” shows SC usage invocation using one of the FKM procedures specified in the generic procedures.

- After receiving the SETUP ACKnowledge, the terminal sends an INFOrmation with a FA IE corresponding to the SC FA.
- While waiting to receive the abbreviated access code, the network returns an INFOrmation with a FI IE specifying the SC FI with status “active”, and an Information Request IE corresponding to “prompt address”.

- After the network accepts the access code, it returns an INFOrmation with a FI IE specifying the SC FI with status “idle”. The call proceeds as described in GR-268 for an ISDN basic call.
- The CALL PROCeeding may include a CDN IE corresponding to the character string stored against the abbreviated access code.

Figure 165 Speed Call usage



6.62.4 Limitations

- A speed call code is one digit long (digits 0-9) for the short list, and two digits long (00-29/49/69) for the long list.
- A stored number can have up to 100 digits, including an asterisk.
- A user can activate CF using SC.
- If a user stores a number in a speed call list with an asterisk (*) as the final digit, it is treated as a partial number. In this case, the network waits for the user to dial more digits to complete the call. This aspect of the feature allows speed call access to an interconnect carrier.

6.63 Authorization Code

6.63.1 Definition

Authorization Code is used to identify callers for billing purposes, assign a Network Class of Service (NCOS,) and control network access. (An NCOS is a designator used within the customer's private network to control access to features and network resources).

A subscriber to a Meridian Electronic Switched Network can voluntarily dial an authorization/account code after dialing the called number, and on receipt of an authorization/account code prompt.

- To access the network, the caller must dial a correct and active authorization code.
- When the code is validated, its associated NCOS prevails.
- This feature generates an SMDR record containing the caller's code.

Two related features, Authorization Code Correction and Authorization Code Immediate Dialing are available.

- Authorization Code Correction allows terminals to correct their code without having to type the whole keying process.
- Re-dialing begins at the beginning of the Authorization code digits only.
- Authorization Code Immediate Dialing provides for the removal of the seven-second pause between the code and the secondary dial tone.
- Authorization Code receives the code and the called station digits.
- Authorization Code collects digits until the subscriber signals the end of dialing by keying in the octothorpe (#) or waiting for the expiry of the interdigit time-out.

6.63.2 Feature activation/deactivation

Entry of the authorization code may be prompted by a network-to-user INFOrmation with the IRQ IE corresponding to prompt which may be accompanied by an announcement or tone over the B-channel. The calling terminals NCOS determines whether or not they get a message.

- Digit collection starts as soon as the prompt commences.
- The authorization code is sent through a series of INFOrmation(s), each one with the KP IE corresponding to an authorization code digit.
- Alternatively, the authorization code could be sent en bloc in a KP IE.
- On the reception of the first digit, the network acknowledges by removing the announcement or tone, whichever is currently provided.
- To allow the user to finish listening to the announcement, a long first digit time-out, of less than 40 s, is used.
- If the entered authorization code is valid, the call is allowed to progress.
- The treatment for entering invalid authorization codes depends on the datafill in the customer group level.

For an example of authorization code usage, please refer to the time sequence diagram for DISA.

6.63.3 Feature interactions and limitations

- An authorization code can be from 2-14 digits long.
- It need not be unique to a customer group.
- The network can have both Authorization Code Last (compulsory) and Account Code Last features.
- A customer group can have either the Authorization Code Last or the Account Code Last feature, but not both.
- If a user voluntarily enters an invalid authorization code, it is discarded and the call is allowed to proceed with the calling terminal's NCOS. In this case, the user is still considered as not having entered an authorization code.

6.64 Expensive Route Warning Tone (ERWT)

6.64.1 Definition

Expensive Route Warning Tone (ERWT) provides a warning tone to indicate the selection of an expensive route. It is given under the following conditions:

- a route marked as expensive is selected by Automatic Route Selection for a call
- the call being processed was not queued
- the network class of service and customer data are selected to receive ERWT.

After the ERWT, the caller can refuse the call by clearing, waiting for a pre-determined delay or activating CBQ.

Figure 166 Expensive Route Warning Tone

USER A/TERMINAL A	MESSAGE	NETWORK
call request	SETUP (CRn, BC,...) →	
	:	
	← CALL PROC (CRn)	
	← PROGress (CRn, PI=8)	in–band info. available
warning tone on		

6.64.2 Feature activation and limitations

The ERWT is provided by a PROGress from the switch. ERWT is not given to the following:

- calls with overlap outpulsing
- calls that are forwarded
- AUL

6.65 Class of Service Restrictions

6.65.1 Definition

Class of Service Restrictions allows/denies access by individual stations. The restrictions can be arranged to control all calls originating or terminating on stations and tie trunks. The following restrictions are provided:

- Denied Incoming (DIN) - station is denied any incoming calls
- DOR - station is denied making any outgoing calls.
- Denied Termination
- Fully restricted service - fully restricted stations are denied access to the exchange network. Attendant restricted stations are only allowed access to the exchange network through an attendant.
- Station Direct inward dialing restriction
- Semi-restricted service - these stations are allowed access to the exchange network through an attendant
- Toll-restricted service - these stations are either toll denied or assigned toll diversion to the attendant
    - — Unrestricted Service - allowed full access to the exchange network, toll network or any service accessible by dialing.

6.66 Code Restrictions

6.66.1 Definition

Customers can define NPA or NXX restriction for stations or groups of stations within a customer group. Code Restrictions provides additional control on the network access.

- Each customer may have 15 different code restriction levels.
- Code restrictions are assigned to each NCOS.
- Through this link, the code restriction levels are associated with stations.

6.67 Electronic Key Telephone Service

6.67.1 Definition for EKTS

This feature is based on the requirements for Electronic Key Telephone Service (EKTS) identified by Bellcore in GR-205-Core Issue 1, Revision 1, “ISDN Electronic Key Telephone Service” and is similar to the Meridian Digital Centrex Multiple Appearance Directory Number (MADN) Single Call Arrangement (SCA) feature.

A terminal must subscribe to either Basic EKTS or CACH EKTS to gain access to the EKTS service. The EKTS service uses EKTS call control procedures for all voice (VI) call type appearances of the DNs on a subscribers terminal. The VI appearances of the DNs may be EKTS shared, or they may be non-shared. In addition, a terminal may also subscribe to CMD or PMD call types on some of the Directory Numbers. Restrictions as noted in this section apply. Calls offered to the DN/CT of either CMD or PMD are offered per GR-268 Procedures.

A DN with the same CT that is assigned to more than one set is called an EKTS shared DN. The sets that are assigned the EKTS shared DN are known as an EKTS group. An EKTS group can be composed of 500/2500 sets, Meridian Business Sets (MBS) and ISDN sets. The bearer capabilities supported with EKTS are speech, 3.1 kHz audio, and Circuit-Mode Data. In addition to having VI, one terminal in the EKTS group can be assigned CMD (creating a single DN configuration for that terminal) provided that one member of the EKTS group is using an NI-2 terminal.

EKTS allows its members to:

- share a directory number appearance
- hold and retrieve EKTS shared calls
- bridge onto an established EKTS call
- bridge calls together to form a conference
- control the privacy status of an EKTS call
- receive delayed or abbreviated ringing for an incoming EKTS call
- transfer ringing on incoming calls to other terminals.

Up to 32 members can belong to an EKTS group, which is referred to as a Call Appearance. Basic EKTS permits only one Call Appearance per DN; only one call (either originating or terminating) can be active at a time. CACH EKTS permits up to 16 Call Appearances per DN. The CACH Call Appearances may contain the same or different terminals.

ISDN terminals which subscribe to EKTS shared DN must support the terminal identification procedures described in Section 6.7, “Terminal Identification Procedures”.

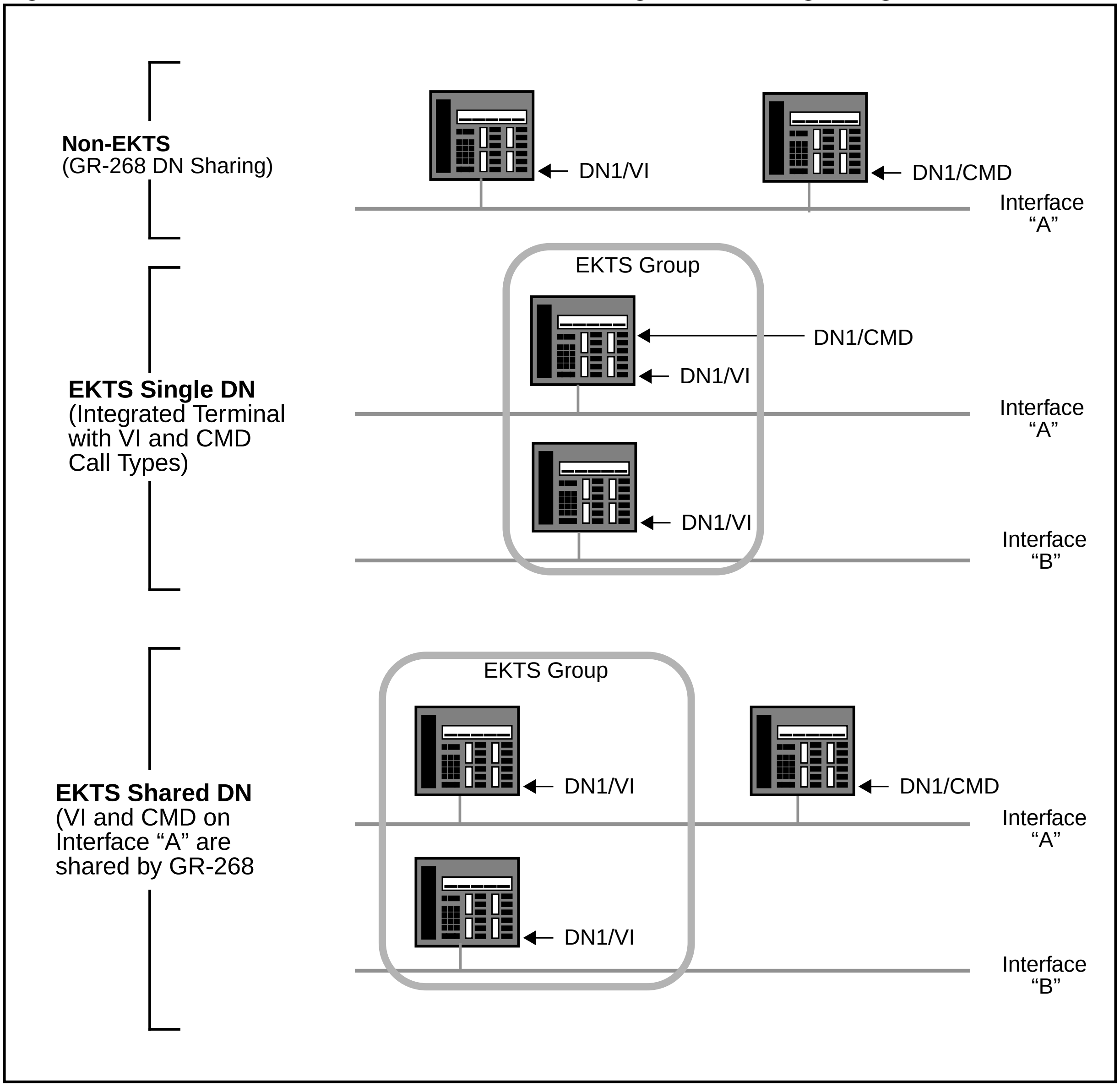
DNs assigned to EKTS CACH terminals use Call Appearance Information Element (CAPI) signalling for all VI calls.

6.67.1.1 DN sharing on EKTS and CMD

Circuit-Mode Data can be assigned, in addition to VI, to a single terminal in an EKTS group. That terminal must be provisioned to support for both VI and CMD on the DN appearance. Only one member of the EKTS group can have CMD appearances. The number of Circuit Mode Data appearances allowed is based on the Call Reference Busy Limit for the DN/CMD call pair type. Up to 16 CMD call appearances may be supported on that terminal. Up to 16 VI call appearances of a DN may also be supported.

Figure 167, "Voice Interface and Circuit Mode Data configurations using a single DN", illustrates various EKTS and non-EKTS configurations involving VI and CMD.

Figure 167 Voice Interface and Circuit Mode Data configurations using a single DN

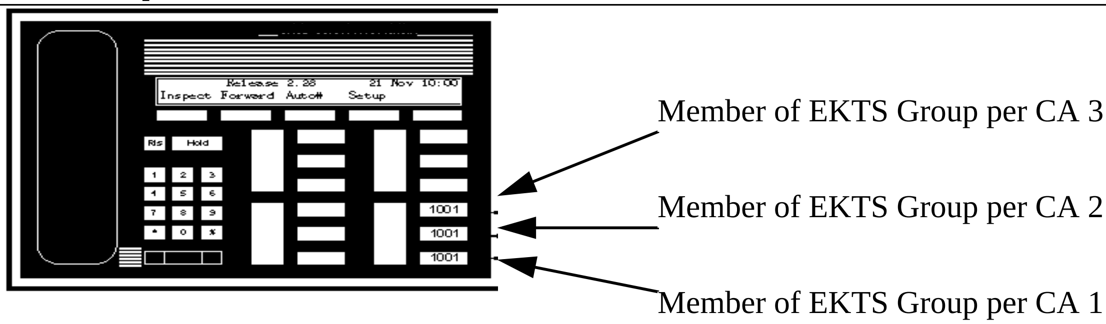


6.67.1.2 EKTS Call Appearance Call Handling (CACH)

An EKTS terminal can be assigned the option of Call Appearance Call Handling (CACH). CACH provides an alternative signaling mechanism such that calls are directed via a call appearance rather than a DN.

It is likely that a terminal would have multiple appearances of the EKTS CACH DN as shown Figure 168, “Example ISDN EKTS CACH Terminal”. In this example the terminal has three CAs for the DN 1001. Each one can operate as a separate call. Other terminals may also have appearances for each of the CAs.

Figure 168 Example ISDN EKTS CACH Terminal

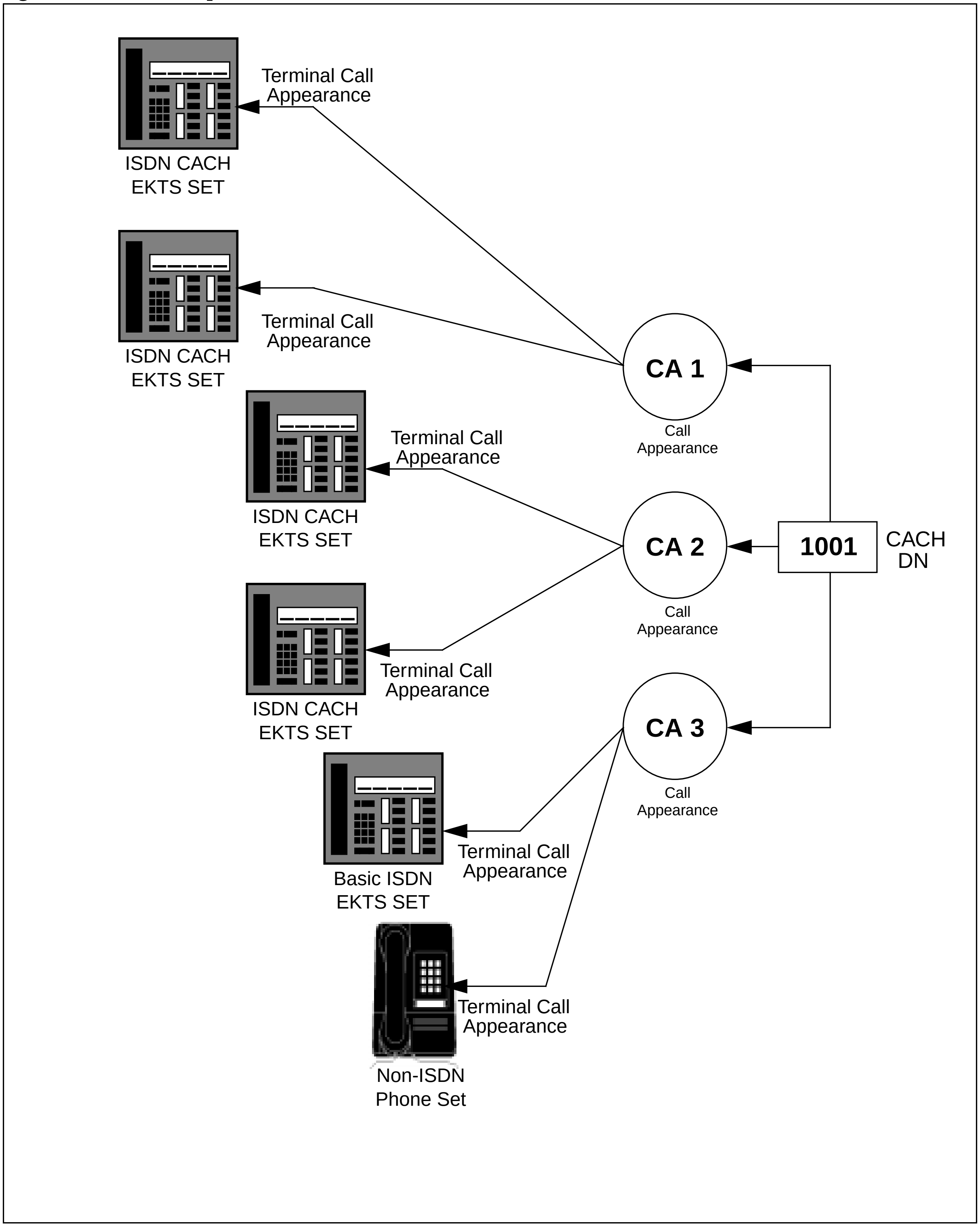


A Terminal Call Appearance is a single member of a single CA Group, that is, a key on a terminal. The diagram in Figure 169, “Relationship of DN to CA to Terminal” depicts the relationship between the DN, the CAs, and the terminals. In this case the DN 1001 is an EKTS CACH DN with 3 CAs. Each CA has two members. This is just an example of how the service may be deployed.

When a set is provisioned as EKTS, these procedures are used for all VI call appearances on the set.

The DMS-100 requires that the first provisioned member of an EKTS CACH group be an ISDN NI-2 terminal.

Figure 169 Relationship of DN to CA to Terminal



6.67.2 Procedures for EKTS Terminals

6.67.2.1 Call Origination

6.67.2.1.1 Originating Call Establishment

If an EKTS user is not assigned the CACH option, the EKTS user originates a call in the same manner as defined in Section 5.7.1.1, “Call establishment at the originating interface”.

6.67.3 Procedures for EKTS Non-Shared Calls

If the CACH option has been assigned to the EKTS user, the user shall include the Call Appearance information element corresponding to the selected call appearance of the DN in the SETUP message sent to the network. If the Call Appearance information element is not present in the SETUP message or is present but invalid, and the CACH option has been assigned to the user, the network will send a RELease COMPlete with cause #96, “mandatory information element missing”, or cause #100, “invalid information element contents”, respectively.

When the Calling Party Number information element is included in a SETUP message from a user assigned the CACH option, the Calling Party Number will be ignored by the network. The terminal shall include all other information elements in the SETUP message as defined in Chapter 5.

If the Call Appearance information element is included in the SETUP message, the network will screen the call appearance identifier against the list of identifiers assigned to the calling user's TSP to identify which DN and which call appearance of the DN to associate with the call. The DN identified will be used by the network as the calling party number of the call. If the call appearance is already allocated to another call, the network will reject the call request by sending a RELease COMplete message with cause value #34, “circuit/channel congestion”. If a SETUP message is subsequently received from another member of the CA, the network will reject the call request by sending a RELease COMplete message with cause value #34, “circuit/channel congestion”.

6.67.3.1 Call Origination

6.67.3.1.1 Associated Call Establishment

Upon the receipt of a valid SETUP message, the network sends a KEY SETUP message to all other members of the CA. The other EKTS members receiving associated call offering can be on the same interface as the originating EKTS user or on other interfaces.

The KEY SETUP message is broadcast and includes:

- a new call reference
- Bearer Capability information element containing the bearer capability of the outgoing call
- for an EKTS user that is not assigned the CACH option, the Called Party Number information element containing the originating number

- Endpoint Identifier information element to direct the message to each specific user
- for a user that is assigned the CACH option, the Call Appearance information element for the selected call appearance.

For each KEY SETUP message sent, timer T303 is started. If the network does not receive a KEY SETUP ACKnowledge message or call clearing message in response to the KEY SETUP message, the network will retransmit the KEY SETUP message and restart timer T303.

For a given associated call offering application, if a KEY SETUP ACKnowledge message is received while timer T303 is running, the network will cancel timer T303. The network will retain the call reference value for this call to this user which has responded. This user is now called an associated user.

For a given associated call offering application, if T303 is running and the network receives a clearing message from the specified user, the network will cancel T303 and clear the call to the responding user. If T303 expires a second time and no user has responded with a KEY SETUP ACKnowledge message, the network will release the call reference for the particular associated call offering application.

If a clearing message is received by the network from a user that the associated call offering has not been directed to, the network will clear the call to this responding user.

If the network receives a DISConnect or RELease message from a user which has sent a KEY SETUP ACKnowledge message, the network will return a KEY RELease message to this user and retain the call reference for this user. If the network receives a RELease COMplete message from a user which has sent a KEY SETUP ACKnowledge message, the network will clear the call reference to this user for this call.

All users which have responded to a KEY SETUP message with a KEY SETUP ACKnowledge message and have not returned a RELease COMplete message are considered to be associated users for this call. Subsequent PROGress and/or CONNect messages which are sent to the calling user are also sent to each associated user.

6.67.3.1.2 Call Abandoned

If the calling user clears the call attempt before the called user has answered by sending a clearing message to the network, call clearing for the called and calling users will proceed as defined in Chapter 5. To each associated user, the network will send a RELease message containing cause value #16, “normal call clearing”.

For associated call offerings for which no response has yet been received, the network will allow T303 to time-out. If it is the first expiry of T303, the timer will not be restarted and the KEY SETUP message will not be resent. If a KEY SETUP ACKnowledge or call clearing message is received before T303 expires, the network will cancel T303 and clear the call to the responding user.

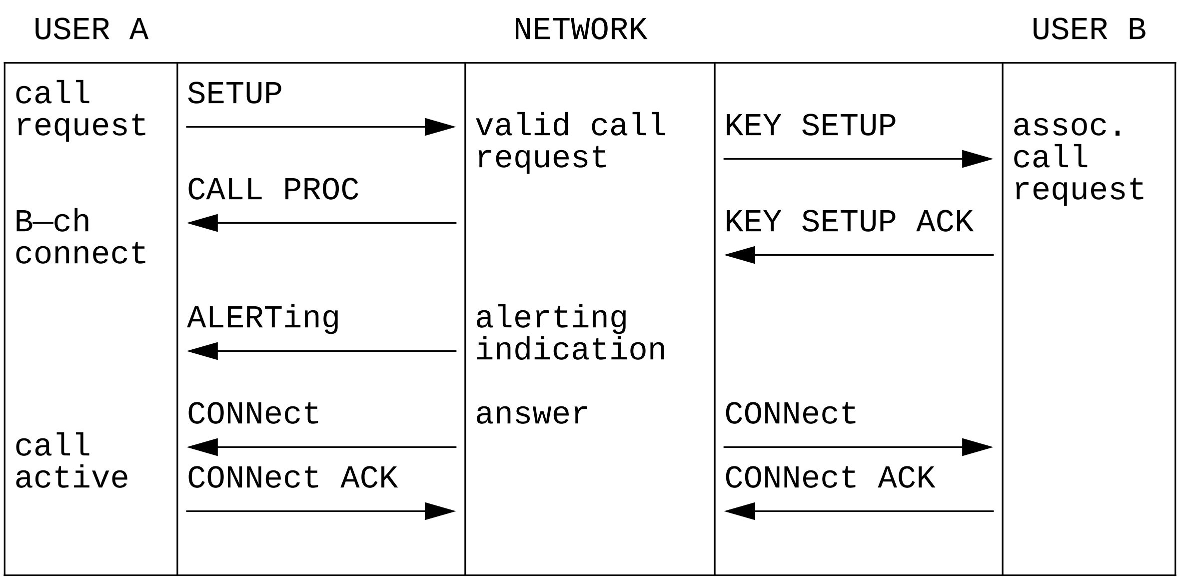
After T303 is canceled or expires, no further responses will be acknowledged by the network for this particular call offering application.

6.67.3.1.3 User Call Rejected

If the call is rejected by the remote user or network before being answered, the network will clear the call to the calling user by using the procedures defined in Chapter 5. Each associated call offering application will be cleared as defined above with the cause value equal to the cause value sent to the calling user.

Figure 170 Successful Call Origination

Scenario: A is originating an EKTS call. User B is a member of the EKTS group.



6.67.3.2 Call Termination

6.67.3.2.1 Call Delivery

The call offering procedures for an EKTS call are basically the same as those defined in Section 5.7.1.2, “Call establishment at the Destination Interface”. The differences being that the call is offered to all members of the CA on one or more interfaces. Each user receives its own SETUP message from the network broadcast containing the following:

- a new call reference
- Channel identification information element coded to “no channel” since channel negotiation is performed with the CONNect and CONNECT Acknowledge messages or RETRieve and RETRieve ACKnowledge messages for EKTS
- Bearer Capability information element coded to the bearer capability associated with the incoming call
- Endpoint Identifier information element selecting the particular user

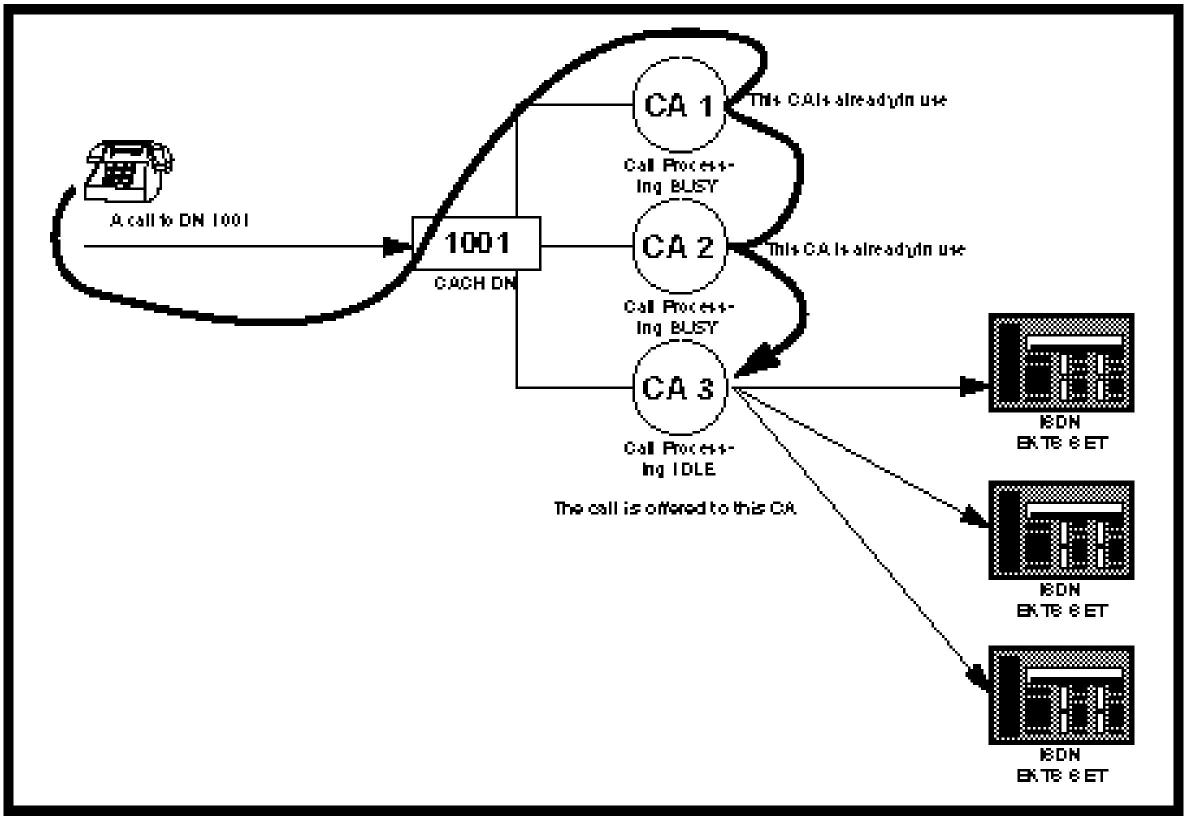
- Signal information element coded to “normal alerting” or “alerting off' depending on the ringing option assigned (refer to the feature EKTS Ring Forward for details)
- For a user that has not subscribed to the CACH option, the Called Party Number information element, coded to the DN to which the call is directed.
- For a user that has subscribed to the CACH option, the network will select an idle call appearance for the called DN associated with the user's TSP and include the call appearance identifier in the Call Appearance information element; the Called Party Number information element will not be included in the SETUP message in this case. For a DN with multiple call appearances.

  The network selects an idle appearance in the following manner:

  The CAs exist in an ordered list, that may be sequential or non-sequential (that is, the order can be modified through provisioning). The call offering procedures are similar to a linear searching algorithm. The objective being to find the first idle CA (available for an incoming call) in the list.

  For example, if a call were to terminate on the EKTS CACH DN 1001, call processing would have to determine which CA is available to take the incoming call. Therefore, a search takes place in which the CA list is traversed in search of an idle CA. When an idle CA is found, the call is offered to the members of that CA. This is detailed in Figure 171, “Terminating CACH Call”, where CA1 and CA2 are already in use on other calls at the time the call in question terminates to EKTS CACH DN 1001. Since CA3 is idle, it is selected (and marked as busy), the call is offered to the members of EKTS group associated with CA3.

Figure 171 Terminating CACH Call



The call offering applications are considered independent but the messages sent to the calling user are based on the responses received from all users which have been offered the call.

If a user responds to a SETUP message with a DISConnect or RELease message and there is at least one other user still receiving terminating treatment for the call, the network will cancel any timers running for this particular call offering and send a KEY HOLD message with network-specific cause value #8, “call is proceeding”, to this responding user. If a user responds to a SETUP message with a RELease COMplete message and there is at least one other user still receiving terminating treatment for the call, the network will clear the call reference for this particular call offering application. If there are no other users receiving terminating treatment, the network will clear the call in both directions as defined in Chapter 5. For members that have been sent a KEY HOLD message, the network will clear these members by sending a RELease message with cause value #21, “call rejected”.

If a user responds to the SETUP message with a CALL PROCeeding and/or ALERTing message followed by a DISConnect or RELease message, the network will determine if any other user is still receiving terminating treatment. If there is at least one other user still receiving terminating treatment for the call, the network will cancel T310 if running for the particular call offering application and will send a KEY HOLD message to the user containing network-specific cause value #8, “call is proceeding”, and signal information element encoded to “alerting off”. If the network receives a RELease COMplete message from a user that had previously sent a CALL

PROCeeding and/or ALERTing message, the network will clear the call reference for this particular call offering application. If there are no other users in the CA receiving terminating treatment, the network will clear the call in both directions as defined in Chapter 5. For members that have been sent a KEY HOLD message, the network will clear these members by sending a RELease message with cause value #21, “call rejected”.

6.67.3.2.2 Call Treatment Applied to Calling User

If no response is received from any called user following the first transmission of the SETUP message(s) prior to the expiration of every T303 timer or the only message received is a call clearing message in response to one or more (but not every) SETUP message, then upon retransmission of one or more SETUP messages, the network will return a PROGress message with network-specific progress indicator #16, “destination not responding, call reattempted” to the calling user.

Upon the second expiry of all T303 timers, the network will clear the call to the calling user as described in Chapter 5 with cause value #18, “no user responding”.

The network will send an ALERTing message to the calling user on receipt of the first ALERTing message from the called users before a CONNect message is received from any called user. No further indications are sent to the calling user if the network receives subsequent ALERTing messages from other users in the terminating CA.

6.67.3.2.3 Called Party Answer

A called user which is being offered the incoming call shall answer the call by sending a CONNect message to the network. The network will cancel all timers for this particular call offering application. For those users which have been sent a KEY HOLD message for this call, a RETRieve message is used as a request to answer the call.

In response to a CONNect or RETRieve message and a B-channel is available, the network will send a CONNect ACKnowledge message in response to a CONNect message and a RETRieve ACKnowledge message in response to a RETRieve message to the answering called user. The CONNect ACKnowledge message or RETRieve Acknowledge message will contain the Channel identification information element identifying the B-channel to which the user shall connect (see Figure 172, "Successful Call Termination").

If a B-channel is not available and at least one other user in the terminating CA is being offered the call, the network will send a KEY HOLD message, containing the Signal information element encoded to “alerting off”, in response to a CONNect message, or a RETRieve REJect message in response to a RETRieve message. The Cause information element in either the KEY HOLD or the RETRieve REJect message will contain cause value #34, “circuit/channel congestion”, or #44 “requested circuit/channel not available”. The call offering procedures will continue to all other users in the CA.

If a B-channel is not available and no other users in the terminating CA are being offered the call, the network will reject the CONNect message and initiate clearing with a RELease message containing either cause value #34 or #44. In addition, the network will initiate clearing to any other user in the CA which has been sent a KEY HOLD message with a RELease message with cause value #21, “call rejected”. Clearing to the calling user will proceed as defined in Chapter 5.

Upon the successful establishment of a connection between the calling and called user, the network will perform one of the following procedures for every other user still undergoing terminating treatment:

- To each called user which has responded with a CALL PROCeeding and/or ALERTing message, or has previously been sent a KEY HOLD message, the network will cancel all timers, and send a KEY HOLD message containing the Signal information element encoded to “alerting off”.
- For any call offering application where timer T303 is still running, the network will continue to offer the call until the second expiration of T303, a non-rejecting message or a call clearing message is received. If a user responds with a DISConnect or RELease message, the network will stop timer T303 and send a KEY HOLD message to this responding user. If a user responds with a RELease COMplete message, the network will clear the particular call offering application. If no response is received before the second expiration of T303, the network will release the call reference for this call offering application.

  If a user sends a CALL PROCeeding or ALERTing message while the call is still being offered and timer T303 is still running, the network will return a KEY HOLD message containing the Signal information element encoded to “alerting off”.

Any further CONNect or RETRieve messages will be treated as defined in Section 6.67.3.3, “EKTS Bridged Calls”.

6.67.3.2.4 Call Abandoned

At any time before a CONNect ACKnowledge or RETRieve ACKnowledge message has been sent by the network to a called user, if the network receives a request from the calling user to release the call, the network will initiate clearing for each call offering application as defined in Chapter 5. For those users sent a KEY HOLD message, the network will initiate clearing by sending a RELease message and continue clearing as defined in Chapter 5.

Figure 172 Successful Call Termination

Scenario: User A and user B are members in the same EKTS group which receives an incoming call. User A answers the call.

USER A		NETWORK		USER B
call request	SETUP ←	incoming call	SETUP →	call request
	ALERTing →	alerting ind to calling user	ALERTing ←	
answer	CONNect →	connect user A, key hold user B	KEY HOLD →	assoc. user
call active	CONNect ACK ←			

6.67.3.3 EKTS Bridged Calls

When an EKTS call has reached the ringing state, the network will interpret the receipt of a RETRieve message from an associated user in the CA as a request to bridge onto the call.

The network will bridge the user onto the call and return a RETRieve ACKnowledge message to this user if the following conditions apply:

1 the call is in the ringing state

2 privacy is not enabled on the call

3 resources are available to bridge the call

4 a B-channel is available

5 the conference size has not reached its limit

6 the remote party has not disconnected from the call

7 no incompatible feature is active.

If one of the above conditions are not met, the network will reject the RETRieve message with a RETRieve REJect message containing one of the following causes applying to the above conditions, respectively:

1 cause value #29, “facility rejected”

2 cause value #29, “facility rejected”

3 cause value #34, “circuit/channel congestion”

4 cause value #34, “circuit/channel congestion”

5 cause value #34, “circuit/channel congestion”

6 cause value #29, “facility rejected”

7 cause value #29, “facility rejected”

If the bridging is successful, the RETRieve ACKnowledge message will also include a Notification indicator information element specifying “user bridged onto call” and a Connected number information element identifying the remote party.

If the call converts from a two way call to a bridged call, a NOTIFY message with a Notification indicator information element specifying “user bridged onto call” is sent to the other user in the CA already connected to the call and the remote user will receive a NOTIFY message with a Notification indicator specifying “connected via conference facility (conferee)” (see Section Figure 173, “Successful Bridging”).

If an EKTS bridged call converts to a two party call as a result of one of the active EKTS members becoming an associated member, the remaining active member will receive a NOTIFY message containing a Notification indicator information element specifying “call no longer bridged”. The remote party will receive a Notification indicator information element specifying “conference facility released”.

For an outgoing call which has not yet been answered, any in-band tones being applied or subsequent tones to be applied to the users already connected will also be sent to this user recently bridged onto the call.

If the call is rejected while more than one user in the CA is bridged onto the call, the network will clear the call to each connected user as defined in Chapter 5 with the following exceptions:

- The network specific timer started after sending PROGress will only be cancelled when all users have initiated call clearing.
- If a call clearing message other than RELease COMplete is received from an EKTS user connected to the call and there is at least one other user in the CA still connected, the network will return a KEY RELease message to the user that disconnected from the call and release the B-channel connection to that user, while retaining the call reference. If the network receives a RELease COMplete message from a user in the CA, the network will clear the call to this user, but will only clear the entire call if no other user in the CA is still connected to the call.
- After every user connected to the call disconnects or the network specific timer expires, the network will initiate clearing of every established call reference associated with this call as defined in Chapter 5. Clearing a user which has received a KEY RELease message will be initiated with a RELease message.

If the remote user was on hold against the entire CA when the bridge request is received, the bridging will retrieve the held call. The network will send a NOTIFY message to all other users in the CA. The NOTIFY and RETRieve ACKnowledge messages will contain a Notification indicator information element specifying “call retrieved from hold”.

As a special case, if after returning a CONNect ACKnowledge or RETRieve ACKnowledge message to the answering user on an incoming call, the network receives a subsequent CONNect message from another EKTS user in the group that has or has not yet been sent a KEY HOLD message (to update the call condition), the network will treat this as a bridge request. If the user can be bridged onto the call, the network sends a CONNect ACKnowledge message after bridging the user onto the call. The CONNect ACKnowledge message will also contain a Notification indicator information element specifying “bridged call” and a Connected number information element with the address of the remote party. Since the call has converted to a bridged call, the other member who answered the call first is sent a NOTIFY message with a Notification indicator specifying “bridged call” and the remote party is sent a NOTIFY message with a Notification indicator information element specifying “connected via conference facility (conferee)”.

For this special case, if the call cannot be connected, the network sends a KEY HOLD message containing the appropriate cause value as previously defined for the RETRieve REJect message and the Signal information element encoded to “alerting off”.

Figure 173 Successful Bridging

Scenario: User A and user B are members in the same EKTS group. User A is active on a call. User B is associated with the call and bridges onto the call to convert the call to a bridged call. Privacy is disabled.

USER A		NETWORK		USER B
active	NOTIFY ◄────	call active bridge req. valid,notify users A, B, and remote user	RETRieve ◄──── RETR ACK ────►	bridge request active

6.67.3.4 Bridged Call Exclusion

The bridged call exclusion option (i.e. privacy) may be used to restrict other members in the CA from bridging onto an active EKTS call. If privacy is enabled on a call, bridging is not allowed. If privacy is disabled (i.e. released) on a call, bridging is allowed.

The following different privacy options can be assigned to an CA:

1 Automatic bridged call exclusion, manual re-enable - For this privacy option, the initial privacy status for the CA is private meaning that bridging cannot occur unless an active member of the CA releases privacy for the call. This mode allows only one member to bridge onto the call after privacy has been explicitly released. Privacy is immediately reinstated as soon as a member bridges onto the call.

Hence, privacy must be explicitly released every time a new member is to be added to the call.

2 Automatic bridged call exclusion, automatic re-enable - For this privacy option, the initial privacy status for the CA is private. This mode allows any number of members to bridge onto the call after privacy has been explicitly released. Privacy can be restored by user control only. Hence, privacy need only be released once when a conference bridge of arbitrary size is being established.

3 Manual bridged call exclusion - This mode specifies the initial privacy status for the CA to be non-private. Bridging may occur at any time unless an active EKTS member explicitly invokes privacy on the call. The privacy can also be released by the user after it is invoked.

The following items apply to each bridged call exclusion option:

- Only one option may be assigned per CA
- For every originating call originating from an CA or terminating on an CA, all members are notified of the initial privacy status of the call
- The privacy status can be changed by: an originating member during call establishment and by an active member connected to the call
- A member who changes the privacy status of the call is referred to as the privacy status controller. A member ceases to be the privacy status controller when the initial privacy status of the call is restored
- Notification is given to all associated members when the privacy status changes
- Only one member can control the privacy status of a call at a time.

Users trying to bridge onto a call when privacy is enabled will be rejected. If a user sends a RETRieve message to the network as a request to bridge onto the call when privacy is enabled, the network will send a RETRieve REJect message with cause value #29, “facility rejected”.

During call origination, the initial privacy status is included in the first message sent to the calling user (i.e. SETUP ACKnowledge or CALL PROCeeding). This message will contain a Notification indicator information element indicating the privacy status. The other members will receive notification of the initial privacy status by the inclusion in the KEY SETUP message(s) of a Notification indicator information element.

For calls terminating on an CA, the initial privacy status is sent to the answering user in either a CONNect ACKnowledge or RETRieve ACKnowledge message by including a Notification indicator information element specifying the initial privacy status. The other members receive a KEY HOLD message with a Notification indicator information element specifying the initial privacy status.

6.67.3.4.1 Procedures for Changing Privacy

For modes 1 and 2, the privacy status can be changed to non-private either during the call establishment phase or the call progress/active phase of a call.

Refer to Section 6.10, “Generic procedures for supplementary service access” for definitions of these call phases.

- During the call establishment phase either Feature Key Management procedures or Dial Code Access procedures may be used to change the call privacy status to non private. Using Feature Key Management procedures, the user sends the privacy release feature activor and the called party address information within a SETUP message and/or subsequent INFOrmation messages as defined in generic procedure G4. Using dial code access procedures, the user sends the access code corresponding to privacy release feature invocation along with the called party address information as defined in generic procedure G8.

  After the request to release privacy and all the call information is received and validated by the network, the CALL PROCeeding message is sent to the calling party containing a Feature Indication information element coded to “privacy release” with status “active”, and a Notification indicator information element specifying “privacy disabled”. If the KEY SETUP message(s) have not already been sent, the KEY SETUP messages will include a Notification indicator information element specifying “privacy disabled”. Associated users will receive a NOTIFY message with the same Notification indicator information element.
- During the active/progress phase of a call, a user connected to the call can release privacy by sending an INFOrmation message containing a Feature Activation information element with the privacy release feature activator to the network. The network will send a NOTIFY message in response to this user with a Feature indication information element with the privacy release feature indicator with status “active” and a Notification indicator information element specifying “privacy disabled”. Other members will receive a NOTIFY message with a Notification indicator information element specifying “privacy disabled”.

For mode 1, privacy is automatically enabled as a result of a user bridging onto the call. When this occurs, the network sends to the privacy controller a NOTIFY message with a Feature indication information element with the privacy release feature indicator and status “idle” and a Notification indicator information element specifying “privacy enabled”. This user is now no longer the privacy controller. Other members will receive a NOTIFY message with a Notification information element specifying “privacy enabled”.

For mode 2, the privacy controller can enable privacy by sending an INFOrmation message with a Feature activation information element with the privacy release feature activator to the network. The network will send a NOTIFY message in response to this user with a Feature indication information element with the privacy release feature indicator with status “idle” and a Notification indicator information element specifying “privacy enabled”. This user is now no longer the privacy controller. Other members will receive a NOTIFY message with a Notification indicator information element specifying “privacy enabled”.

For mode 3, the privacy status can be changed to private either during the call initiation phase or the call progress/active phase of a call. The network allows the assignment of feature keys or dial codes to allow privacy to be enabled/disabled for a given call by means of:

1 A single access code or feature activator. Under this operation, when the network receives the access code or the feature activator for a call for which privacy has not already been enabled, the feature request will be interpreted as a request to enable privacy. After privacy has been enabled, a subsequent receipt of the same feature activator from the same user will be interpreted by the network as a request to disable privacy.

2 A pair of feature activators. Under this operation, one feature activator will always be interpreted as a request to enable privacy, and the other feature activator will be interpreted as a request to disable privacy.

— During the call establishment phase either Feature Key Management procedures or Dial Code Access procedures may be used to change the call privacy status to private. Using Feature Key Management procedures, the user sends the privacy feature activor and the called party address information within a SETUP message and/or subsequent INFOrmation messages as defined in generic procedure G4. Using dial code access procedures, the user sends the access code corresponding to privacy enable feature invocation along with the called party address information as defined in generic procedure G8.

  – After the request to enable privacy and all the call information is received and validated by the network, the CALL PROCeeding message is sent to the calling party containing a Feature Indication information element with the privacy feature indicator with status "active", and a Notification indicator information element specifying "privacy enabled". If the KEY SETUP message(s) have not already been sent, the KEY SETUP messages will include a Notification indicator information element specifying "privacy enabled". Associated users will receive a NOTIFY message with the same Notification indicator information element.

— During the active/progress phase of a call, a user connected to the call can enable privacy by sending an INFOrmation message containing a Feature Activation information element with the privacy feature activator to the network. The network will send a NOTIFY in response to this user with a Feature indication information element with the privacy feature indicator with status "active" and a Notification indicator information element specifying "privacy enabled". Other members will receive a NOTIFY message with a Notification indicator information element specifying "privacy enabled".

For mode 3, the privacy controller can release privacy by sending an INFOrmation message with a Feature activation information element containing the privacy feature activator. The network will send a NOTIFY message in response to this user with a Feature indication information element with the privacy feature indicator with status "idle" and a Notification indicator information element specifying "privacy disabled". This user is now no longer the privacy controller. Other members will receive a NOTIFY message with a Notification indicator information element specifying "privacy disabled".

The network will reject a request to enable or disable privacy if one of the following is true:

- The requesting user is not connected to the call or has placed the call on hold.
- The privacy status requested already exists.
- The remote party has disconnected from the call.
- The conference size has reached its maximum.

The network will reject the request with an INFOrmation message with cause value #29, “facility rejected”.

The network will also reject a request to enable or disable privacy when the user has not subscribed to the capability to alter privacy. The network will reject the request with an INFOrmation message with cause value #50, “requested facility not subscribed”.

For modes 1 and 2 when privacy is disabled and the privacy controller sends a call clearing message for this call, the network will enable privacy, either clear the call in both directions or return a KEY RELease message depending on the call state and status as described in Section 6.67.3.10, “Release Treatment,” on page 597. The first clearing message or the KEY RELease message sent to the privacy controller will include a Feature indication information element with the privacy release feature indicator with status “idle”. The KEY RELease message will also contain a Notification indicator information element specifying “privacy enabled”. This user is now no longer the privacy controller. If the call is not being cleared, other members will receive a NOTIFY message with a Notification indicator information element specifying “privacy enabled”.

For mode 3 when privacy is enabled and the privacy controller sends a call clearing message for this call, the network will release privacy, either clear the call in both directions or return a KEY RELease message depending on the call state and status as described in Section 6.67.3.10, “Release Treatment”. The first clearing message or the KEY RELease message will include a Feature indication information element with the privacy feature indicator with status “idle”. The KEY RELease message will also contain a Notification indicator information element specifying “privacy disabled”. This user is now no longer the privacy controller. If the call is not being cleared, other members will receive a NOTIFY message with a Notification indicator information element specifying “privacy disabled”.

For modes 1 and 2 when there is a privacy controller but the control of privacy is no longer allowed (e.g. when the conference has reached its maximum size), the call will be returned to its initial privacy status of private and the privacy controller and the other members will receive a NOTIFY message with a Notification indicator specifying “privacy enabled”. The NOTIFY message sent to the privacy controller will also include a Feature indication information element with the privacy release feature indicator with status “idle”.

6.67.3.5 Call Appearance Reservation

Call Appearance Reservation supports the following functions:

- Non-reserved Call Appearance (CA) this is the default value Call Appearance Reservation value.
- Originating Only CA(s) - User may designate one or more CAs exclusively for originating calls. The switch will not offer a terminating call on such a CA.
- Terminating Only CA(s) -User may designate one or more CAs exclusively for terminating calls. The switch will not allow the user to originate a call on such a CA. Offer terminating calls to a non-reserved CA before selecting a Terminating Only CA.
- For an Originating and Priority Incoming Only CA - a user may designate one or more CAs exclusively for Originating and Priority Incoming Calls.
  — A Priority Incoming Call is a terminating call that originated outside of the EKTS group.
  — The DMS-100 first attempts to offer a priority incoming call on a non-reserved CA.
  — If one is not available, the DMS-100 attempts to offer the call on a CA reserved for Terminating Only.
  — If a Terminating Only CA is not available, the DMS-100 chooses a CA reserved for Originating and Priority Incoming Only.

DMS-100 supplies the concept of ORIGDN (Originating DN) flag for a CACH DN, such that the CPE makes an automatic selection of an outgoing CA upon automatic CA selection. A Primary DN could be an ORIGDN by default. CA Reservation applies to CAs that appear on ISDN, MBS, and/or IBN terminals.

The Call Appearance Reservation type is assigned on a CA basis. Therefore, all members of the CA (ISDN, MBS or IBN terminals) will have the same Call Appearance Reservation value.

6.67.3.6 Hold and Retrieve

A user assigned EKTS has the capabilities of the Hold and Retrieve supplementary service. A member who successfully invoked hold is a holding member. The one who retrieves a held call is the active member. They are treated differently.

- A member who successfully invokes hold shall be referred to as a holding member.
- A member who retrieves a held call shall be referred to as a retrieving member.
- An active member

There is a difference between an associated member and a holding member. A holding member, although not connected to the call, is still part of the call. An associated member is not considered part of the call but is associated with the call.

There are two operation modes of hold for an EKTS call which can be assigned to the EKTS group at subscription time. These two modes are called MADN hold and EKTS hold. These two modes differ in their interaction with the bridged call exclusion capability. A description of these two operation modes of hold is given in the following sections.

6.67.3.6.1 MADN Hold Operation

Non-bridged calls

If a member invokes hold on a non-bridged call, each member receives notification indicating that the call is held. If prior to invoking hold, the holding member had altered the privacy status of the call, the initial privacy status of the call is restored and each member is updated of the new privacy status.

Any member may retrieve the held call. If a member retrieves the call, every member receives notification indicating that the call is retrieved.

Bridged calls

If a member invokes hold on a bridged call, only that member's portion of the call becomes held. The remaining connection(s) are retained.

A held portion of a bridged call can be retrieved only by the holding member.

Hold events on bridged calls do not affect subsequent bridging attempts or privacy status changes.

If a member invokes hold on a bridged call, then another member enables bridged call exclusion, the holding member cannot return to the call until the invoking member disables bridged call exclusion (i.e., the privacy status of the call is returned to non-private).

6.67.3.6.2 EKTS Hold Operation

Non-bridged and non-private calls

If a member invokes hold on a non-bridged and non-private call, every member receives notification indicating that the call is held.

Any member may retrieve the call. If a member retrieves the call, every member receives notification indicating that the call is retrieved. If the retrieving member is not the holding member and the holding member has activated privacy release prior to hold, the network enables privacy and notifies each member of the privacy status change. In this case, the member who originally held the call is no longer the privacy status controller of the call.

Non-bridged and private calls

If a member invokes hold on a non-bridged and private call, no member receives notification indicating that the call is held.

Only the holding member is permitted to retrieve the held call.

The current privacy status of the call is not affected by hold and retrieve events under these circumstances.

Bridged calls

If a member invokes hold on a bridged call, only that member's portion of the call is held. The remaining connection(s) are retained.

A held portion of a bridged call only be retrieved by the holding member regardless of the current privacy status.

Hold events on bridged calls do not affect the current privacy status or subsequent bridging attempts and privacy status changes.

If a member invokes hold on a bridged call, then another member enables bridged call exclusion, the holding member cannot return to the call until the invoking member disables bridged call exclusion (i.e., the privacy status of the call is returned to non-private).

6.67.3.6.3 Hold and Retrieve Procedures

If an EKTS user is connected to the call and the call is not undergoing call clearing, the user may place his portion of the call on hold by sending a HOLD message to the network. The network will return a HOLD ACKnowledge message to the user.

If no other user in the EKTS group is bridged onto the call when the HOLD ACKnowledge message is returned, the network will place the call on hold and send a NOTIFY message to all associated members. Each NOTIFY message and the HOLD ACKnowledge message returned to the user that put the call on hold will contain a Notification indicator information element specifying “call on hold”.

If at least one other member of the EKTS group is bridged onto the call when the HOLD ACKnowledge message is returned, the network will place the users portion of the call on hold, but the remaining connection(s) will be retained.

If the MADN hold operation applies and if, prior to issuing the hold request, the holding member has altered the privacy status of the call, the network will restore the initial privacy status of the call. A NOTIFY message containing a Notification indicator information element specifying the initial privacy status is sent to all members. The NOTIFY message sent to the holding member also contains a Feature indication information element with the privacy or privacy release feature indicator and status “idle”.

The hold request will be accepted if the following conditions apply:

1 the call is currently in the active state

2 no incompatible feature is active on the call

The network will reject a hold request with a HOLD REJect message with a Cause information element containing cause value #29, “facility rejected”.

An EKTS user can retrieve a call or this user's portion of the call from hold by sending a RETRieve message to the network. A request to retrieve a call may be issued from a holding member or an associated member. If the retrieve request is issued from an associated user when the call is not bridged and not held against the entire CA, the retrieve request is considered to be a request to bridge onto the call as defined in Section 6.67.3.3, “EKTS Bridged Calls”.

The network will return a RETRieve ACKnowledge message to the user if the retrieve request is successful otherwise a RETRieve REJect message is sent.

If the retrieve request is successful and the call is not bridged, a NOTIFY message is sent to all other members in the CA. The RETRieve ACKnowledge message sent to the retrieving user and the NOTIFY message(s) contain a Notification indicator information element specifying “call retrieved from hold”. If the retrieving user has not already been notified of the address of the remote user, a Connected number information element will also be included in the RETRieve ACKnowledge message.

If the EKTS hold operation mode applies and if, prior to issuing a hold request, the holding member activated privacy release and if the retrieving member is not the member who originally held the call, the network will enable privacy on the call. A NOTIFY message containing a Notification indicator information element specifying “privacy enabled” is sent to each member. The NOTIFY message sent to the member who originally held the call will also contain a Feature indication information element with the privacy release feature indicator and status “idle”.

If a member invokes hold on a bridged call, then another member enables bridged call exclusion, the holding member cannot return to the call until the invoking member disables bridged call exclusion (i.e., the privacy status of the call is returned to non-private).

The network may perform the autohold procedures as described in the Hold and Retrieve feature upon receiving a RETRieve message.

6.67.3.7 DN Bridging

An EKTS user is allowed to bridge calls together to form a three way connection. This capability is based on the conference capability defined for the flexible calling feature.

The user can invoke the conference feature in one of two ways as defined for flexible calling:

1 The user can include a DN bridging Feature activation information element within a SETUP message or subsequent INFOrmation message during Overlap sending. If the request is valid, the network acknowledges the request with a CALL PROCeeding message with a Feature Indication information element with the DN bridging feature indicator with status “active”. The call reference for this call is then considered the conference ID and the call is considered the first call being setup for a conference.

2 The user can include a DN bridging Feature activation information element within an INFOrmation message of an established call. If the request is valid, the network acknowledges the request with an INFOrmation message with a Feature indication information element with the DN bridging feature indicator with status “active”.

The details of the above procedures are shown in the flexible calling feature description.

Once the conference capability is invoked, the controller can add a call to the conference as follows:

1 The controller can request origination of a new call which autoholds the conference call. Once the new call is established, the conference call can be retrieved causing the two calls to be bridged.

2 The controller can hold the conference, initiate or retrieve a call, and retrieve the conference call to bridge the two calls together.

3 The controller can retrieve a held call causing the held call to be bridged onto the conference.

The detailed procedures for adding a call to a conference are described in the definition of the flexible calling feature. (See Section 6.43, “Flexible Calling (FC)”).

For cases 1and 2, the bridging request will be allowed if the controller can bridge onto the held conference call (i.e. bridging resources are available and privacy has not been enabled for the call and if no other user in the CA has bridged onto the currently connected call.

For case 3, the bridging request will be allowed if the controller can bridge onto the held call and no other EKTS user in the group is bridged onto the held call.

If the bridging cannot be performed, the network returns a RETRieve REJect message with cause value #29, “facility rejected”.

Once the three way conference call is established, the conference is treated as a single call. Therefore, other EKTS members can bridge onto the conference and the privacy of the conference can be user controlled.

The controller or any other user connected to the conference shall be allowed to hold or retrieve their conference appearance of the conference.

The controller is also capable of dropping the last party added to the conference.

A user is not allowed to be the controller of two or more concurrent conferences.

When the network receives a clearing message from any user with an appearance of the conference, the network will return either a KEY RELease message or call clearing message as appropriate. If the entire call is to be cleared, the network will include a Feature Indication information element with a DN bridging feature indicator with status “idle” in the first clearing message sent to the controller.

6.67.3.8 Abbreviated and Delayed Ringing

When abbreviated or delayed ringing are assigned to users in an EKTS group, a SETUP message sent to these users for an EKTS call includes a Signal information element. The Signal information element is coded to normal alerting for normal users and users assigned abbreviated ringing, and alerting off for users assigned delayed ringing.

Upon sending the SETUP messages, in addition to all normal call offering timers, the network will start timer EKTS-T1. If timer EKTS-T1 expires and at least one user assigned abbreviated ringing or one user assigned delayed ringing have responded positively to the SETUP messages and are still receiving terminating treatment for the call, the network will send an INFOrmation message containing a Signal information element indicating “alerting off” to each user assigned abbreviated ringing and still receiving terminating treatment and “normal alerting” to each user assigned delayed ringing and still receiving terminating treatment.

The network will cancel EKTS-T1 when:

- the call is answered
- the call is to be cleared
- no user in the EKTS group assigned abbreviated or delayed ringing is receiving terminating treatment.

6.67.3.9 Station Ringing Transfer (SRT)

The station ringing transfer capability allows a user to change the alerting pattern for incoming calls to a specific DN/BC appearance. When activated, calls which would normally have been offered to the particular service profile with normal alerting will be offered the call with the Signal information element coded to “alerting off”. One or more alternate users in the same EKTS group will be offered the call with a SETUP message containing a Signal information element coded to “normal alerting”. The alternate users are defined at subscription time.

The user can enable/disable SRT by the following methods:

- By including an SRT Feature activation information element in an originating SETUP message (see Section 6.16, “G5 - Feature Key Management (Call Progress/Active Phase)”) or in an INFOrmation message during Overlap sending (see Section 6.15, “G4 - Interactive Feature Key Management (Call Initiation Phase)”).
- By including an SRT Feature activation information element in an INFOrmation message of an established call reference (see Section 6.17, “G6 - Interactive Feature Key Management (Call Progress/Active Phase)”).
- By including an SRT Feature activation information element in an INFOrmation message with a null call reference (see Section 6.12, “G1 - Feature Key Management (Non-call related)”).

The network will reject the SRT enable request if the network determines that no user will receive alerting if this request is honored. The cause value #29, “facility rejected” will be contained in the rejection message.

6.67.3.10 Release Treatment

Once the call has reached the active state, the network may receive a release request from a user involved with the call.

If the network receives a DISConnect or RELease message from a user in the CA connected to the call, the network will determine if any other user in the CA is connected to the call. If this condition exists, the network will send a KEY RELease message to the EKTS user that sent the clearing message, release the B-channel associated with this user for this call, and retain the connection to the other EKTS users bridged onto the call.

After receiving the DISConnect or RELease message from an EKTS user connected to the call, if no other user in the CA is still connected to the call, the network will clear all EKTS members of the group associated with this call by sending a RELease message with cause value #16 “normal call clearing”. Normal call clearing is performed on the EKTS user that sent the clearing message and the remote user (see Figure 174, "Clearing of Entire Call when EKTS User Disconnects"). If the network receives a RELease COMplete message from a user in the CA, the network will clear the call to the particular user, but will only clear the entire call if no other member of the CA is connected to the call.

Figure 174 Clearing of Entire Call when EKTS User Disconnects

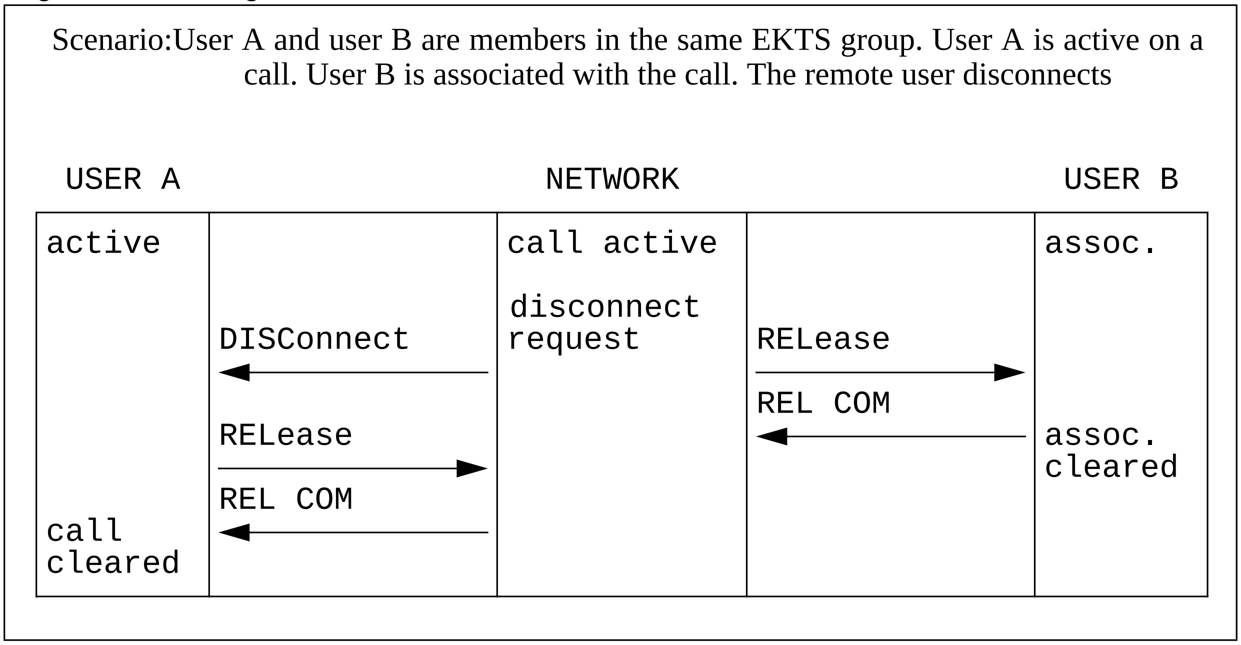
Scenario: User A and user B are members in the same EKTS group. User A is active on a call. User B is associated with the call. User A disconnects from the call. The entire call is cleared.

USER A		NETWORK		USER B
active		call active		assoc.
clear request	DISConnect →			
		clear entire call	RELease →	
	← RELease		← REL COM	assoc. cleared
call cleared	REL COM →			

If the network receives a DISConnect or RELease message from an associated user, the network will return a KEY RELease message. If the network receives a RELease COMplete message from an associated user, the network will clear the call reference for this call to this particular user.

If the release request is received from the remote user, the network will clear the entire call if the call is not bridged (see Figure 175, "Clearing of Entire Call when Remote User Disconnects"). If the call is bridged, the network will clear the remote user but maintain the bridge for the EKTS users. The privacy status will be enabled if not already enabled and the privacy status controller (if any) and other members will be notified of any privacy status change. The bridged EKTS users will also receive a NOTIFY message with a Notification indicator information element specifying “remote party disconnected”.

Figure 175 Clearing of Entire Call when Remote User Disconnects



6.67.4 Feature Interactions and Limitations for Non-Shared DN’s

The following features/options and Basic EKTS are mutually exclusive:

- Hunt groups other than Key Set Short Hunt

The following features are compatible with EKTS but have limitations:

- Call Forwarding subject to the following restrictions:
  - — only one primary member/EKTS group,
  - — only assigned to Primary DN,
  - — subsets can not include non primary EKTS group members,
  - — only the primary member, and those secondary members of an EKTS group that subscribe to Secondary Member Call Forward Programming, can program, activate and deactivate Call Forwarding,
  - — With CFD the entire group is rung for the data filled amount of time before the call will be forwarded,
  - — Entire call is forwarded, i.e. once a call is forwarded from an EKTS group, no member of that EKTS group may answer the call.

- Call Park - Only the member of the CA who parked the call will be re-rung. Only one call may be parked per CA. Call park cannot be invoked on a bridged call.
- Call Pickup - EKTS groups members are not restricted to belong to the same call pickup group or to belong to any group at all.
- Executive Busy Override (EBO) - EBO cannot be used to barge into a bridged call. EBO can be used to barge into a non-bridged call but bridging is not allowed after the barge in.
- The Single DN feature may be subscribed on an EKTS terminal. However, the Single DN is not allowed to be an EKTS Shared DN (e.g., MADN DN).
- Non-Initializing Terminals SPIDSs are not allowed to be EKTS terminals

Privacy release is not allowed if the external party is an attendant console or operator.

EKTS hold can interact with the following types of conference calls:

- Three-way calling
- Station controlled conference
- Attendant conference
- Preset conference
- Meet-me conference

6.67.4.1 Additional Call Offering

Additional call offering is not compatible with EKTS as a comparable capability is inherent to the normal call offering procedures within EKTS.

6.67.4.2 Flexible Calling

Please refer to Section 6.43, “Flexible Calling (FC)” for a description of the interactions between EKTS Shared DN and Flexible Calling.

6.67.5 EKTS Ring Forward (RF)

6.67.5.1 Definition

EKTS Ring Forward (RF) is similar to the MADN RF MDC feature. EKTS RF allows flexibility in the ringing (audible alerting) options that may be assigned to each CA of an EKTS DN.

When EKTS RF is assigned to an EKTS group, the following ring alerting options may be assigned to the individual appearances of the EKTS DN:

- Always - the EKTS appearance rings from the time the call completes to the group until it is answered or abandoned.

- Never - calls completing on the group never cause ring alerting for this appearance.
- Abbreviated - the appearance rings from the time the call completes on the group until it is answered, or abandoned, or until EKTS RF takes effect automatically or manually.
- Delayed - the appearance begins ringing when EKTS RF takes effect on the incoming call.

6.67.5.2 Procedures

- EKTS RF allows the forwarding of audible ringing for an incoming call terminating to an EKTS DN from one designated sub-group of CAs to another.
- Forwarding is invoked either automatically after a time-out, or manually or using a FA key, referred to as the MADN Ring Forward Manual (MRFM) key.
- The manual or automatic mode of operation is a subscription option assignable to an EKTS group.
- The user may override the automatic mode of operation by manual activation using the MRFM key.
- The MRFM key, and the list of EKTS DN appearances with which the key is associated, are designated at subscription time.
- A single MRFM key on a terminal can be used to activate EKTS RF for all EKTS DN appearances on the terminal having the EKTS RF option.
- An ISDN terminal can have more than one MRFM key assigned, and the keylist for the different MRFM keys can overlap.

6.67.5.3 Call termination

- The call offering procedures for EKTS calls are described in the previous sections on EKTS.
- Terminating calls are offered to each member of an EKTS group through a SETUP sent by the network.
- When EKTS RF is subscribed to for a particular EKTS DN, calls are offered to each terminal sharing it, using the Signal IE in the SETUP, coded according to the alerting option subscribed for each EKTS DN CA.
- After sending SETUPs, in addition to all normal call offering timers, the network starts the EKTS RF timer.
- If it expires, or manual RF is activated, and:

  — at least one user assigned abbreviated ringing, or

  — one user assigned delayed ringing responded positively to the SETUP(s), and is still receiving terminating treatment for the call.

  the network sends:

  — an INFOrmation containing a Signal IE indicating “alerting off” to each user assigned abbreviated ringing and still receiving terminating treatment, and

— “normal alerting” to each user assigned delayed ringing and still receiving terminating treatment.

The network cancels the EKTS RF timer when:

- the call is answered
- the call is to be cleared
- no user in the EKTS group assigned abbreviated or delayed ringing is receiving terminating treatment.

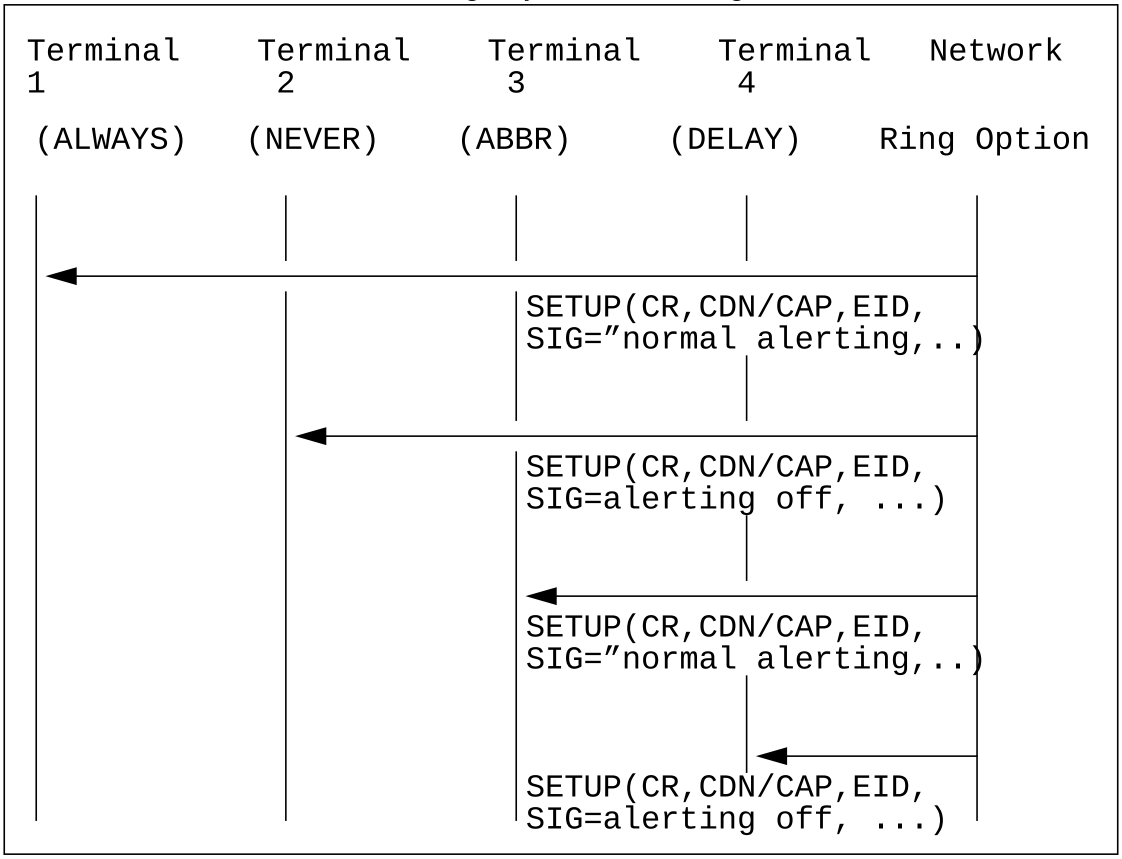
The timer value for automatic activation of EKTS RF is assignable for each EKTS group, and has a range from 0-60 s.

When EKTS RF is activated, only calls currently alerting on the associated EKTS group, that have not already had it activated against them, are affected. The following calls are not affected:

- subsequent incoming calls
- calls which have already had EKTS RF activated against them
- calls no longer in the ringing state
- calls ringing on other DNs on the activating terminal.

An example of the initial terminations on four different terminals is shown in Figure 176, “EKTS initial termination on a group with EKTS Ring Forward”. Each of the terminals, 1, 2, 3, and 4 has an appearance of the EKTS DN being terminated upon, with respective ringing option ALWAYS, NEVER, ABBReviated and DELAYed. The SETUP is sent from the network to each terminal with the Signal IE coded according to the subscribed ringing option as shown.

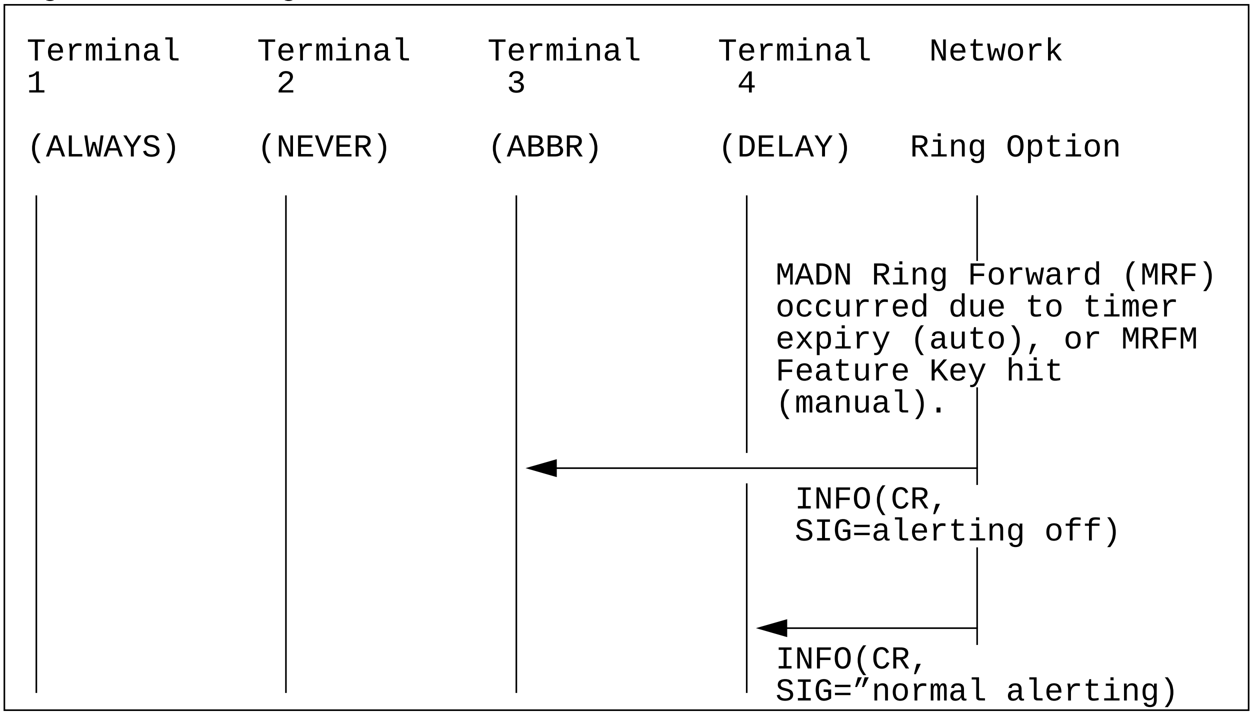
Figure 176 EKTS initial termination on a group with EKTS Ring Forward



In Figure 177, "EKTS Ring Forward occurred after initial termination", the Ring-Forwarding has just occurred due to either timer expiry (auto Ring-Forward), or MRFM feature key use (manual Ring-Forward). In this scenario:

- An INFOrmation, having Signal IE coded with value "alerting off", is sent to Terminal 3, that has ABBReviated ringing option, turning off the audible ringing on that set.
- Another INFOrmation with SIG="normal alerting", is sent to Terminal 4, that has DELAYed ringing option. This turns on the audible ringing. The other two Terminals (1 and 2) are not affected.

Figure 177 EKTS Ring Forward occurred after initial termination



6.67.5.4 Manual activation of EKTS RF

The message sequence, when a terminal tries to activate Manual EKTS RF, is shown in Figure 178, “EKTS Manual Ring Forward feature activation”. EKTS RF activation is only valid after one or more EKTS calls have been presented to the terminal activating this feature.

- The INFOrmation containing the FA for MRFM is sent when the user presses the MRFM key.
- The network screens to see if the activation is allowed.
- If it is, RF occurs on all the EKTS DNs affected by this MRFM key.
- If there are no FIs associated with the key, there is no message returned to the terminal to directly indicate activation success or failure.
- Indirectly, MRFM activation success or failure can be verified by the ringing change caused by RF.

Figure 178 EKTS Manual Ring Forward feature activation

```
Terminal                                Network
 X

  An EKTS call was presented to Terminal X.

- User hit MRFM key
  on Terminal X.
 ------------------------------------------->
                     INFO(CRd
                          FA=MRFM)

                                          -Screen for valid MRFM
                                           activation. If passed,
                                           will cause Ring
                                           Forwarding on all
                                           affected EKTS DNs.
```

6.67.5.5 Timers

EKTS-T1 is defined for the delayed and abbreviated ringing capability and has a range from 12-30 s, with a default value of 18.

6.67.6 EKTS Secondary Member CF programming

6.67.6.1 Definition

EKTS Secondary Member CF programming allows secondary members of an EKTS group to program, activate, and deactivate Call Forwarding. It is applicable to the basic EKTS and CACH EKTS services.

6.67.6.2 Procedures

- EKTS members are designated as either primary or secondary at subscription time, with one member of the group designated as the primary, and all others as secondary members.
- CF for the EKTS group is subscribed to by the primary member, and unless secondary members subscribe to EKTS Secondary Member CF programming, only the primary member can program, activate, and deactivate CF.
- EKTS Secondary Member CF programming allows the Call Forward Universal and Call Forward Intergroup variants of Call Forward List (CFX) and Call Forward for Directory Number Call Type (CFXDNCT) that can normally be programmed by the primary member to be programmed by a secondary member.
- For CFXDNCT, this feature applies only to voice call types.
- CF programming by a secondary member uses Dialed Access Codes (DCA) only.
- This feature is not permitted on Call Appearances which subscribe to an EKTS Call Appearance REServation type that prevents originating a call.

6.67.6.3 Feature activation and programming

EKTS Secondary Member CF activation and deactivation use procedures G8 and G7 respectively.

- To activate CF from a secondary EKTS member's terminal, select an appearance of a MADN DN, or originate a call by selecting the EKTS DN.
- Instead of dialing a destination DN, dial the feature access code to activate Call Forward Programming (CFP).
- A special dial tone is returned by the network.
- Dial the destination DN digits to which all subsequent calls is forwarded.
- Depending on whether or not the programming is successful, a confirmation or re-order tone is returned.
- If programming is successful, the network sends notification to the primary EKTS member, or CACH Controller, of CF activation. Only the primary member or CACH Controller may have CF on a feature key.

  Note: This feature does not alter in any way the operation of the Call Forward feature for a CACH Controller, even though it can override any current Call Forward setting set by the CACH Controller.

Figure 179, “EKTS Secondary Member Call Forward programming”, illustrates one of the sequences defined in procedure G8 (see Section 6.19, “G8 - Interactive Dial Access (Call Initiation Phase)” that may be used to activate CF.

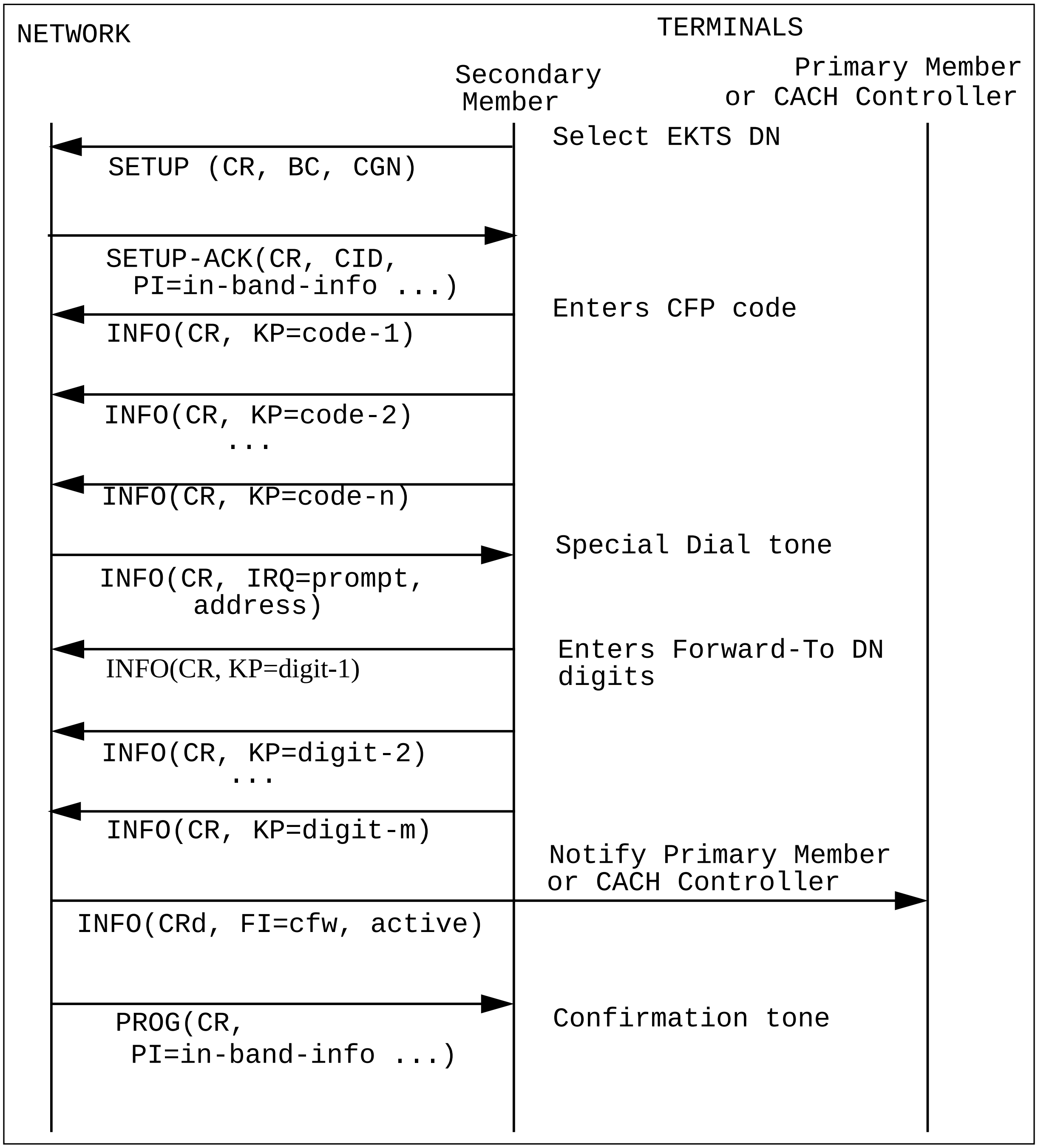
- Before entering the feature access code for CFP, originate a call by sending a SETUP to the network.
- The feature access code for CFP is then sent, using the KP IE contained in one or more INFOrmation messages.
- An INFOrmation indicating additional digits are required is returned, along with in-band special dial tone.
- Enter the forward-to DN digits; they are sent to the network using the KP IE contained in one or more INFOrmation messages.
- All methods of digit collection supported by DMS-100 for CFU/CFI are also supported for the Call Forwarding for MADN feature. These include:
  - Single Overlap Sending
    - Overlap
    - En bloc.
  - Dual Overlap Sending
    - Overlap followed by En bloc
    - En bloc followed by Overlap
    - currently supported methods for IRQ prompting for digits.
- If the activation is successful:

- the network sends a PROGress along with in-band confirmation tone to the secondary member's terminal
- the terminal of the primary member, or CACH Controller, is sent an INFOrmation to turn on the CF FI
- Reminder Rings are provided, if the CACH Controller subscribes to the service.

• If activation is not successful:

- the secondary member receives negative acknowledgment treatment (re-order tone) under either of the following conditions:
  - when CF was activated and the user attempts to activate it for the second time, or
  - when the secondary member entered the feature access code but was not subscribed to EKTS Secondary Member CF, or
  - when another member has already entered the CF programming or deactivation state and the DMS-100 has not completed processing the first request. In this case, the second requestor is provided a re-order tone and ISDN sets are sent cause value #29, “facility rejected”.

Figure 179 EKTS Secondary Member Call Forward programming

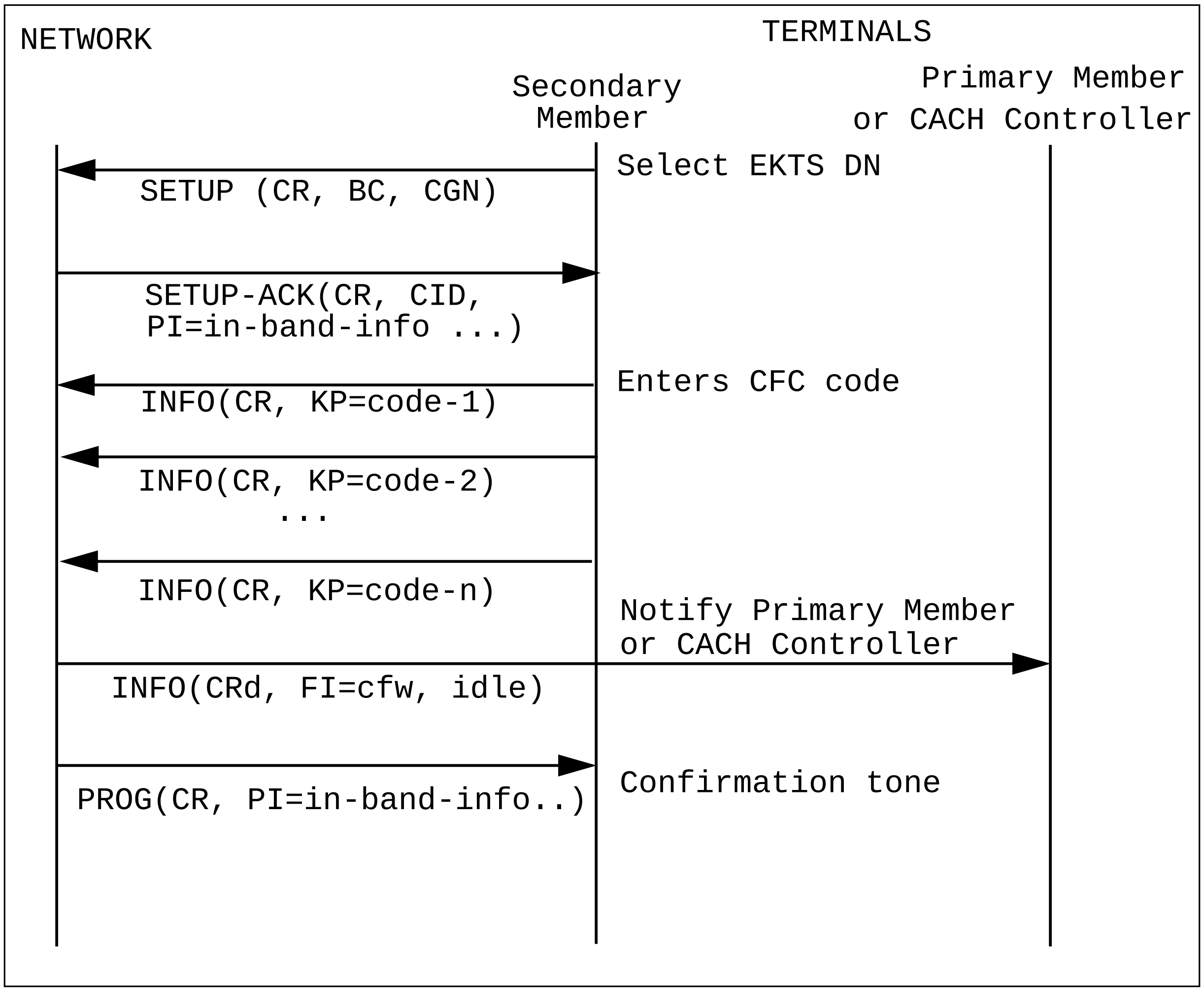


6.67.6.4 EKTS Secondary Member Call Forward cancellation

Figure 180, “EKTS Secondary Member Call Forward cancellation”, shows the exchange of messages across the user-network interface when CF is cancelled by a secondary EKTS member.

- To cancel CF, select an appearance of the EKTS DN or MADN, and enter the FA code for Call Forward Cancellation (CFC).
- When the cancellation is completed, an in-band confirmation tone is heard, and the primary member (or CACH Controller) terminal is sent an INFOrmation to turn off the CF FI.

Figure 180 EKTS Secondary Member Call Forward cancellation



6.67.7 Electronic Key Telephone Service Intercom (EKTS-ICM)

6.67.7.1 Definition

EKTS Intercom (ICM) is based on the MDCGIC feature that allows a user, upon selecting the appropriate intercom group, to directly terminate on a pre-designated terminal.

6.67.7.2 Procedures

A terminal subscribed to the ICM feature must support the terminal identification procedures as described in Chapter 5.

6.67.7.3 Originating operation

- The originating user invokes ICM by sending a SETUP with the CA IE corresponding to the selected ICM group to the network as shown in Figure 181, “Intercom call origination”.
- The network returns a CALL PROCeeding to the user to indicate that the call is being processed.
- If an invalid intercom group is included in the CA IE, the network rejects the CAR by sending a RELease COMplete having cause value #50 “requested facility not subscribed”.
- Follow normal call establishment procedures as defined in Chapter 5.

Figure 181 Intercom call origination

Scenario: Terminal is idle. The user initiates a ICM call for intercom group #x.

USER/TERMINAL	MESSAGE	NETWORK
ICM call request for intercom group #x	SETUP (CRn, BC, CAP=x) ⟶	
connect B–ch	CALL PROC (CRn, CID=B–ch) ⟵	connect B–ch
	Note	

Note: Normal call establishment occurs, with the messages specified in Chapter 5.

6.67.7.4 Terminating operation

The network offers the intercom call by sending a SETUP with the following information:

- channel identification IE specifying “no channel”
- EID IE specifying the terminal to which the ICM call is directed
- CA IE specifying the selected intercom group

A call answered by the terminating user results in the terminal using normal call establishment procedures as defined in Chapter 5, as shown in Figure 182, “Intercom call termination”. The only difference being that the B-channel is selected upon answer (for example, with the CONNect and CONNect ACKnowledge) as described in the ACO feature (see Section 6.28, “Additional Call Offering (ACO)”.

Figure 182 Intercom call termination

Scenario: Terminal is idle. The user receives a ICM call for intercom group #x.

USER/TERMINAL	MESSAGE	NETWORK
intercom call offered	SETUP(CRn, BC,CID=no ch, EID, CAP=x) ←	incoming intercom call
	ALERTing (CRn) →	
call answered	CONNect (CRn) →	connect call
intercom call connected	CONNect ACK (CRn, CID=B–ch) ←	

If the destination terminal is busy, the terminating user can accept the ICM call by freeing up a B-channel (that is, using the HOLD) before and sending a CONNect in response to the incoming SETUP.

If the user does not answer within two seconds, the terminal makes an automatic connection and sends a CONNect to the network.

6.67.8 Feature interactions and limitations

The only feature compatible with ICM is Hold and Retrieve.

6.67.9 Electronic Key Telephone Service Group Intercom (EKTS-GIC)

6.67.9.1 Definition

EKTS GIC is based on the MDC GIC feature that enables a customer to terminate, using abbreviated dialing, on a member of a pre-designated group.

An intercom group can have a maximum size of:

- 10 members - who dial a single digit (0-9) to reach others in their group
- 100 members - who dial a 2-digit ***number*** (00-99)
- 1000 members - who dial a 3-digit ***code*** (000-999)
- 10,000 members - who dial a 4-digit ***code*** (0000-9999)

An ISDN set can be a member of several different GIC groups. However, each group must be represented by its own GIC identifier.

The DMS switch accommodates a maximum of 4095 GIC groups. These can all be assigned to one large customer group, or can be spread across a number of them. Only sixteen GIC identifiers can be downloaded to a terminal using parameter downloading.

6.67.9.2 Procedures

These procedures are based on the intercom capabilities described in GR-205-Core Issue 1, Revision 1, *ISDN Electronic Key Telephone Service*.

A terminal subscribed to GIC must support the terminal identification procedures as described in Chapter 5.

6.67.9.3 Originating operation

- The originating user invokes the GIC feature by sending a SETUP, with the CA IE corresponding to the selected intercom group, to the network as shown in Figure 183, “Group intercom call origination”.
- If En bloc dialing procedures are used, the user also includes the intercom address in a KP IE in the SETUP.
- If Overlap procedures are used, the network returns a SETUP ACKnowledge to allow the user to enter the GIC address, sending the appropriate number of address digits using the KP IE contained in one or more INFOrmation(s).
- If an invalid intercom group is included in the CA IE, the network rejects the CAR by sending a RELease COMplete containing cause value #50 “requested facility not subscribed”.

6.67.9.4 Terminating operation

If there is no active intercom call on the selected intercom appearance, the network offers the intercom call by sending a SETUP with the following information:

- channel identification IE specifying “no channel”
- EID IE specifying the terminal to which the GIC call is directed

- CGN IE containing the originating intercom address
- CA IE specifying the selected intercom group

The terminating user answers the call by using normal call establishment procedures as defined in Chapter 5, as shown in Figure 184, “Group intercom call termination”. The only difference being that the B-channel is selected upon answer (for example, with the CONNect and CONNect ACKnowledge), as described in Section 6.28, “Additional Call Offering (ACO)”.

If the destination terminal is busy, the terminating user can accept the GIC call by freeing up a B-channel (that is, using the HOLD can not) before, and sending a CONNect in response to the incoming SETUP.

Figure 183 Group intercom call origination

Scenario: Terminal is idle. The user initiates a GIC call for intercom group #x.

USER/TERMINAL	MESSAGE	NETWORK
GIC call request for intercom group #x	SETUP (CRn, BC, CAP=x) →	
connect B–ch	SETUP ACK (CRn, CID=B–ch) ←	connect B–ch
user enters 1st intercom address digit	INFO (CRn, KP=digit) →	
user enters remaining digits	INFO (CRn, KP=digit) →	
	:	
	CALL PROC (CRn) ←	intercom address complete
	Note	

Note: Normal call establishment occurs with the messages specified in Chapter 5.

Figure 184 Group intercom call termination

Scenario: Terminal is idle. The user receives a GIC call for intercom group #x.

USER/TERMINAL	MESSAGE	NETWORK
intercom call offered	SETUP (CRn, BC,CID=no ch, CGN, EID, CAP=x) ←	incoming intercom call
	ALERTing (CRn) →	
call answered	CONNect (CRn) →	connect call
intercom call connected	CONNect ACK (CRn, CID=B–ch) ←	

6.67.10 Feature interactions and limitations

- All members of an GIC must be members of the same customer group.
- AUD may be used, but only destinations within the GIC may be programmed and used for GIC calls.
- A CPU group may be composed of a mixture of DN and GIC appearances. A DN may be used to pick up a call directed to a GIC appearance, and similarly a GIC appearance may be used to pick up a call to a DN.
- EBO is supported for GIC calls.
- FC is supported for GIC calls. GIC and DN calls may be bridged together, and calls may be transferred between GIC and DN appearances.
- Hold and Retrieve is supported for GIC calls.
- MSB may be applied selectively to GIC appearances.
- PRK is supported for GIC calls, but the parked call must be retrieved from a member of the GIC group.
- RAG and call back queuing are supported for GIC calls. GIC calls are only recalled on GIC appearances.
- SC user is supported for GIC calling, but only destinations within the GIC group may be programmed and used for GIC calls.

The following features are not supported for GIC calls:

- additional call offering
- AUL
- CF
- CF validation
- DN hunting
- EBO exempt
- ESB
- feature code access
- last number redial
- loudspeaker paging access
- EKTS shared-DN

6.68 Key Set Short Hunt (KSH)

6.68.1 Key Set Short Hunt

6.68.1.1 Definition

Key Set Short Hunt allows incoming calls to hunt through a set of DN appearances on an ISDN terminal for an idle DN on which to terminate.

This feature is also applicable to EKTS. The set of DNs to be hunted over may include all of, or a subset of, the DN appearances on a terminal, and need not appear consecutively.

- The hunting for an idle appearance starts with the dialed DN and hunts up the given keys from there, where up means of increasing key value.
- Hunting is not circular, and stops either once an idle DN is found, or the hunt list following the dialed DN is exhausted.
- If the hunt list is exhausted without finding an idle DN, an optional overflow DN or overflow route is terminated on.
- If no overflow DN or route is assigned for the hunt list, the calling party receives busy treatment.

6.68.1.2 Feature activation

This feature is subscribed to by the end user on a service profile basis.

6.68.1.3 Feature interactions and limitations

- Only one hunt list is allowed per EKTS terminal.
- The hunt list may not contain ICM or GIC members.
- A given DN can not appear in more than one short hunt group or any other type of hunt group.
- The same DN may therefore not be a member of both a short hunt group and a DNH hunt group. It should only be included if it is to be hunted over.
- Any EKTS member appearance in the hunt key list must be the primary member of that EKTS group.

Chapter 7: Data services

7.1 Introduction

This chapter describes ISDN Data services offered by Nortel's ISDN switch, from the point of view of any basic rate (2B+D) user-network interface.

- Data services encompass both CMD and PMD services, as set forth in the 1988 CCITT I-Series of Recommendations.
- The PMD services are provided by the DMS Packet Handler (DMS PH).
- DMS PH is a packet handler for the DMS-100 product family that provides a full featured X.25 packet services for ISDN B and D channels. It is an integral component of the Nortel Networks ISDN switch, capable of providing Bellcore TR compliant packet services.
- The DMS PH provides the protocol engines (X.25/X.75/X.75') required for packet switching. It relies on the common DMS operations, maintenance and provisioning systems to provide all OA&M functions.
- The data services description uses the principles and terminology of CCITT Recommendations X.200 and X.210, the reference model for Open Systems Interconnection.

This chapter includes the specification of:

- PMD services on semi-permanent (provisioned at subscription time) B-channel(s)
- PMD services provisioned on the D-channel
- CMD services available on-demand to user-network B-channel(s).

The Nortel Networks ISDN switch provides full flexibility with respect to data services' access by any basic rate interface. Data services can be offered to any user-network 2B+D interface on either, or both, of its two B-channels as well as on its one D-channel, simultaneously.

The following is a list of the ISDN PMD services to be offered:

- D-channel packet mode access for X.25 terminal equipment using CCITT LAPD (per Chapter 4 of this document) at the data link layer (layer 2) and 1988 CCITT X.25 packet level protocol (layer 3).

- B-channel packet mode access for X.25 terminal equipment using 1988 CCITT LAPB at layer 2 and 1988 CCITT X.25 at layer 3.
- Circuit mode data transport providing a transparent point-to-point 64 kb/s connection on a B-channel.

Packet terminals which support D-channel packet service (SAPI 16) must use static TEIs.

- In addition, two TEIs are required for integrated circuit switched - D-channel packet mode terminals (static TEI for packet access).
- However, in the future, support will be provided to allow integrated circuit - D-channel packet terminals to share a single TEI.

Note that rate adaption for the CMD service on B-channels is the responsibility of CPE Terminal Adaptor (TA) equipment. In general, rate adaption is an area where many standards have been proposed without the emergence of a clear consensus. For CMD service on a B channel, the ISDN connection is effectively transparent to any rate adaption protocol adopted by TA equipment.

One example of such a rate adaption standard is the Nortel Networks T-link protocol, as implemented in Datapath equipment. Details on the T-link protocol specification and its implementation are available from Nortel Networks.

The ISDN PMD services, as described above, will be augmented by future enhancements to include additional capabilities and packet mode services:

- PMD services available On-Demand to user-network B-channels (CCITT Recommendation X.31 Case B). Specifically, the following future enhancements are planned:
  - — On-demand B-channel connections (Call Origination)
  - — On-demand B-channel connections - Conditional Notification (Call Termination)

7.2 Physical layer specification

This section describes rate adaption protocols and procedures necessary for non-ISDN terminal equipment to access ISDN data services on the B-channel(s) of any user-network 2B+D interface.

For a specification of all other areas of layer 1, refer to Chapter 3.

7.2.1 Rate adaption

- Rate adaption for B-channels is a process whereby bit streams having speeds less than 64 kb/s are increased to 64 kb/s at layer 1.
- It is necessary for ISDN data services' access by terminal equipment operating at speeds less than 64 kb/s.
- The preferred method of rate adaption, for packet mode services, is HDLC interframe flag stuffing as specified by 1988 CCITT Recommendation X.31. This method is supported for X.25 LAPB services.

- For 56 kb/s terminal equipment accessing PMD services, the preferred method of rate adaption is to increase the clocking rate to 64 kb/s.
- Rate adaption for the CMD services on B-channels is the responsibility of CPE TA equipment.
- For CMD service on a B-channel, the ISDN connection is effectively transparent to any rate adaption protocol adopted by TA equipment.
- For CMD service interworking with PSDS (see Section 7.5.1, “Interworking with Public Switched Digital Service (PSDS)”), use rate adaption, as specified in CCITT V.110, for 56 kb/s terminals for compatibility with the 56 kb/s BC of PSDS.

7.3 Data link layer specification

The data link layer specifications for both B- and D-channel data services are described in this section.

7.3.1 Data link layer specification - B-Channel

Base the layer 2 protocol for X.25 packet mode data on the B-channel on CCITT 1988 (Blue Book) X.25 - LAPB (Link Access Procedure, Balanced).

Circuit mode data services on the B-channel are handled transparently by the ISDN switch. It shall be the responsibility of CPE TA equipment to implement an appropriate protocol at layer 2 and above.

7.3.1.1 LAPB specification

The data link layer protocol for X.25 packet mode data on the B-channel is fully compatible with CCITT 1988 LAPB and Bellcore GR-301.

7.3.1.1.1 LAPB system parameters

CCITT Recommendation X.25 defines several LAPB system parameters without specifying their values. The following values will be supported by the Nortel Networks ISDN PH which are in compliance with as defined in GR-301.

- Timer T1 specifies the period after which transmission of any frame may be repeated:
  - the default value for T1 is 2 s
  - adjustment range from 1-20 s
  - adjustment increment = 0.5 s
- Timer T2 indicates the f time available before the acknowledging frame must be initiated to ensure its receipt by the DTE or DCE. The parameter T2 range lies between 0- 0.4 s.
- Idle channel Timer T3 is a time period for which LAPB may stay idle before channel state condition is passed to the packet layer for failure procedures. The value of T3 varies from 1-30 s, in 1 s increments, with a default value of 5 s.
- The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency) is specified by parameter N1, and is set at 2120 bits, for a maximum packet size of 256 octets.

- The maximum number of attempts to complete a successful transmission is specified by parameter N2, with the following values:
  - — default of 3
  - — adjustment range from 2-15
  - — adjustment increment = 1
- The maximum number of outstanding (unacknowledged) I-frames (k) shall be:
  - — 7 and 127 for modulo 8 and 128 frame sequencing respectively
  - — adjustment range from 1-7 (modulo 8) and 8-127 (modulo 128)
  - — adjustment increment = 1
  - — the default value would be modulo 8 with a link level window size of 7

7.3.2 Data link layer specification - D-channel

The layer 2 protocol for X.25 PMD service on the D-channel is based on 1988 CCITT Recommendations Q.920 and Q.921 - ISDN user-network interface data link layer specification, and it is compliant to the ISDN D-channel Exchange Access Signalling and Switching requirements, TR-TSY-000793. A subset of LAPD shall be used, as defined by Chapter 4, together with the following provisions:

- Use multiple frame operation on packet (SAPI = 16) links.
- Initially, pre-assigned TEIs (manually established at subscription time) are supported for one or multiple packet mode data terminals on the subscriber D-channel, for both SVCs and PVCs.
- It is the responsibility of the terminal equipment (TE or CPE TA) to ‘remember' pre-assigned TEIs, and to supply only those values when establishing data link(s) with the network.
- Determine link layer parameters at subscription time. Parameters use the ranges and defaults specified in Chapter ranges and defaults specified in Chapter 4.
- Provide a separate, longer timer (T200 in Chapter 4) for packet data links, since signaling links have priority status.
- Unacknowledged information (UI) transfer procedure are not supported for packet links.
- View terminals as disconnected from the D-channel of the 2B+D loop whenever the logical link(s) to the ISDN switch are disconnected.
  - — When D-channel packet mode service is first initialized, the network attempts to establish a logical link to the terminal by transmitting SABME.
  - — When the terminal is attached to the loop, it should also try to establish a logical link with the switch by sending SABME.

This procedure is recommended since incoming calls destined for a terminal that is ‘disconnected’ (from the network) is cleared by the network.

7.4 Network layer X.25 PMD services

This section describes the X.25 PMD transport service offered by the Nortel Networks ISDN switch. The service is available for both B- and D-channels at the basic rate user-network interface.

7.4.1 Packet Device Configuration on BRI

See Chapter 2:, "ISDN BRI Configurations" for information on packet device configurations.

7.4.2 General considerations

The network layer procedures implemented by the Nortel Networks ISDN PH conform to CCITT Recommendation X.25, and Bellcore technical recommendations as defined in GR-301 and TR-846. Both B and D-channels access provide for 1988 version of X.25 at layer 3.

In this subsection, the term DTE/DCE interface, as described in Recommendation X.25, refers to a logical link within a D-channel of the basic rate user-network interface, or to the single logical link (specified by LAPB) within a B-channel.

In general, ISDN X.25 users have access to the same packet mode services as dedicated X.25 users in a Public Packet Switching Network (PPSN).

- Initially, provision (semi-permanent) both B- and D-channel X.25 packet mode data services at subscription time.
- Thus for PMD transfer across the DTE/DCE interface, there must be a logical link on the desired channel.
- Should an incoming call arrive at the PH, destined for a loop with no logical links established between terminal and PH, the PH clears the incoming call by sending a ‘clear indication’ packet to the calling DTE.
- When a logical link is established by exchanging SABM (or SABME) and UA, the PH sends a ‘Restart Indication’ packet to the terminal to initialize the network layer before processing any Call Request packet.
- The Nortel Networks ISDN switch supports a very comprehensive set of packet level facilities. The facilities supported include most of the 1988 X.25 optional facilities.

7.4.3 Types of calls

There are two types of packet mode data calls available to users on the user-network interface, Switched Virtual Call (SVC), and Permanent Virtual Circuit (PVC) calls.

- A virtual circuit is the bi-directional association between two DTEs over which all data transfer takes place.

- When a packet mode data call is established between two DTEs, the combination of logical channels and switch resources used is termed a virtual circuit.
- Virtual circuits differ from conventional circuits in that network bandwidth is allocated only when data or control packets are actually being transferred.

7.4.3.1 Switched Virtual Call (SVC)

- Switched Virtual Call allows a user to set up a virtual circuit for the transfer of data on an as-needed basis.
- The virtual circuit is up only for the duration of the call.
- A DTE initiates the call setup procedure when it has data to transfer to another DTE, and when communications are complete, the call clearing procedures are initiated to disconnect the virtual connection.

7.4.3.2 Permanent Virtual Circuit (PVC) call

PVC call, in contrast, is a permanent association between two DTEs. Each end has a logical channel pre-assigned for a PVC, and the virtual circuit setup information is stored as datafill in the ISDN switch PH. A PVC is established as soon as the system comes up, thus eliminating call setup and clearing by the DTE.

7.4.4 Logical channels

The network layer of X.25 provides for concurrent operation of several calls over a single logical link. This is accomplished by the use of logical channels. The maximum number of simultaneous calls possible on a logical link corresponds to the number of logical channels provisioned for that link.

7.4.4.1 Logical channel range

Four types of logical channels and their ranges must be chosen at subscription time. Base this selection on the number of simultaneous calls or users to be permitted on a particular access line. Over assignment of logical channels not only wastes switch resources, but may allow degradation of response time if the access link is over-used.

The four types of logical channels are:

1 PVC logical channels

2 one-way incoming logical channels for SVCs

3 two-way logical channels for SVCs

4 one-way outgoing logical channels for SVCs.

- DMS PH supports up to 64 and 512 logical channels on D and B-channel respectively.
- Logical channel 0, both on D and B-channel, is reserved for control packets that affect the entire interface (restart and diagnostic packets).
- Note that while the logical channel range defined at subscription time varies:

- 1-63 on D-channel
- 1-511 on B-channel

- The logical channel range defined may reside anywhere between 1-4095 for both B and D-channels, and the range must be continuous.
- When initiating a call:
  - the DTE selects the highest numbered free logical channel for an outgoing call
  - the DCE selects the lowest numbered free channel for an incoming call

  This procedure is defined to minimize call collision probability.

7.4.5 Sequenced data transfer

Sequenced data transfer means that data packets are delivered to the user in the same sequence as they were transmitted, and without duplication or loss. Both modulo 8 and modulo 128 packet sequence numbering are supported.

7.4.6 X.25 facilities

This section contains a list of the X.25 facilities (or ‘services’) available at the user-network 2B+D interface, as defined in the Optional User Facilities (section 3.2.6) of the GR-301, and *ISDN X.25 Supplementary Services* (TR-TSY-000846). All facilities are available for both B- and D-channel access. The subscription parameter values for the supported facilities are listed in the Section 7.6, “X.25 subscription parameter values”, of this document.

7.4.6.1 X.25 facilities supported

- Incoming Calls Barred
- Outgoing Calls Barred
- One-way Logical Channel Incoming
- One-way Logical Channel Outgoing
- Non-standard Default Packet Sizes
- Non-standard Default Window Sizes
- Default Throughput Class Assignment
- Flow Control Parameter Negotiation
- Throughput Class Negotiation
- Closed User Group
- Closed User Group with Outgoing Access
- Closed User Group with Incoming Access
- Closed User Group with Outgoing Acesss/Incoming Access
- Fast Select and Fast Select Acceptance
- Reverse Charging and Reverse Charging Acceptance
- Local Charging Prevention
- RPOA Selection

- RPOA Selection Barred
- IC Preselection
- Hunt Group
- Called Line Address Modified Notification (CLAMN)
- Transit Delay Selection and Indication
- CCITT Specified DTE facilities

7.4.6.2 Additional facilities

In addition to the above-mentioned facilities, following facilities are planned for future:

- User Testing Facilities (DTE may call itself) - Future release
- Network User Identification (NUI) - CCN Format
- Direct Call

7.4.6.3 Facilities not currently planned

The following is a list of the facilities currently not supported at the basic rate user-network interface:

- Charging Information
- NUI Override
- Reverse Charging barred
- Internetwork Calls barred
- 1980 X.25 DTE Support

7.4.7 Addressing

- The DMS-100 ISDN switch supports the E.164 numbering plan for packet mode terminals.
- Each packet mode terminal at the user-network interface is assigned a unique address or subscriber number (maximum 10 digits).
- For example, if there are two packet mode terminals in the user-network interface, one using the B-channel and the other using the D-channel, each terminal is assigned a different subscriber number.
- There is a need for the interworking of DTEs on the PPSN and the packet mode terminals on the ISDN.
- The use of escape codes has been standardized by CCITT and is the mechanism for interworking between X.121 and E.164 numbering plans.
- The following provides address formats for different interworking configurations:
  - — ISDN-to-ISDN - For calls between ISDN users, the calling user specifies the called address as: <subscriber number>. This address format requires prefixes to distinguish local, 10-digit, and international calls.

— ISDN-to-PPSN - For calls originating, from an ISDN user, destined for a user in a PPSN, the calling user specifies the called address as: <escape code 0> <DNIC of PPSN> <Network Terminal Number>.

— PPSN-to-ISDN - For calls originating from a PPSN user and coming into an ISDN over X.75' interface, the called address format is: <Escape code 0 or 9> <E.164 subscriber number>.

Support of Double escape code (0+9) is supported as identified in TR-TSY-000448. Treatment of the double escape code (0+9) may be one of the following three options:

1 double escape code sequence allowed

2 double escape code sequence not allowed

3 double escape code allowed but ‘ignored’.

Initially, DMS-PH supports the first two options.

7.4.8 User maintenance capability

This capability is supported on DMS-PH in a future release as described below.

User Self-Testing Capability - A user may be able to place a virtual call to its own address on BRI (packet service), even if the interface is configured for the incoming calls barred. If a user places a virtual call to its own address, the DCE/PHF should perform incoming call logical channel selection in the usual manner.

7.5 Circuit Mode Data services

- Transparent circuit switched service provides a point-to-point, 64 kb/s connection between two ISDN B-channel terminals.
- The service is referred to as ‘transparent’ because the network performs no encoding or decoding of the information within the channel.
- In addition circuit switched connections between ISDN B-channel users and users connected to a PSDS are possible.
- Network layer call control procedures are as specified in Chapter 5.

7.5.1 Interworking with Public Switched Digital Service (PSDS)

- Public Switched Digital Service is the generic name for 56 kb/s circuit switched data.
- Service on non-ISDN networks has a restricted bearer capability, that is it can only support connections up to 56 kb/s.
- An ISDN user wishing to interwork with this service must arrange a unique DN for this capability with the ISDN network administrator. The ISDN switch will associate the restricted BC with this DN for both outgoing and incoming calls.

- To support interworking with PSDS, implement CPE rate adaption by setting the least significant bit of the B-channel byte to ‘one’, as specified by CCITT recommendation V.110.

7.6 X.25 subscription parameter values

- ISDN X.25 features are provided through the provisioning of ISDN X.25 service parameters, as identified in GR-301 and TR-846. These services represent the layer 2/3 service parameters and optional facilities.
- ISDN parameters are provisioned against a DN/Call Type, DN/Channel Type, or PVC basis.
- CT refers to circuit-mode, packet-mode or voice-band services. Parameters provisioned against these CTs are termed CMD, PMD, or VI information.
- Channel type refers to the B or D-channel, and is a refinement of the PMD only.

  The rest of the section provides information on the layer 2, layer 3 and optional user facilities parameters. For each of the listed parameter provisioning basis (that is, DN/Call type, DN/Channel type), range of values and defaults are provided.

Table 176, "X.25 Layer 2 parameters-LAPB only" defines the layer 2 (Link level) parameters:

Table 176 X.25 Layer 2 parameters-LAPB only

Parameter	Provisioning	Range	Default
Link Level Frame Sequencing	DN/Channel	MOD 8 or MOD 128	MOD 8
Link Level Window Size	DN/Channel	1 - 7 or 1 -127	7
Acknowledgment Timer (T1)	DN/Channel	1 - 20 s	2 s
Response Timer (T2)	DN/Channel	0 - 4 s	2 of 100 ms
Idle Channel Timer (T3)	DN/Channel	1 - 30 s	5 s
Max. re-transmissions (N2)		2 -15	3

Table 177, "X.25 layer 3 parameters,” on page 627, lists the packet level parameters. It also defines the logical channel assignment sub-parameters, that is, the assigned logical channels for each type of service, at the time of subscription.

Table 177 X.25 layer 3 parameters

Parameter	Provisioning	Range	Default
Packet Level Sequencing	DN/Call type	MOD 8 or MOD 128	MOD 8
Start logical channel number	DN/Channel	1 to 4095	1
Number of Permanent Virtual Circuits	DN/Channel	0 - 511 B-chn, 0 - 63 D-chn	0
Number of one-way incoming logical channel	DN/Channel	0 - 511 B-chn 0 - 63 D-chn	0
Number of non-restricted channel	DN/Channel	0 - 511 B-chn 0 - 63 D-chn	1
Number of One-way Outgoing logical channel	DN/Channel	0 - 511 B-chn 0 - 63 D-chn	0

Table 178, "X.25 - Optional user facilities" defines X.25 optional user facilities and their values.

Table 178 X.25 - Optional user facilities

Parameter	Provisioning	Range	Default
Incoming calls barred	DN/Calltype	Yes or No	No
One way Incoming LC subscribed	DN/Channel	Yes or No	No
One way Outgoing LC subscribed	DN/Channel	Yes or No	No
Non-standard Default Packet size	DN/Channel	Yes or No	No
Incoming Maximum Packet size	DN/Channel	16,32,64,128,256 for B/D channel	128
Outgoing Maximum Packet size	DN/Channel	16,32,64,128,256 for B/D channel	128
Non-standard default Window size	DN/Calltype	Yes or No	No
Incoming Packet layer Window size	DN/Calltype	1-7, 1-127	2
Outgoing Packet layer Window size	DN/Calltype	1-7, 1-127	2
Default TC Assignment	DN/Channel	Yes or No	No
Incoming Default TC Assignment	DN/Channel	up to 64kb/s on B-channel, up to 9.6 kb/s on D-channel	None
Outgoing Default TC Assignment	DN/Channel	up to 64kb/s on B-channel, up to 9.6kb/s on D-channel	None
Flow Control parameter Negotiation	DN/Channel	Yes or No	No
Throughput Class Negotiation	DN/Channel	Yes or No	No
Closed User Group Subscription	DN/Channel	Yes or No	No
Fast Select Acceptance	DN/Channel	Yes or No	No
Reverse Charging Acceptance	DN/Channel	Yes or No	No
Local charging Prevention	DN/Channel	Yes or No	No
RPOA Selection Barred	DN/Channel	Yes or No	No
IC Preselection	DN/Channel	Yes or No	No

Chapter 8: Subscription parameters

8.1 Introduction

This chapter provides a list of some of the subscription parameters that must be supported for the functional ISDN BRI.[1] It is included in this specification to provide one common source for guidance to terminal designers and users on the configurable attributes of the DMS-100 ISDN BRI. These parameters provide for the characterization of an ISDN basic interface arrangement on the DMS-100. They are categorized into the following groups:

> ***Note:*** A directory number may be associated with one or more service profiles. See Section 8.6, "Parameters per Directory Number", for a description of directory number assignments.

8.2 DMS office parameters

- Layer 2 system parameters
- Q.931 layer 3 timer values
- Layer 2 system parameters - a list of layer 2 system parameters (LAPD) such as protocol timers and re-transmission counters are specified in Chapter 3
- Q.931 layer 3 timer values - a list of layer 3 timers and their default values are given in Chapter 4
- AutoSPID capability - indicates whether Automated SPID is enabled for the switch.

8.3 Interface parameters/characteristics

The following parameters specify the characteristics of the ISDN BRI. They are not changeable by switch administration.

- configuration
- number of B-channels
- maximum number of service profiles

1. For information on subscription parameters for stimulus applications contact Nortel Networks.

- maximum number of TEIs allowed
- D-channel data rate
- Configuration - is always point-to-multipoint, that is, the network always sends a broadcast SETUP.
- Number of B-channels - defines the maximum number of B-channels supported by the interface; the value is 2.
- Maximum number of service profiles - defines the maximum number of service profiles that may be associated with a BRI; the value is 8.
- Maximum number of TEIs allowed - defines the maximum number of TEIs allowed on the physical interface.
  - — Pre-assigned TEI values may be selected from the range 0-63, while dynamic TEI values are in the range 64-126.
  - — This parameter is defined on an interface basis for resource allocation purposes; the allowed value is 8.
- D-Channel data rate - defines the D-channel data rate to be 16 kb/s, and handles call control signaling and packet data.
- 1B fully initializing terminal (FIT)
- 1B non-initializing terminal (NIT)
- Two B-channel FIT and NIT
  - — Switch Static provisioned TEI assignment is not supported on the 2B-channel terminal.
- SPID initialization capabilities
  - — SPID assignment is required whenever an Automatic TEI assignment is completed, and the TSP is provisioned as an initializing terminal. SPID assignment and initialization is not required for NITs.
- For a 2 B-channel FIT, only a single SPID is required for circuit mode access.
- Single DN capability - In the previous ISDN product (prior to NA007) a DN was allowed to subscribe to both CMD and VI CTs for alternate voice and data service on a single B-channel.
  - — This feature extends this capability to allow the Single DN to be used for two active B-channel calls.
  - — The enhanced Single DN capability is made available to both FITs and NITs which subscribe to the 2 B-channel access, have AFC and ACO-U provisioned, and have CMD CT subscribed on that DN.
- CT provisioning on a DN basis - On one B-channel terminals, provisioning of CTs on a DN basis is not supported.
  - — CT provisioning is only allowed on a terminal basis.
  - — For 2B-channel terminals, CT provisioning is provided on a DN basis.

- — The 2 B-channel terminal continue to support the assignment of multiple DNs. Each of these DNs may subscribe to the VI the CMD or both CTs.
- — The introduction of CT provisioning does not effect the provisioning of any current features.

8.4 TSP parameters

The following subscription parameters are service related and are specified on a TSP on the interface.

8.4.1 Signaling type

Signaling Type defines the type of signaling capabilities supported on the interface. The allowable parameters are defined in Section 5.5.7.3, "Protocol Version Control information element".

8.4.2 Number of TEIs

This parameter defines the number of TEIs the TSP supports.

8.4.3 Type of TEI

Type of TEI specifies whether each TEI is fixed or dynamic.

8.4.4 List of valid fixed TEIs

This parameter defines the list of valid fixed TEIs for the TSP. The values are in the range 0 - 63. The list size must be less than or equal to the number of TEIs supported by the service profile.

8.4.5 Terminal Service Profile Identifier (TSPID)

TSPID identifies the terminal service profile used by a dynamic TEI terminal, and is contained within the SPID IE which is exchanged during the terminal initialization procedures.

The TSPID can have any character string value, from 1 to 18 characters. Each TSPID must be unique on an interface. Although not required, the service provider may choose to make each TSPID unique on the switch. In addition, the service provider may choose to format it so that it follows the Generic format recommended by Bellcore: the primary DN of the TSP followed by a two-digit sharing terminal ID.

8.4.6 Authorized call types

This specifies the CTs that either can be requested, or to which calls may be terminated. The profile may support one or more of the following BCs. The allowed values are:

- VI - voiceband information (speech and 3.1 kHz audio)
- CMD
  - — circuit-mode data (64 kb/s unrestricted) including circuit-mode 64 kbit/s rate adapted from 56 kb/s
  - — circuit-mode 64 kb/s restricted

- PMD - packet mode data (note: switched B-channel access is currently supported with the circuit-mode call types at this time)

8.4.7 Number of circuit switched B-channels

This parameter defines the number of switched B-channels that may be assigned simultaneously to the TSP.

- The allowed range is 0 - 2.
- At this time the maximum number of B-channels supported per TSP is 1. A physical terminal can support 2 B-channels provided 2 TSPs are subscribed to.

8.4.8 Number of provisioned B-channels

This parameter defines the maximum number of provisioned B-channels that may be simultaneously assigned to the TSP.

- The allowed range is 0 - 2.
- At this time the maximum number of B-channels supported per TSP is 1.
- A physical terminal can support 2 B-channels provided 2 TSPs are subscribed to.

8.4.9 Directory Numbers (DN)

- The maximum number of DN appearances that may be supported per TSP is 64.
- A parameter specifies the primary DN associated with the TSP.
- The set of valid secondary DNs must be specified for the TSP.
- The maximum number of calls that can be associated with each DN specified for the TSP is also defined.
- A single default DN is specified for the TSP.
- The network uses the default DN if a terminal does not provide a calling DN when initiating a call.

8.4.10 EKTS-shared DN

EKTS-Shared DN specifies those DNs that are EKTS-shared DNs, and therefore may be shared with other TSP s. Not all EKTS DNs are necessarily shared.

8.4.11 Intercom groups

- This parameter defines any intercom group identifiers associated with the TSP.
- If it consists of more than two members, an intercom address is also specified for the particular group.
- In addition, parameters are defined to identify a subset of this capability as incoming-only calls, or outgoing-only calls.

8.4.12 Calling number delivery service

- This parameter defines whether the network will deliver:
  - a CPN
  - a connected number
  - redirecting number and reason

  information to the terminal.
- The allowed range is Yes or No. The default is Yes.
- A separate parameter is provided on a per DN basis to specifically control the delivery of the CPN and CPS IEs.

8.4.13 Network resource selector

- The Network Resource Selector manages modem pools that are classified as network resources.
- For outbound modem pooling within ISDN the Network Resource Selector (NRS) is assigned to a subset of DNs identified in the key list.
- If not identified in the key list, the NRS applies to all DNs on the set.
- There are two methods to access a modem pool from an ISDN terminal:

1 Using “Prefix NRS Outbound” (PNO), a specific modem pool is accessed. The modem pool to be used is stored in the network.

2 Using “Prefix NRS Default” (PND), allows a user to access the default modem pool group stored in the network.

8.4.14 Message Waiting

- Message Waiting allows messages to be forwarded and retrieved from a message center, or to be queued up against the called party's terminal.
- Only messages forwarded to a message center are supported for functional terminals.
- When the message indicator is on, the subscriber can retrieve messages by dialing the message center, that can be either an attendant or, a store and forward message system.

8.4.15 Flexible Call

This parameter allows a user to request the network to attach conference facilities to an established call.

- The call becomes a conference call when the network acknowledges the request, and the user becomes the controller of the conference.
- The controller may start a conference of 3, 6, 12, 16, 24, or 30.
- Two sizes of FC may be assigned to a TSP.
- Transfer (explicit, implicit, or no transfer)
- Explicit transfer can be done without a FC being active.

8.4.16 Hunting

Hunting enables a call to be routed to another station, if the original station is currently busy. This increases the possibility of calls being completed.

- It is based on network-determined-user-busy, not user-determined-user-busy.
- It is not activated if a functional terminal rejects or ignores a call termination after the network has offered the call to the interface.
- A hunt number must be busy before hunting continues on to another station in the hunt group.

There are three types of hunting.

1 Directory Number Hunting (DNH)

2 Multiline Hunting (MLH)

3 Distributed Line Hunting (DLH)

8.5 Feature Activator/Indicator assignments

For each ISDN NI-2 feature activator/indicator, specify the feature identifier. The allowed features follow.

8.5.1 Release (RLS)

Release, which requires a FA/FI, allows a user to abandon a feature programming sequence. The user may then originate or receive other calls.

8.5.2 Hold service subscribed

- If so, user may invoke Hold for any functional DN appearance associated with the service profile.
- The allowed parameter values are yes or no.
- Currently, all users have the hold capability.

8.5.3 EKTS privacy

EKTS Privacy allows the party connecting additional parties to a call, to talk to those parties before adding them to a multiple party call.

8.5.4 EKTS privacy release

This parameter allows the party connecting additional parties to a call to connect those parties.

8.5.5 Automatic Dial (AUD)

AUD allows a user to automatically terminate to a pre-determined destination without having to supply the address of the destination for each call.

8.5.6 Call Pickup (CPU)

Call Pickup allows a terminal to answer incoming calls to another terminal within a predefined Call pickup group.

- Call pickup group is provided on an individual terminal within a customer group.
- Call pickup can be assessed using FA/FI, or code access.

8.5.7 Flexible call (FC 3 to 30)

This parameter allows a user to request the network to attach conference facilities to an established call.

- The call becomes a conference call when the network acknowledges the request, and the user becomes the controller of the conference.
- The controller may start a conference of 3, 6, 12, 16, 24, or 30.
- Two sizes of FC may be assigned to a terminal.
- When the first call of the conference has been established, subsequent calls (maximum of one at this time) can be added as follows:
  - — The controller can request origination of a new call; the conference may be placed on hold by the terminal, and the new call established; the conference can then be retrieved causing the two calls to be bridged.

— The controller can retrieve a held call causing the held call to be bridged into the conference.

— The controller can hold the conference, initiate or retrieve a call, and retrieve the conference call to bridge the two calls together.

8.5.8 Transfer (Transfer)

Transfer allows a controller of a conference call, established using FC, to send a transfer request causing the network to disconnect the controller from the conference, but maintaining the connection between the conferees. A transfer request can be issued while the conference is held or active.

This parameter also allows a call to be transferred to another party without invoking a flexible call.

8.5.9 Call Forwarding Universal (CFU)

Allows a CF subscriber to transfer all calls to that DN/CT or group of DNs to another DN.

8.5.10 Drop (DROP)

Drop allows a controller of a conference call, when there are more than two users in conference established using the FC, to send a drop request for the network to clear the last call added to the conference.

If the conference has only two users, the network interprets a drop request as one to release the conference facilities, and revert to a normal two-way connection.

8.5.11 Automatic callback (ACB)

Automatic Call Back (ACB) attempts to call the DN associated with the most recent outgoing call made by the customer.

- ACB can be activated by either a feature key or an activation code.
- Activate AR using an activation code.

8.5.12 Speed calling (SPS, SPS, SPU)

- Speed Calling allows a subscriber to store frequently-dialed numbers, and to make calls to these numbers by entering only the corresponding abbreviated access code.
- The stored numbers can be a directory number, authorization code, account code or feature access code, and can include either an asterisk or octothorpe.
- Two forms of lists are provided for the storage of frequently dialed numbers.
  — A short list that may consist of a maximum of 10 stored numbers.
  — A long list with three versions. It can store a maximum of 30, 50, or 70 stored numbers, depending on the version.
- There are two types of speed call lists.

— A personal list where the user assigns and changes numbers; they are not accessible by other stations.

— A group list that can be accessed by a number of terminals, but only one controlling station within the group can alter the contents.

  – group lists can be up to 70 numbers

  – they are accessed by a two-digit code.

8.5.13 Call Park (PRK)

Call Park (PRK) allows terminals to hold a call against a DN (that of the terminal CA issuing the feature request). The call may later be retrieved by the same or another terminal.

The feature is divided into two components:

- PRK Store enables a subscriber to park calls against their own DN
- PRK Retrieve enables a subscriber to retrieve parked calls from any CA.

8.5.14 Leave message (LVM)

- This parameter performs Call Request Activation (CRA) in the Message Waiting/Call Request feature.
- If a user receives a ringing no answer or busy treatment, depress the Leave Message (LVM) FA.
- If the request is accepted, it is enqueued on the call request queue against the called set, and the MWI on the called set is turned on.
- If the request is completed, the LVM indicator of the requestor is turned on, and confirmation tone heard. The indicator is turned off when the call is taken down.
- If the request can not be completed, no visual or audible feedback is given to allow the user to activate another feature (for example, Ring Again).

8.5.15 Intercom

Intercom introduces two intercom calling services, ICM and GIC, for ISDN functional signaling subscribers as part of the ISDN EKTS.

While using similar signaling procedures, these two services differ in the capabilities they provide and match different subscriber needs.

- Intercom (ICM) is convenient for Manager/Secretary communications.

  — A terminal may be assigned one or more ICM appearances which, when selected, automatically originate a call to another terminal on an associated ICM appearance.

  — An ICM appearance is not assigned a DN and may only call or be called by the one ICM appearance with which it has been associated.

  — No MDC features may be applied to an ICM appearance, although a call on an ICM appearance may be held and retrieved.

- Use GIC to provide a efficient communication service within a department or project team.
  - — A terminal may be assigned one or more GIC appearances.
    - – These appearances are organized into GIC groups.
    - – Each member of the group is assigned an intercom address to identify it to other members of the group.
    - – Groups may include up to 10,000 members.
  - — To make a call on a GIC appearance, the user selects the appearance, and provides the intercom address of the GIC member to which the call is directed.
  - — A GIC appearance is not assigned a DN and generally may only call or be called by other members of the GIC group.
  - — A substantial set of MDC features are supported for GIC calling.

8.5.16 Executive Busy Override (EBO)

This parameter allows a user access to a busy terminal.

- When a busy indication is received, the calling terminal may choose to invoke EBO.
- Once invoked, the called terminal, and the party connected to the called terminal, receive a custom warning tone, after which the calling terminal enters a 3-way call connection with them.
- After establishing a 3-way connection, the user receiving the busy indication can force the third party out of the call by activating EBO again, thus completing the call.

8.5.17 Bridge Call Exclusion (PRL/PRV)

This parameter allows a EKTS member to make a call private or allow other members of the EKTS group to bridge into the call.

8.5.18 Make Set Busy (MSB)

This parameter makes the interface busy (for example, makes all DNs on the interface busy).

8.6 Parameters per Directory Number

8.6.1 Preferred interLATA Carrier (PIC)

This parameter indicates the interLATA carrier to which interLATA calls originated from this DN should be routed. The IEC code is in the range 0-999. The IEC codes are designated by Bellcore.

The PIC is used if the user does not signal the carrier selection on call origination.

Note: This parameter can also be applied to ‘Parameters per Directory Number/Bearer’ capability.

8.6.2 Preferred intraLATA Carrier (LPIC)

This parameter indicates the intraLATA carrier to which intraLATA calls originated from this DN should be routed. The IEC code is in the range 0-999. The IEC codes are designated by Bellcore.

The LPIC is used for intraLATA calls if the user does not signal the carrier selection on call origination.

8.6.3 Calling Party Number (CPN) presentation

CPN Presentation indicates whether the switch should allow or restrict presentation of the DN of the calling party.

8.6.4 Calling Party Subaddress information transfer

This parameter defines whether the network should accept and transfer Calling Party Subaddress information from the calling user on call origination.

- The allowed range is yes or no; default no.
- The called user does not directly subscribe to this capability to receive this information.
- But the called user must not subscribe to Block Delivery of Calling Number to be able to receive a calling party subaddress.

8.6.5 Called Party Subaddress information transfer

This parameter indicates whether, on call origination, the network should accept and transfer CPS information from the calling user.

- The allowed range is yes or no.
- The called user does not subscribe to this capability, and may receive this information if the calling party subscribes, and has sent both a Called Party Number and a Called Party Subaddress information element.

8.6.6 Low Layer Compatibility information transfer

This parameter indicates whether, on call origination, the network should accept and transfer LLC information from the calling user.

- The allowed range is yes or no.
- The called user does not subscribe to this capability, and may receive this information if:
  - — the calling user subscribes
  - — sends a LLC IE on call origination.

8.6.7 High Layer Compatibility information transfer

High Layer Compatibility information transfer indicates whether, on call origination, the network should accept and transfer High layer Compatibility information from the calling user.

- The allowed range is yes or no.
- The called user does not subscribe to this capability, and may receive this information if:

— the calling user subscribes

— sends a HLC IE on call origination.

- If presentation is allowed, the user may also restrict presentation on a per call basis by subscribing to the Calling Line ID Restriction (CLID) feature.

8.6.8 Automatic Line (AUL)

Automatic Line allows a calling user to automatically terminate on a pre-determined destination without having to supply its address for each call.

8.6.9 Block Delivery of Calling Number (CGN)

This parameter allows a called user that does not wish to subscribe to the delivery of the Calling Party Number (CGN) information element, to block the delivery of the CGN element.

8.6.10 Block Delivery of Called Number

This parameter allows a called user that does not wish to subscribe to the delivery of the CDN information element, to block the delivery of the CDN element.

8.6.11 Number to be used if CGN not present

This parameter allows a Charge Number (CHG), if available, to be delivered in the CGN information element when there is no calling number present.

- The charging number and option must be set for that DN.
- The charging number is delivered when the following conditions are met:

  — No calling number is available.

  — A charge number (either ISUP charge number, or ANI) is available.

  — Interworking has occurred (for ISUP originations).

  — The CHG option on the BRI DN has been set.
- For a POTS trunk (with Automatic Number Identification (ANI)), the ANI is delivered in the CGN information element whenever ANI is available, and the above conditions are met.
- However, the ANI is not delivered if the call has been forwarded within the serving switch.
- When a charge number is delivered in the CGN information element, the field values in the information element are set as follows:

  — TON = unknown

  — Numbering Plan Identification (NPI) = ISDN numbering plan E.164

  — Presentation Indicator (PI) = presentation allowed

  — Screening Indicator (SI) = network provided

  — IA5 Number digits = 10-digit number

8.6.12 Generate Automatic Message Accounting (AMA) record

This parameter allows the Telephone Operating Company (OC) to optionally generate an AMA record when a call terminates to a line or through a Virtual Facilities Group (VFG).

This feature allows the OCs to have access charges per termination, and to assign up to 200 unique call codes and optionally 200 unique service feature codes.

8.6.13 Name to be sent to called party

This parameter allows a called party to receive the name of the calling party when name information is available. The name of the involved party is presented as long as:

- The user's customer group has been assigned the option.
- The name of the party is stored in the network, and is stored in the network node where the DN is defined.
- The call is intragroup, or intergroup with customer group transparency.

8.6.14 Multiple Appearance DN

Multiple Appearance DN allows each group member to be simultaneously active on a call with a different remote party. The remote party may be a member of the same MADN MCA group.

8.6.15 Last Number Redial (LNR)

This parameter allows the last number dialed by the calling user to be re-dialed using a single key. The last number dialed is stored as the LNR number for that DN.

8.6.16 Terminal Will Not Ring

This parameter prevents the terminal from ringing on incoming calls.

8.7 Parameters per Directory Number/Bearer Capability

8.7.1 Preferred InterLATA carrier (PIC)

This parameter allows a different PIC to be assigned to each BC supported by the user.

- The PIC is not assignable to a BC of 64 kb/s restricted.
- It may also be used on a per directory number basis.
- The PIC for the bearer capability equal to 64 kb/s restricted is supported on a DN basis only on 1B-channel terminals.
- Automatic Call Back (ACB) can be assigned for voice calls.
- Automatic Recall (AR) can be assigned for voice calls.
- Call Forwarding Universal, Call Forwarding Busy, Call Forward Don't Answer.

8.8 Parameters per group of Directory Numbers (Key- List)

- Make Set Busy - allows a terminal to be made busy to incoming calls.
  - While this feature is active on a set, all incoming calls receive either a busy tone or some other treatment (tone or announcement).
  - For intragroup calls blocked by MSB, the calling party always receives a busy tone.
  - Also the made busy set receive no messages or treatments to indicate that calls are attempting to terminate on it.
  - A made busy set can still originate calls.
  - The set still appears busy to incoming calls even when it is involved in one or more calls.
- Last Number Redial Associated with Set - allows a subscriber to re-dial the last called number by depressing a single key rather than dialing the entire number. It is associated with the entire group of DNs on the set, rather than a specific DN.
- Prevent Barge-in on Existing Calls - allows the network to store information that do not allow a second call to the same DN, thus blocking an incoming EBO.
- Do Not Disturb - an existing MDC feature allowing the network to deny incoming calls to selected stations. The selected stations can be an individual station, a group of stations, or all stations within a diversion group.

  The feature may be (de)activated either by the Attendant Console or a scheduled update to the network storage tables.
- Call Forward Busy Exclude Intergroup Calls - an option available, from within CFB that prevents calls being forwarded to a remote terminal outside the customer group.

- Call Forward Busy Exclude Intragroup Calls - an option available, from within CFB, allowing the prevention of the forwarding of incoming intragroup calls.
- Call Forward Busy Unrestricted - an option available, from within CFB, allowing calls to be forwarded to a remote terminal either inside or outside the customer group.
- Call Forward Don't Answer Exclude Intergroup Calls - an option available, from within the Call Forward Don't Answer, preventing calls from being forwarded to remote terminals outside the customer group.
- Call Forward Don't Answer Exclude Intragroup Calls - an option available, from within Call Forward Don't Answer, that allows the prevention of the forwarding of intragroup calls to a remote terminal.
- Call Forward Don't Answer Unrestricted - an option available, from within Call Forward Don't Answer, allowing the calls to be forwarded to a remote terminal in or outside the customer group.
- Call Forward Busy - allows calls to a terminal to be forwarded to a pre-determined terminal within the customer group when the base terminal is busy.

  This feature can only be assigned at subscription time. When is assigned to a terminal, the remote terminal's address may also be assigned. The remote terminal number can be changed by the base terminal using a feature access code.
- Call Forward Don't Answer - allows the base terminal, which does not answer an incoming call within a customer group prescribed time, to have the call routed to a remote terminal or to an attendant station.

  This feature can only be assigned at subscription time. When assigned to a terminal, the remote terminal's destination address may also be assigned. The remote terminal's number can be changed by the base terminal using a feature access code.
- Call Forward Don't Answer Variable Timer - provides the ability to store a Call Forward Don't Answer time in the network. This option is intended only for cases where a particular group of DNs require a Call Forward Don't Answer time that differs from the customer group Call Forward Don't Answer time.
- Call Forward Intragroup - allows a terminal that has been assigned CF to forward calls to a user-defined remote terminal within the customer group.
- Call Forward Universal - allows a terminal that has been assigned CF to forward calls to a user-defined remote terminal inside or outside the customer group.

Chapter 9: Parameter Downloading

9.1 Introduction

Integrated Services Digital Network (ISDN) terminals need information that is stored on the switch in order to properly operate the ISDN terminal.This feature is compliant to the Bellcore Parameter Downloading TR-NWT-001281 *ISDN Parameter Downloading Generic Requirements,* Revision 2, December 1996" and takes the place of the present Service Profile Management used for NI-1 and early terminals. For information on Service Profile Management see Appendix E: "Management Services". Without Parameter Downloading (PD) the user would be required to manually enter this information into the terminal.

With PD, the ISDN terminal can send a REGISTER message to trigger the switch to send information, such as service information and DN data, to the ISDN terminal in a series of FACILITY messages. Thus, the switch programs the terminal for the user.

9.1.1 Functional overview

PD is initiated from the terminal with a REGISTER. Upon receiving the REGISTER from the terminal the DMS-100 determines what services are required based upon the information registered against that particular terminal. After the REGISTER is verified, call processing activity on that terminal is suspended. If the message content is correct, the data associated with that terminal is downloaded. Once the terminal receives all the data, it sends a RELCOM message and call processing is allowed on the terminal.

9.1.2 Feature description

PD is activated when a REGISTER message is sent from an initialized ISDN terminal to the DMS-100. When the DSM-100 receives the message, it busies the terminalto further call originations or terminations. Once this has occurred the following information is sent to the terminal.

DN (Directory Number) independent data:

- FA-FI (Feature Activator - Feature Indictor) List Information
- Intercom Group Appearance List

DN dependent data:

- Directory Number
- Originating DN Flag[1]
- Bearer Capability List
- Directory Number Appearance Identifier List
- Call Reference Busy Limit List
- DN Dependent FA-FI Per Call Type Information
- Call Appearance Identifier List Information

The switch formats the data into CMISE/ROSE and send it to the terminal in a series of FACILITY messages. When the final bit of data has been sent to the terminal, the switch then sends a FACILITY message to the terminal indicating that PD is complete. The switch sets a PDL-T1 timer (for 5 seconds) to await a RELEASE COMPLETE reply from the terminal ((R)3-74). If no RELEASE COMPLETE is received during this time, then the switch sends a RELEASE COMPLETE (ROIV-m-Event Report (timerExpiry)) message to the terminal.

9.1.3 DN Independent Download

The first set of data to be downloaded is the DN Independent data. The DN independent data consists of paired FA-FI, and Intercom Group Appearance (GIC) data.

9.1.4 FA-FI List Information

The FI typically indicates a key on the set on which the feature is stored. The feature identifier value (FA-FI) is sent to the terminal as part of the parameter download. A service description is sent coresponding to the feature assigned tothe feature key (FA-FI). Additionally, if this is a version 2 Parameter Downloading request, the Bellcore Keyword for the feature is sent to the terminal.

The following is sent to the terminal:

- Feature Identifier value (typically indicating the key and lamp on the terminal associated with this feature)
- Service Description (a textual description of the feature which appears on the terminal's display when the feature is activated)
- Bellcore Keyword (an indication to the terminal of which feature this is) -- if necessary[2]

1. Only present in Version 2

2. Only present in Version 2

9.1.5 Intercom Group Appearance List

The last data component for the DN-independent parameters is the Intercom Group Appearance List. This is only applicable to CACH EKTS terminals. The information required is the Intercom group name (text), the CA ID (number), and the intercom group address (group member number). The Group Intercom (GIC) feature can be assigned to any ISDN terminal regardless of whether they are EKTS and/or CACH.

The following are downloaded to the terminal as part of parameter downloading:

- GIC group name (8 ASCII characters)
- Call appearance identifier (14 bit integer)
- GIC group member (0-99)

9.1.6 DN Dependent Download

The next set of data sent is the DN-dependent information for each DN on the terminal. This information consists of the following data parameters:

- Directory Number
- Originating DN flag 1
- Bearer Capability
- DN Appearance Identifier List
- Call reference Busy Limit for the DN
- FA - FI (Feature Activator - Feature Indictor) information
- Call Appearance Identifier List for the DN

9.1.6.1 Directory Number

All the DNs and EKTS shared DNs assigned to a TSP are downloaded to the terminal. Each DN and EKTS shared DNappearance has a separate DN dependent message sent with its information using component encoding.

9.1.6.2 Originating DN flag

A flag may be downloaded which marks a DN as the orginating DN for the terminal.

9.1.6.3 Bearer Capability List

A bearer capability list for all allowable bearer capabilities for each DN that appear on a terminal interface is downloaded.

9.1.6.4 Directory Number Appearance Identifier List

Directory Number Appearance Identifier List includes the key numbers where the DN appears and the default bearer capability for each appearance.

The following are downloaded to the terminal as part of parameter downloading:

- Call Appearance Identifier (14 bit integer) - the key on the terminal on which the DN appears.

- Default Bearer Capability
- Call Appearance Reservation (DOR / DTM / DTMEPI)[1]

9.1.6.5 Call Reference Busy Limit List

Call Reference Busy Limit (CRBL) is the number of simultaneous calls to a Directory Number (DN) that can be supported per call type (VI or CMD).

9.1.6.6 DN-Dependent FA-FI per Call Type information

The FA-FI information specific to the DN CT (circuit mode data or voice) is included in the paired FA-FI list of services dependent on a DN call type.

The following data must be sent to the terminal:

- Feature Key Number (14 bit integer)
- Feature Description (up to twenty characters of text)
- Bellcore Keyword for feature (up to eight character of text)[2]

9.1.6.7 Call Appearance Identifier List information

Call Appearance Identifier List Information is only applicable for CACH EKTS terminals. As with the regular DN Appearance, CACH has an optional call appearance reservation (denied origination, denied termination, or denied termination except priority incoming).

The following information is downloaded to the terminal:

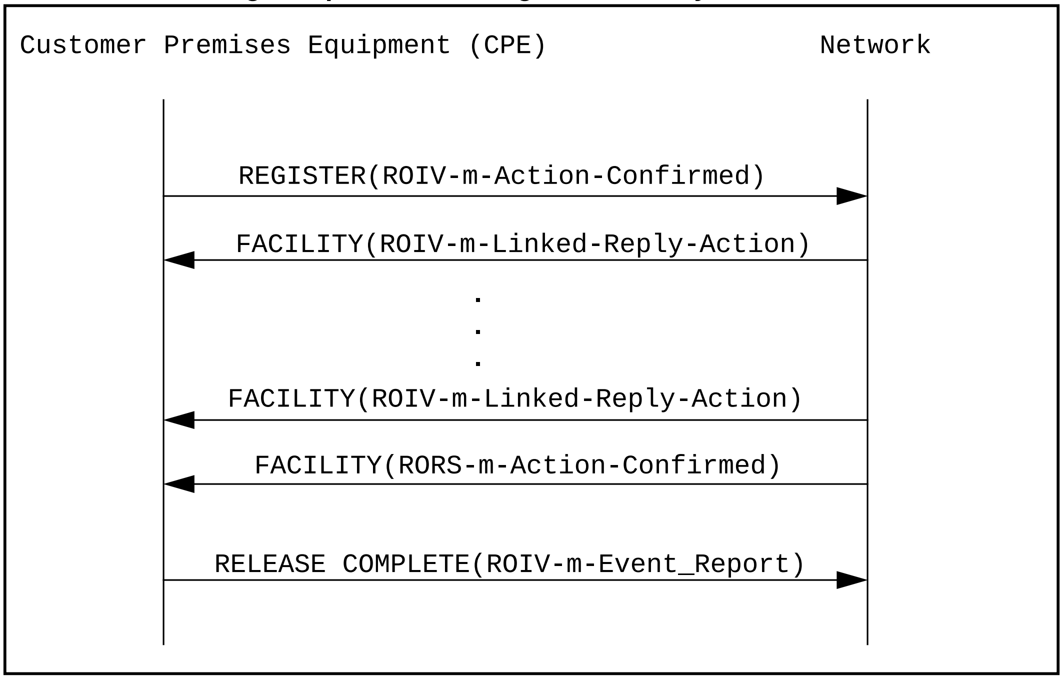
- Call Appearance Identifier (14 bit integer)
- Call Appearance Reservation (DOR / DTM / DTMEPI)

1. Only present in version 2 requests. DOR is Denied Origination. DTM is Denied Termination. DTMEPI is Denied Termination Except Priority Incoming.

2. Only present in version 2 requests.

9.1.7 Messaging

Figure 185 Normal Message Sequence following terminal's layer 3 initialization



In cases where Parameter Downloading results from a provisioning change on the switch, the above diagram would be preceded by a NOTIFY (Service Profile Updated) message 1 from the DMS-100 to the terminal (CPE).

In cases where the PDL-T1 timer expires before the RELEASE COMPLETE message is sent from the CPE to the switch; a RELEASE COMPLETE (ROIV-m- Event Report (timerExpiry) error message is sent from the switch to the CPE After this, the CPE should no longer attempt to respond.

If the terminal needs to abort the download, then the RELEASE COMPLETE (ROIV-m-Event_Report) error message is sent to the switch at that time. After this the switch should terminate services and discontinue sending messages.

If the switch needs to abort the download, then RELEASE COMPLETE (ROIV-1m-Event_Report) error message is sent to the terminal, the switch terminates services, and no more messages should be exchanged.

If the CPE makes an invalid PD request to the switch, then the switch should respond with a RELEASE COMPLETE (ROER or RORJ) error message. Improper messages are discussed in the next chapter.

9.1.8 Notify

PD Notification sends a Q.931 NOTIFY message from the switch to an NI-2 initializing terminal, whenever there is a change to the downloadable data (other than service description data).

The intent of the NOTIFY is to inform the terminal and/or the terminal user that PD-related data has changed. If the terminal is able to perform downloading, the terminal or terminal user may then request downloading of the new data.

9.1.8.1 Notify description

Whenever there is a change to PD-related data (other than service description data) in DMS-100 tables, within five minutes a Q.931 NOTIFY message or messages is/are sent to the NI-2 initializing terminal associated with that data. The NOTIFY message contains a Notification Indicator (NI) IE. The Notification Description field of the NI IE indicates “Service profile update”. The Q.931 message does not contain any PD data.

A NOTIFY message is sent to any NI-2 initializing terminal for which PD-related data has changed, regardless of whether the terminal has previously requested Parameter Downloading and regardless of whether the terminal is capable of downloading data. An initializing terminal is a terminal which has successfully completed a terminal initialization sequence with the DMS-100 switch, as specified in Bellcore document TR-TSY-00847, *ISDN Features - Common Switching and Generic Requirements.*

Table 179 Notification Indicator

8	7	6	5	4	3	2	1	Octet #
0	Notification Indicator - Information element identifier							1
	0	1	0	0	1	1	1	
Length of notification indicator contents								2
1 Ext	Notificattion - description - Service Profile Update							3
	1	1	1	0	1	0	0	

9.1.9 ISDN Call Forwarding

If Call Forwarding is active on an ISDN terminal when a download occurs the forwarding works as follows:

- CFB if active, continues to forward calls.
- Call Forward No Answer will not forward calls because the terminal is busy.
- Call Forward Variable continues to forward calls.
- Message waiting works with either CFB or Call Forward No Answer, therefore it will continue to operate only in busy cases.

9.1.10 Restrictions/limitations

Call processing is not available during PD.

PD is implemented only for NI-2 terminals.

Parameter Downloading only works on NI-2 FITs.

9.1.11 Parameter Downloading DN-Independent parameters

9.1.11.1 CACH

The CACH option is a “yes” or “no” parameter. A “yes” indicates that this terminal uses call appearance identifiers. These call appearance identifiers are provisioned separately. Each ISDN EKTS terminal with the CACH option could have up to 16 appearances (that is, key) of that DN. Each CA can handle a different call.

9.1.11.2 Paired FA and FI:

The next data is the DN Independent Paired FAs and FIs. The following is a list of FA/FI supported by DMS.

- ACB Automatic Call Back
- PRV Make Call Private
- PRL Make Call Public
- CPU Call Pick-UP
- DROP Drop
- PRK Retrieve Park Call
- AUD Auto Dial
- EBO Executive Busy Override
- MSB Make Set Busy
- SCS Speed Call Short
- SCL Speed Call Long
- SCU Speed Call User
- CIDSDLV Make ID Public
- CIDSSUP Make ID Private
- Conference Size FC3, FC6, FC12, FC18, FC24, FC30
- TRANSFER Call Transfer
- ICM Intercom

9.1.11.3 Intercom Group

The GIC group name indicates which intercom group the terminal is a part of, and the GIC member number indicates which member the terminal is in that group.

The following are downloaded to the terminal as part of parameter downloading:

- GIC group name (8 ASCII characters)
- Call appearance identifier (14 bit integer)
- GIC group member (0-99)
- DN Dependent Parameters

9.1.11.4 Directory Number

The list of directory numbers is downloaded to the terminal. The following are downloaded to the terminal as part of parameter downloading:

- DN (seven digits: NXXYYYY)
- DN Appearance Identifier (integer) - the key on the terminal on which the DN appears.

9.1.11.5 Bearer Capability list

The Bearer Capability list contains all the BCs that are assigned for each DN. The allowable BCs are SPEECH, 3_1_KHZ, 56KDATA, and 64KDATA.

9.1.11.6 Directory Number Appearance Identifier List

Each terminal can have multiple DN appearances. Multiple DN appearances allow a subscriber to originate voice or data calls with different BCs. Each DN appearance has a default BC provisioned against it. Each DN appearance/default BC combination is downloaded to the terminal. A terminal may have more voice or data appearances than calls allowed to be made from the terminal.

The following are downloaded to the terminal as part of parameter downloading:

- Call Appearance Identifier (14 bit integer) - the key on the terminal on which the DN appears.
- Default Bearer Capability

9.1.11.7 Call Reference Busy Limit

Call Reference Busy Limit is the number of simultaneous calls to a DN that can be supported per call type (VI or CMD).

The following are downloaded to the terminal as part of parameter downloading:

- Limit (1-16) - the number of calls allowed against the DN/CT
- Call Type - the CT for which this limit applies

Appendix A: ISDN DPN Data Services

A.1 Introduction

This appendix describes ISDN data services offered by Nortel Networks ISDN over the basic rate (2B+D) user-network interface when utilizing the Data Packet Network (DPN)-based packet handler.

In describing the packet mode data services, the principles and terminology of CCITT Recommendations X.200 and X.210, the reference model for Open Systems Interconnection are discussed.

Nortel Networks ISDN switch provides full flexibility with respect to data service's access by any BRI. Data services can be offered to any user-network 2B+D interface on either, or both, of its two B-channels as well as on its one D-channel, simultaneously.

The ISDN data services to be offered are:

- D-channel packet mode access for X.25 terminal equipment using CCITT LAPD (per Chapter 4: "Data Link Layer Specification" of this document) at the data link layer (layer 2) and 1984 CCITT X.25 packet level protocol (layer 3)
- B-channel packet mode access for X.25 terminal equipment using 1980 or 1984/1988 CCITT LAPB at layer 2 and 1980 or 1984/1988 CCITT X.25 at layer 3
- B-channel packet mode access for SDLC terminal equipment using IBM SDLC. SDLC services currently supported include: SNA single host TPAD and HPAD, SNA multi-host TPAD.

The ISDN data services, as described above, are augmented by future enhancements to include additional capabilities and packet mode services, such as PMD services available On-Demand to user-network B-channels (CCITT Recommendation X.31 Case B).

This appendix includes the specification of:

- Packet mode data services dedicated (provisioned at subscription time) on B-channel(s).

- Packet mode data services provisioned on the D-channel.

A.2 Physical layer specification

This paragraph describes rate adaption protocols and procedures necessary for non-ISDN terminal equipment to access ISDN data services on the B-channel(s) of any user-network 2B+D interface.

For a specification of all other areas of layer 1, refer to Chapter 3: "Physical layer specification".

A.2.1 Rate adaption

Rate adaption for B-channels is a process whereby bit streams having speeds less than 64 kb/s are increased to that level at layer 1. Rate adaption is necessary to access ISDN data services using terminal equipment operating at speeds less than 64 kb/s.

The preferred method of rate adaption, for packet mode services, is HDLC interframe flag stuffing, as specified by 1988 CCITT Recommendation X.31. This method is supported for X.25 LAPB and SNA SDLC services.

In the case of 56 kb/s terminal equipment accessing packet mode data services, the preferred method of rate adaption is to increase the clocking rate to 64 kb/s.

A.3 Data link layer specification

The data link layer specifications for both B- and D-channel data services are described here.

A.3.1 Data link layer specification - B-channel

The layer 2 protocol for X.25 packet mode data on the B-channel is based on Section 2 of 1980 and 1984 CCITT Recommendations X.25 - LAPB (Link Access Procedure, Balanced).

Layer 2 protocols for SDLC data services on the B-channel is based on IBM SDLC as defined in Appendix C of *IBM SDLC and Data Link Control Standards,* IBM GA 27-3093-3.

A.3.1.1 LAPB specification

The data link layer protocol for X.25 packet mode data on the B-channel is fully compatible with CCITT 1980 and 1984/88 LAPB.

A.3.1.1.1 LAPB system parameters

CCITT Recommendation X.25 defines several LAPB system parameters without specifying their values. The following values are supported by the Nortel Networks ISDN PH:

- T1 specifies the period after which transmission of any frame may be repeated:
  - the default value for T1 is 3 s
  - the adjustment range between 1-655 s
  - the adjustment increment = 1 s.

- T2 indicates the time available before initiating the acknowledging frame:
  - — the default value is 200 ms
  - — the adjustment range between 100-1000 ms
  - — the adjustment increment = 100 ms.

- The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency) is specified by parameter N1, and defaults to 16.44 kb; adjustment range between 1-16.44 kb, with adjustment increments = 1 bit.
- The maximum number of times that a command is sent before a station enters the disconnected mode is specified by parameter N2, and defaults to 10; adjustment range from 1-15; adjustment increment = 1.
- The default maximum number of outstanding (unacknowledged) I-frames (k) is 7 and 127 for modulo 8 and 128 frame sequencing respectively; adjustment range between 1-7 (modulo 8) and 8-127 (modulo 128); adjustment increment = 1.

An idle link timer (T203 for LAPD, T2 for LAPB) is provided, but not defined in X.25. On a previously established link, after the ISDN switch PH has not received frames from a DTE for interval T (that is, T203 for LAPD, T2 for LAPB) the PH forces a DTE response with RR or RNR. The value for T defaults to the value specified for timer T1; adjustment range between 1-655 s; adjustment increment = 1 s.

Refer to NTP 241-1001-184, *LAPB/X.25 Specification*, for exact details of the Nortel Networks implementation of the CCITT LAPB recommendation.

A.3.2 Data link layer specification - D-channel

The layer 2 protocol for X.25 packet mode data service on the D-channel is based on 1984 CCITT Recommendations Q.920 and Q.921 - ISDN user-network interface data link layer specification. Use a subset of LAPD, as defined by Chapter 4: "Data Link Layer Specification", together with the following provisions:

- Use Multiple frame operation on packet (SAPI = 16) links.
- Initially, support pre-assigned TEIs (manually established at subscription time) for one or multiple packet mode data terminals on the subscriber D-channel, for both SVCs and PVCs. The terminal equipment (TE or CPE TA) is responsible to 'remember' pre-assigned TEIs, and to supply only those values when establishing data link(s) with the network.
- Determine link layer parameters at subscription time; use the ranges and defaults specified in Chapter 4: "Data Link Layer Specification".
- Provide a separate, longer timer (T200 in Section 4.5.8.1, "Timer T200" for packet data links, since signaling links have priority status.
- Unacknowledged Information (UI) transfer procedure is not supported for packet links.
- Support only the extended (modulo 128) control field format.

- View terminals as disconnected from the D-channel of the 2B+D loop when the logical link(s) to the ISDN switch are disconnected.
  - — When D-channel packet mode service is first initialized, the network attempts to establish a logical link to the terminal by transmitting SABME.
  - — When the terminal is attached to the loop, it should also try to establish a logical link with the switch by sending SABME.
  - — This procedure is recommended since the network clears incoming calls destined for a terminal that is 'disconnected' from it.

As a subscriber option, the network may attempt to set up the logical link when an incoming call arrives. This is referred to as ‘dynamic D-channel establishment’. Only if the set up attempt fails, is the incoming call cleared.

Refer to NTP 241-1001-194, *LAPD/X.25 Specification*, for exact details of the Nortel Networks implementation of CCITT LAPD/X.25 Recommendation.

A.4 Network layer X.25 Packet Mode Data (PMD) services

This section describes the X.25 Packet Mode Data (PMD) transport service offered by the Nortel Networks ISDN switch. The service is available for both B- and D-channels at the basic rate user-network interface.

A.4.1 General considerations

The network layer procedures implemented by Nortel Networks ISDN PH conform to CCITT Recommendation X.25. B-channel access provides for 1980 and 1984/1988 versions of X.25 at layer 3, while D-channel access supports only 1984/1988 X.25 at layer 3.

The term, DTE/DCE interface, as described in Recommendation X.25, refers to, a logical link within a D-channel of the basic rate user-network interface, or to the single logical link (specified by LAPB) within a B-channel.

In general, ISDN X.25 users have access to the same packet mode services as dedicated X.25 users in a Public Packet Switching Network (PPSN).

- Initially, provision both B- and D-channel X.25 PMD services (dedicated) at subscription time.
- Thus for packet mode data transfer across the DTE/DCE interface, there must be a logical link (as specified in Section A.2, "Physical layer specification") on the desired channel.
- Should an incoming call arrive at the PH, destined for a loop with no logical links established between it and the terminal, it clears the incoming call by sending a'clear indication' packet to the calling DTE.
- When a logical link is established by exchanging SABM (or SABME) and UA, the PH will send a'Restart Indication' packet to the terminal to initialize the network layer before any Call Request packet is processed.
- The Nortel Networks ISDN switch supports a very comprehensive set of packet level facilities, including most of the 1984 and 1988 X.25 optional facilities, and additional facilities not defined by X.25.

Refer to NTP 241-1001-184 *LAPB/X.25 Specification*, for exact details of the Nortel Networks implementation of the CCITT X.25 recommendation.

A.4.2 Types of calls

There are three types of packet mode data calls available to users on the user-network interface, SVC, PVC, and Direct Calls (DC).

- When a PMD call is established between two DTEs, the combination of logical channels and switch resources used is termed a virtual circuit.
- A virtual circuit is the bi-directional association between two DTEs over which all data transfer takes place.
- Virtual circuits differ from conventional circuits in that network bandwidth is allocated only when data or control packets are actually being transferred.

A.4.2.1 Switched Virtual Call

SVC allows a user to set up a virtual circuit for the transfer of data on an as-needed basis.

- The virtual circuit is up only for the duration of the call.
- A DTE initiates the call setup procedure when it has data to transfer to another DTE.
- When communications are complete, initiate the call clearing procedures to disconnect the virtual connection.

A.4.2.2 Permanent Virtual Call (PVC)

PVC is a permanent association between two DTEs.

- Each end has a logical channel pre-assigned for a PVC, and the virtual circuit setup information is stored as datafill in the ISDN switch PH.
- A PVC is established as soon as the system comes up, thus eliminating call setup and clearing by the DTE.

A.4.2.3 Direct Call (DC)

Direct Call provides the flexibility of a SVC with the convenience of a PVC.

- With DC service, call request information is defined at subscription time, and is associated with a particular logical channel.
- Users need not specify the called terminal address when a call request is initiated on that logical channel number.
- An X.25 outgoing call that provides no destination address causes a search for a DC envelope (within the PH) associated with its logical channel.
- If it exists, the DC envelope provides a destination address, facility data, and user data.
- A DTE may override DC data by inserting a destination address in the call request packet.
- In this case, the DCE ignores all information it has for the DC option.

- To restrict where a DTE can call, specify an additional feature at subscription time to prevent override.

A.4.3 Logical channels

The network layer of X.25 provides for concurrent operation of several calls over a single logical link. This is accomplished using logical channels. The maximum number of simultaneous calls possible on a logical link corresponds to the number of logical channels provisioned for that link.

A.4.3.1 Logical channel range

Choose four types of logical channels, and their ranges at subscription time. Base this selection on the number of simultaneous calls or users to be permitted on a particular access line. Over-assignment of logical channels not only wastes switch resources, but may allow degradation of response time if the access link is over-used.

The four types of logical channels are:

1 PVC logical channels

2 one-way incoming logical channels for SVCs

3 two-way logical channels for SVCs

4 one-way outgoing logical channels for SVCs

For LAPB/X.25 service, logical channels are identified by a 4-bit logical group number, and an 8-bit logical channel number. This allows for the capability to address 4096 discrete logical channels. Logical channel 0, however, is reserved for control packets that affect the entire interface (restart and diagnostic packets), so only 4095 channels are available for assignment.

For LAPD/X.25 service, the logical channel range is 0-511. Channel 0, is again reserved for control packets that affect the entire interface (restart and diagnostic packets), so only 510 channels are available for assignment.

> ***Note:*** While the logical channel range defined at subscription time is between 1-511 for D-channels, or 1- 4095 for B-channels, the range must be continuous.

When initiating a call:

- the DTE selects the highest-numbered free logical channel for an outgoing call
- the DCE selects the lowest numbered free-channel for an incoming call (or vice versa, as selected at subscription time).

This procedure is defined to minimize call collision probability.

A.4.4 Sequenced and expedited data transfer

- Sequenced data transfer - data packets are delivered in the same sequence as they were transmitted, without duplication or loss. Modulo 8 packet sequence numbering is supported.
- Expedited data transfer - the ability to send a limited amount of data on the virtual circuit, which is delayed by flow control mechanisms. This feature

is provided by the X.25 interrupt procedure. For X.25(1984/88) DTEs, a maximum of 32 octets of user data can be carried in the interrupt packet.

A.4.5 X.25 facilities

Here is a list of the X.25 (1984/88) facilities (or 'services') available at the user-network 2B+D interface. All facilities are available for both B- and D-channel access.:sp.X.25 optional user Facilities Supported:

- Incoming Calls Barred
- Outgoing Calls Barred
- One-way Logical Channel Incoming
- One-way Logical Channel Outgoing
- Non-standard Default Packet Sizes
- Non-standard Default Window Sizes
- Default Throughput Classes Assignment
- Flow Control Parameter Negotiation
- Throughput Class Negotiation
- Closed User Group
- Closed User Group with Outgoing Access
- Closed User Group with Incoming Access
- Incoming Calls Barred within a Closed User Group
- Outgoing Calls Barred within a Closed User Group
- Closed User Group Selection
- Closed User Group with Outgoing Access Selection
- Fast Select and Acceptance of
- Reverse Charging and Acceptance of
- Local Charging Prevention
- Network User Identification (NUI)
- Charging Information
- RPOA Selection
- Hunt Group
- Call Redirection
- Call Redirection Notification
- Extended Frame Sequence Numbering (link layer only)
- Called Line Address Modified Notification
- CCITT-specified DTE facilities
- Transit Delay Selection and Indication

See CCITT recommendation X.25 1984/88 for full descriptions of the facilities listed above.

A.4.5.1 Additional facilities

In addition to the X.25 defined facilities the following facilities are also provided:

- DC
- Interexchange Carrier Preselect
- Protocol Conversion Screening
- Traffic Class

Here is a brief description of those additional packet facilities.

- DC - requires registration at subscription time and can be defined for any non-PVC logical channel with outgoing calls allowed. With this service, define call request information at subscription time, and allow users to make calls associated with the logical channel or channels without having to specify the destination address each time a call request is initiated. See Section A.4.2, "Types of calls", for details.
- Interexchange carrier preselect - can be specified at subscription time. It allows a user to select a default interexchange carrier for inter-LATA calls. This selected default IC can be overridden at call setup time using the RPOA selection facility.
- Protocol conversion screening - requires registration at subscription time, and is invoked on a per call basis.
  - — This facility, if subscribed to, allows restricted network access (DTE) on the basis of permitted protocol-to-protocol communications.
  - — Screening for which protocols can communicate is defined by service data collected at subscription time.
  - — If permitted, protocols for either user, do not include the access protocol of the other, the call is cleared.
  - — The call clearing procedure is initiated and the cause is shown as access barred.
- Traffic class - requires registration at subscription time, and can be requested by a user on a per call basis. There are two types of traffic classes available to users, Priority and Normal. Priority packets usually have a lower delay than Normal packets over the same virtual circuit.

A.4.5.2 Facilities not implemented

This is a list of the CCITT X.25 (1984/88) facilities currently not supported at the basic rate user-network interface:

- On-Line Facility Registration
- Extended Packet Sequence Numbering
- Packet Retransmission
- Bilateral Closed User Group Related Facilities

A.4.6 Addressing

The DMS-100 ISDN switch supports the E.164 numbering plan for packet mode terminals. Each packet mode terminal at the user-network interface is assigned a unique address or subscriber number (maximum of 10 digits). For example, if there are two packet mode terminals in the user-network interface, one using the B-channel and the other using the D-channel, each terminal is assigned a different subscriber number.

There is a need for the interworking of DTEs on the PPSN and the packet mode terminals on the ISDN. The use of escape codes has been standardized by CCITT, and is the mechanism for interworking between X.121 and E.164 numbering plans. Here are the address formats for different interworking configurations:

- ISDN-to-ISDN - the calling user specifies the called address as: <subscriber number>. This format requires prefixes to distinguish local, 10-digit, and international calls.

  The DMS ISDN switch also supports the alternative option of the user always dialing an international format number consisting of country code plus national significance number. This option eliminates the need for dialing prefixes.
- ISDN-to-PPSN - the calling user specifies the called address as: <escape code 0> <DNIC of PPSN> <Network Terminal Number>.
- PPSN-to-ISDN - the calling user specifies the called address as: <prefix> <escape code 0 > < country code><subscriber number>.

For North American ISDN trial purposes, use the pseudo-DNIC <9001> to distinguish those users on the ISDN from those on the public packet switching network for intra-LATA calls.

A.4.7 Directory Number Sharing Across Packet and Circuit Mode Terminals

Prior to BCS 34, PMD calls were handle by the Data Packet Network (DPN), a system which is maintained completely separately from the DMS. Starting in BCS 34, an Integrated Packet Handler (IPH) was introduced to carry PMD calls on Series 3 peripheral of the DMS called the X25/75 Link Interface Unit (XLIU).

When using the DPN, it is possible to datafill a DN with all three CTs: VI, CMD, and PMD. The data for the PMD DN is kept on the DPN and does not interfere with the DMS data for VI and CMD CT.

A.4.8 User maintenance capabilities

There are five capabilities to aid users and network operators in the operations and maintenance of ISDN PH X.25 access:

1 Access Channel Takedown - A user may make a telephone request (to the network operator) to take down the X.25 service on a particular B-channel, or particular logical link of a D-channel. Two service takedown procedures, Unconditional Takedown and Conditional Takedown, are available:

— Unconditional Takedown - When invoking this procedure, the PH takes the X.25 service on that channel out of service by initiating the link layer disconnect procedure. It also clears all virtual calls and resets all PVCs towards the remote terminals.

— Conditional Takedown - When invoking the conditional takedown procedure, the PH prevents any new virtual calls from being set up on the designated access channel.It takes down the service by initiating the link disconnection procedure when all SVCs have been terminated, and there are no PVCs.

2 User Self-Testing Capabilities - A terminal may place a virtual call to its own address. This allows users to perform tests on their DTE network layer procedures. The user must subscribe to at least two LCNs where at least one can be used for outgoing calls, and at least one other for incoming calls.

3 Idle Line Probe - provides a simple sanity test on the packet mode terminal of the user-to-network interface.

— Provided that there is at least one idle LCN available, this service has the network periodically send a Clear Indication packet on an idle logical channel.

— The DTE must transmit a Clear Confirmation packet within the response period, or the network disconnects the link layer.

— After that, the network tries to reconnect the link layer and reinitialize the packet layer by sending a Restart Indication packet.

4 Link Audit At layer 2 - As described in Section , "CCITT Recommendation X.25 defines several LAPB system parameters without specifying their values. The following values are supported by the Nortel Networks ISDN PH:", an additional timer (T2) is defined at the data link layer to detect idle logical links.

— In general, the PH starts T2 if no frames are sent or received on a logical link, and resets the timer whenever there is activity on that link.

— If T2 expires, the PH forces a DTE response with RR or RNR.

— The value for T2 is specified by the user at subscription time.

— For LAPD the corresponding timer is called T203.

5 Diagnostic Packets - a terminal may subscribe to receive X.25 diagnostic packets from the PH, used to indicate error conditions under circumstances when the usual methods of indication (that is reset, clear, and restart with cause and diagnostic codes) are not adequate.

A.5 Network layer Synchronous Data Link Control (SDLC) services

This subsection describes the Synchronous Data Link Control (SDLC) packet mode data transport services available on the B-channel(s) of any basic rate user-network interface.

A.5.1 General considerations

SDLC service is offered as a network layer packet mode data service by the Nortel Networks ISDN switch. The SDLC service conforms to *IBM Synchronous Data Link Control - General Information*, GA27-3093-3.

Two SDLC services are currently offered, SNA Single Host, and SNA Multihost.

- SNA Singlehost service - implements the SDLC Singlehost Terminal PAD (TPAD) function and SDLC Host PAD (HPAD) functions that use the QLLC protocol to provide transparent communication (that is, private line replacement) to SNA hosts
- SNA Multihost service - implements the SDLC TPAD, to provide communication to multiple SNA X.25 hosts (that is, switched access) using the QLLC protocol.

The Singlehost TPAD attaches IBM-compatible Type 1 and Type 2 Physical Units. The Multihost TPAD interfaces IBM-compatible Type 2 Physical Units over a dedicated B-channel on an ISDN loop. The HPAD interfaces an IBM SNA Host over a dedicated B-channel, also on an ISDN loop.

The following terms are used in this subsection:

- DTE - Data Terminating Equipment. An SNA Host or SNA controller connected to a PAD is referred to as a DTE.
- NCP - Network Control Program
- NPSI - NCP Packet Switch Interface
- PAD - Packet Assembler and Disassembler
- QLLC - Qualified Logical Link Control
- SDLC - Synchronous Data Link Control
- SNA - System Network Architecture
- SNA SDLC Host - Host which talks to the network on an SDLC link through the HPAD
- SNA X.25 Host - Host equipped with a NPSI or other X.25 front end
- Station - SDLC cluster controller plus terminals
- Station State / Station Mode - NRM or NDM
  - — NRM - Normal Response Mode
  - — NDM - Normal Disconnect Mode

A.5.2 Service specification

A.5.2.1 SNA singlehost

The SNA Singlehost service is offered on the Nortel Networks ISDN switch in the following two configurations, selectable at service subscription time:

1 Both the Stations and an SNA SDLC Host are connected to the ISDN switch over B-channels on the ISDN loops.

— The SDLC protocol is used between the SDLC stations and the network, and between the SNA SDLC Host and the network.

— This requires both the SDLC terminal PAD and the SDLC host PAD services on the ISDN switch.

— All communications between the terminal PAD and host PAD are through PVCs.

2 Both the SDLC stations and the SNA X.25 Host are connected to the ISDN switch over B-channels on the ISDN loops.

— However, the SDLC protocol is used between the SDLC stations and the network, and X.25 protocol is used between the SNA X.25 Host and the network.

— Only the SDLC terminal PAD service is required in this case.

— Both switched virtual circuits and PVCs are supported between the terminal PAD and the SNA X.25 Host.

— Note that the host must implement its own PAD for QLLC, for example, by installing the Network Control Packet Switching Interface (NPSI) from IBM.

A.5.2.2 SNA multihost

The SNA Multihost service offered on the Nortel Networks ISDN switch is configured as follows:

- Both the SDLC stations and SNA X.25 Hosts are connected to the ISDN switch over B-channels on the ISDN loops.
- However, use the SDLC protocol between the SDLC stations and the network, and the X.25 protocol between SNA X.25 Hosts and the network.
- Only switched virtual circuits are supported between the terminal PAD and the SNA X.25 hosts.
- The host must implement its own PAD for QLLC, for example, by installing the NPSI.

Refer to NTP 241-1001-193, *SDLC Specification* and NTP 241-1001-196, *SNA Multihost TPAD Specification* for exact details of the Nortel Networks implementation of the SNA Single and Multihost services.

- B-channel rate adaption - implement B-channel rate adaption as specified for X.25 based data services. See Section A.2.1, "Rate adaption".
- Classes of traffic priority -The traffic priority class is specified at subscription time, and can be either normal or high priority. Packet sizes are selectable independent of traffic class. Valid packet sizes are: 16, 32, 64, 128, 256 and 512 bytes.
- Maximum frame size - The maximum frame size allowed is 521 bytes.
- SDLC frame level overview -The SDLC frame level specifications are compatible with the *IBM Synchronous Data Link Control - General Information*, GA27-3093-3 with the following restrictions:

The SDLC service supports only two-way alternate transmission, non-switched, per station.

The following SDLC features are not supported:

— SDLC Loop Configuration

— NRZI (non≠return to zero inverted)

— A station mode of initialization

— SDLC frame types:

  – UI - unnumbered information frame

  – RIM - request initialization mode

  – SIM - set initialization mode

  – BCN - beacon

  – CFGR - configure

  – UP - unnumbered poll

— Group addresses

- Data link configuration - The SDLC service supports point-to-point or multipoint.

  — Communication is through a duplex channel, but logically half duplex.

  — For multipoint, the duplex channel is used as two half≠duplex channels.

  — For example, a primary station may transmit to one station while receiving from another.

- Primary and secondary stations -The SNA TPAD (Single and Multihost) operates as a primary station. That is, it sends SDLC commands to, and receives responses from, the SDLC stations attached to the data link.

  — The secondary SDLC stations attached to the TPAD transmits data only when given permission by the TPAD.

  — The SNA HPAD operates as a secondary station, it receives SDLC commands from the SNA SDLC Host and transmits responses when given permission.

- Station mode definitions -The following station modes of operation are supported:

  — Normal Response Mode (NRM) - a station in NRM exchanges data and flow control supervisory commands with other stations on the link.

  — Normal Disconnected Mode (NDM) - a station in NDM exchanges only mode setting and other control commands.

- SDLC frame format -The SDLC frame format is identical to the HDLC frame format of X.25.

A.5.2.3 Qualified Logical Link Control (QLLC)

Physical and logical paths support the information path between the SNA X.25 host or SNA SDLC host, and the SDLC stations.

- Physical circuits provide physical connections between SDLC DTEs and PADs, and between X.25 DTEs and the network.
- Virtual circuits provide information path between the SNA X.25 host and the SDLC terminal PAD, or between SDLC terminal PAD and the SDLC host PAD.
- A logical link is the association of a virtual circuit to a SDLC DTE, and provides an end-to-end information path between a SNA X.25 host or SNA SDLC host and a SDLC DTE. Logical links are controlled by SNA X.25 hosts and SNA SDLC hosts (indirectly through HOST PAD) through exchanges of Qualified Data Packets (Q-Packets) with Terminal PADs. This function is called QLLC. The elements of the QLLC protocol are according to the *IBM X.25 interface for attaching SNA nodes to Packet Switched Data Networks General Information Manua*l - GA27-3345-1.

Appendix B: ISDN Meridian Feature Transparency Call Control Signaling Specifications

APPENDIX B OVERVIEW

This appendix contains the call control signaling specification for the Meridian Feature Transparency (MFT) product.

Terminal equipment which conforms to Section I of NIS-S208-6 will continue to function on a DMS-100 switch with the current software level provided. This is assured by the protocol version control procedure when layer 2 is established which ensures that the terminal and switch are using the same protocol version.

B.1 INTRODUCTION

B.1.1 General

This section contains the layer 3 specification for the Integrated Services Digital Network (ISDN) basic rate user-network interface between the Nortel Networks DMS-100 ISDN switch and Meridian Feature Transparency (MFT) terminals designed for the basic digital subscriber line (DSL). The interface described in this section is based on the CCITT ISDN I and Q Series Recommendations and ISDN standards established by ANSI/ECSA-T1S1. An MFT terminal is one which supports access to the full range of DMS-100 Meridian Digital Centrex (MDC) features, as described in this specification.

The messages, procedures, and information element encodings described in this specification are a subset of those specified in CCITT Recommendation Q.931. Additional procedures and information element encodings have been provided in order to satisfy the signaling requirements of the interface.

This section contains the messages, information element encoding, and procedures for Meridian Feature Transparency operation. Functional call control and services are described elsewhere in this specification. Please refer to Chapter 1 for a description of the contents of all sections of this document.

B.1.2 Scope And Objective

The purpose of this document is to define the characteristics of the ISDN basic rate interfaces between Meridian Feature Transparency (MFT) terminals and digital subscriber lines terminating on a DMS-100 ISDN switch, the signaling procedures across the interfaces, and the capabilities provided by the DMS-100 ISDN switch to support ISDN basic rate MFT terminals.

Meridian Feature Transparency terminals do not themselves contain knowledge of feature operations and call control. They communicate “events” to the network (for example, keypad presses and on/off-hook) and the network controls the terminal's display, feature lamps/indicators, handset, hands-free, and terminal-generated tones. All of the feature intelligence is provided by the DMS-100.

The range of operations supported is equivalent to that on the Meridian Business Set (MBS), a non-ISDN set which has access to the complete range of Meridian Digital Centrex features. This interface supports access to all Meridian Digital Centrex features for those ISDN customers which require this capability in advance of industry-wide standards and specifications for the same capability on ISDN functional signaling interfaces.

Customers who wish to access ISDN functional Meridian Digital Centrex features using an ISDN signaling interface, which is based on the relevant Bellcore specifications, should refer to Chapters 1 through 9 of this document.

B-channel, circuit-mode speech is the only bearer capability supported for Meridian Feature Transparency terminals. Please refer to the functional signaling sections of this document for information on the support of other bearer capabilities.

B.1.3 Overview of Stimulus Mode Operation

The stimulus signaling specified in this document is a simplified version of the Type 1 stimulus signaling specified in the CCITT Q.931 Red Book (1984). Stimulus mode operation is described as follows:

> Signaling messages sent by stimulus terminals to the network are usually generated as a direct result of actions by terminal users (e.g. handset lifted) and in general do little more than describe the event which has taken place at the man-machine interface. Similarly, signaling messages sent by the network to terminals operating in the stimulus mode contain explicit instructions regarding the operations to be performed by the terminal (e.g. connect B-channel, start alerting, etc.).

The procedures defined in this appendix are based on the concept of the abstract terminal as described in Section 1.8, "Abstract Terminal".

Within a stimulus environment, the network and terminal operate primarily through consideration of the actual “stimuli” contained in the information elements within each message.

The procedures defined in this section are based on the assumption that the network maintains a complete profile of the stimulus terminal. The terminal need not maintain any knowledge of the significance of any activators or indicators at the man-machine interface, or of the associated bearer capability.

These assumptions allow a simplification of the signaling procedures such that only the INFOrmation message is used, with a limited set of information elements to convey information regarding actions at the man-machine interface, such as activation of feature “activators” (keys or equivalent), activation of feature indicators (lamps, etc.) and prompts to generate local tones and connection to the appropriate B-channels.

The stimulus mode terminals need not maintain a record of the state of any call which is currently supported since they have a master-slave relationship with the network.

B.1.4 OVERVIEW OF CALL CONTROL

This section is intentionally left blank to maintain consistency in section numbering with Chapter 5 of this specification. Section 5.2, "Overview of call control" specifies the call states appropriate to functional signaling procedures.

B.2 MESSAGE FUNCTIONAL DEFINITIONS

B.2.1 Overview

Each definition includes:

a) a brief description of the message direction and use;

b) a table listing the information elements contained in the message. For each information element, the table indicates:

1) the section of this recommendation describing the information element,

2) the direction in which it may be sent, i.e., user to network ('u ->n'), network to user ('n->u') or both,

3) whether inclusion is mandatory ('M') or optional ('O'); some explanatory notes are provided to indicate when optional information elements are to be included in the message,

4) the length(s), in octets.

The information elements are listed in order of appearance in the message. The relative order of information elements is the same for all message types.

c) further explanatory notes, as necessary.

B.2.2 Messages for Circuit-Mode Connections

The messages for circuit-mode connections follow.

B.2.3 INFOrmation

This message is sent from the user to the network, or from the network to the user, to provide information and convey 'stimuli' across the user-network interface.

Message type: INFOrmation
Direction: Both

Table 180 INFOrmation Elements

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	Protocol Discriminator on page 673	both	M	1
Call Reference	Call Reference on page 674	both	M	1 -2
Message Type	Message Type on page 675	both	M	1
Cause	Cause on page 680	N->U	O	4 - 6
Date/time	Date/time on page 688	N->U	O	8
Keypad	Keypad on page 683	U->N	O	3
Information Request	INFOrmation on page 670	N->U	O	3
Feature Activation	Feature Activation on page 684	U->N		3 - 4
Feature Indication	Feature Indication on page 685	N->U		3 - 5
Service Profile Identification	Service Profile Identification on page 686	U->N		3 - 22
Endpoint Identifier	Service Profile Identification on page 686	N->U		3 - 4
Locking Shift	Locking Shift Procedure on page 679	both		1
Display Text	Display Text on page 696	N->U		3 - N
B-channel Control	B-Channel Control on page 690	both		3
Meridian Transparency	Meridian Transparency on page 691	both		3 - N
Sequence	Sequence on page 693	both		3
Protocol Version	Protocol Version on page 694	both		3 - N

Notes

- **Cause** may be included to report certain error conditions.
- **Date/time** may be included by the network to indicate the current date and time.
- **Keypad** may be included by the user to transfer dialed digits to the network.
- **Information Request** may be included by the network to request the user to initialize.
- **Feature Activation** may be included by the user for feature invocations, and other call control functions, that are provisioned in the network.
- **Feature Indication** may be included by the network to inform the user of the current status of the identified feature.
- **Service Profile Identification** may be included by the user for terminal initialization procedures.

- **Endpoint Identifier** may be included by the network to identify the endpoint identifier assigned to the terminal.
- **Locking Shif**t is only included if any Code set 6 information elements appear in the message.
- **Display Text** may be included by the network to control the terminal's display.
- **B-Channel Control** may be included by the network to inform the user of a B-channel which is being allocated or released. The user uses the same information element to acknowledge these network-initiated B-channel procedures.
- **Meridian Transparency** may be included by the network to control certain terminal functions, including the terminal's display. The user may include Meridian transparency information elements to inform the network of certain terminal events.
- **Sequence** is only included by the user when the message does not contain a Service profile identification or a Protocol version information element. The Sequence information element may be included when the network wishes to check that no user to network messages have been lost.
- **Protocol Version** may be included by the network or user to perform protocol version control.

B.3 MESSAGE STRUCTURE

The figures and text in this section describe message contents. Within each octet, the bit designated “bit 1” is transmitted first, followed by bits 2, 3, 4, etc. Similarly, the octet shown at the top of each figure is sent first.

This section defines the encoding of all information elements contained within the protocol messages. Only those information elements whose use is currently defined within this document are included. CCITT information elements and others that are currently not contained in this description will be included when their use is required. Also, the encoding of a specific information element may only be a subset of the complete encoding defined in CCITT, until the complete encoding is required.

B.4 Overview

Within this protocol, every message may consist of the following parts:

- Protocol Discriminator;
- Call Reference;
- Message Type;
- Other Information Elements, as required.

Information elements a), b), and c) are common to all the messages and must always be present, while d) information elements are specific to each message type.

This general message structure is illustrated in Figure 186, "General Message Organization Example".

The maximum message length will be 260 octets.

A particular message may contain more information than a particular user or network equipment needs or can understand. All equipment should be able to ignore any extra information present in a message, which is not required for the proper operation of that equipment.

A particular information element may be present only once in a given message, unless otherwise specified.

A particular information element may be present, but empty. This should be interpreted by the receiver as equivalent to that information element being absent.

The term “default” implies that the value defined should be used in the absence of any assignment, or the negotiation of alternative values.

When a field extends over more than one octet, the order of bit values progressively decreases as the octet number increases. The least significant bit of the field is represented by the lowest numbered bit of the highest numbered octet of that field.

Figure 186 General Message Organization Example

```
   8     7     6     5     4     3     2     1
 ------------------------------------------------
|             Protocol Discriminator             |   Octet 1
|------------------------------------------------|
|                       | Length of Call Ref.    |         2
|  0     0     0     0  | Value (in octets)      |
|------------------------------------------------|
|              Call Reference Value              |         3
|------------------------------------------------|
|  0  |              Message Type                |         etc.
|------------------------------------------------|
|                     Other                      |
=             Information Elements               =
|                  As Required                   |
 ------------------------------------------------
```

B.5 Protocol Discriminator

The purpose of the protocol discriminator is to distinguish messages for user-network call control from other messages.

The protocol discriminator is the first part of every message. The protocol discriminator is coded as shown in Figure 195, "Cause Values".

Figure 187 Protocol discriminator

```
  8     7     6     5     4     3     2     1
+-----------------------------------------------+
|     Q.931 user—network call control message   |
  0     0     0     0     1     0     0     0      Octet 1
|             Protocol Discriminator            |
+-----------------------------------------------+


0 0 0 0 1 0 0 0
----------------------
8 7 6 5 4 3 2 1
```

Q.931(I.451) user-network call control message

B.5.1 Call Reference

The purpose of the call reference is to identify the call request at the local user-network interface to which the particular message applies. The call reference does not have end-to-end significance across ISDNs.

The call reference is the second part of every message. The length of the call reference value is indicated in octet 1, bits 1-4 of Figure 188, "Call Reference information element," on page 675.

The maximum length of the call reference value is two octets.

The call reference information element includes the call reference value and the call reference flag.

The call reference flag can take the values “0”, or “1”. The call reference flag is used to identify which end of the layer two logical link originated a call reference value. The origination side always sets the call reference flag to “0”. The destination side always sets the call reference flag to a “1”. Hence the call reference flag identifies who allocated the call reference value for this call and the only purpose of the call reference flag is to resolve simultaneous attempts to allocate the same call reference value.

Figure 188 Call Reference information element

8	7	6	5	4	3	2	1	
0	0	0	0	Length of Call Ref. Value (in octets)				Octet 1
flag	Call Reference Value							2 etc.

Call Reference Flag (octet 2)

Bit 8	
0	The message is sent from the side that originates the call
1	The message is sent to the side that originates the call re

The call reference information element containing a null call reference is one octet long and is coded “0000 0000”, as shown in Figure 189, "Null Call Reference". The null call reference is the only type of call reference used in this specification.

Figure 189 Null Call Reference

8	7	6	5	4	3	2	1	
0	0	0	0	Length of Call Reference Value 0	0	0	0	Octet 1

B.6 Message Type

The purpose of the message type is to identify the function of the message being sent. The message type is the third part of every message; it is coded as shown in Figure 190, "Message Types".

Figure 190 Message Types

8	7	6	5	4	3	2	1	
0	Message Type							Octet 1

8	7	6	5	4	3	2	1	
0	1	1	1	1	0	1	1	— INFOrmation

Message Types

B.7 Other Information Elements (codeset 0)

B.7.1 Coding Rules

The coding of other information elements follows the coding rules described below. These rules are formulated to allow each equipment which processes a message to find information elements important to it, and yet remain ignorant of information elements not important to that equipment.

Two categories of information elements are defined, as given in Figure 191, "Formats of Information Elements," on page 677:

Single Octet Information Elements

Variable Length Information Elements

For the information elements described below, the coding of the information element identifier bits is summarized in Figure 192, "Information Element Identifier Encoding," on page 678.

There is a particular order of appearance for each information element within a message. The code values of the information element identifiers of the variable length formats are assigned in ascending numerical order, according to the actual order of appearance of each information element in a message. This allows the receiving equipment to detect the presence or absence of a particular information element without scanning through an entire message.

Note: Information elements shall appear in messages according to the following rules. All information elements belonging to the CCITT Q.931 codeset shall appear at the beginning of each message in ascending order (of information element identifier value). Any network-specific (codeset 6) information elements required in that message will appear at the end of the message, following a Locking shift information element, in ascending numerical order. Thus there may be two lists of information elements ordered according to ascending information element identifier value, one ascending list for each codeset contained in the message. If a message contains only standard CCITT information elements, or only network-specific information elements, then there shall be a single ascending list.

Where the description of information elements in this specification contains spare bits, these bits are indicated as being coded to “0”. In order to allow compatibility with future implementation, messages should not be rejected simply because a spare bit is set to “1”.

The second octet of a variable length information element indicates the total length of the contents of that information element (i.e. the length starting with octet 3), regardless of the coding of the first octet. It is the binary value of the number of octets of the contents, with bit 1 as the least significant bit.

There is no length field in the single octet information element structure.

An optional variable length information element may be present but empty. For example, an INFOrmation message may contain a Feature activation information element, the content of which is of zero length. This should be interpreted by the receiver as equivalent to that information element being absent. Similarly, an absent optional information element should be interpreted by the receiver as equivalent to that information element being empty.

The following rules apply for the coding of variable length information elements in the format descriptions appearing in Sections B.7.4, "Cause," on page 680, and following.

1 Bit 8 is marked “0/1 ext” if another octet follows. Bit 8 is marked “1 ext” if this is the last octet in the extension domain.

2 Optional octets are marked with asterisks.

Figure 191 Formats of Information Elements

8	7	6	5	4	3	2	1	
1	Information Element Identifier			Contents of Information Element				Octet 1

(a) Single Octet Information Element Format

8	7	6	5	4	3	2	1	
0	Information Element Identifier							Octet 1
Length of Information Element (octets)								2
Contents of Information Element								3 etc.

(b) Variable Length Information Element Format

Note:
Bit 8 is used to distinguish short (single octet) and long (multiple octet) format.

Figure 192 Information Element Identifier Encoding

```
  Information Element
      Identifier

8  7  6  5  4  3  2  1

1  :  :  :  :  :  :  : Single Octet Information Element

   0  0  1  0  —  —  —   Locking Shift

   0  0  1  0  1  1  0   Locking Shift, codeset 6

0  :  :  :  :  :  :  : Variable Length Information Element

   0  0  0  1  0  0  0   Cause
   0  1  0  1  0  0  1   Date/time
   0  1  0  1  1  0  0   Keypad
   0  1  1  0  0  1  0   Information Request
   0  1  1  1  0  0  0   Feature activation
   0  1  1  1  0  0  1   Feature indication
   0  1  1  1  0  1  0   Service profile identification
   0  1  1  1  0  1  1   Endpoint identifier

******************************************************
* The following information elements should follow a *
* Locking shift information element, with Codeset 6  *
* (for network specific use).                        *
******************************************************
   0  1  0  1  0  1  0   Display text
   0  1  1  1  0  1  0   B—channel control
   0  1  1  1  1  0  0   Meridian transparency
   0  1  1  1  1  0  1   Sequence
   0  1  1  1  1  1  0   Protocol version
```

B.7.2 Extensions of Codesets

There are 136 possible information element identifier values using the formatting described in Section B.7.1, "Coding Rules", 8 from the single octet information element format and 128 from the variable length information element format.

One value in the single octet format is specified for shift operations described below. One other value in both the single octet and variable format is reserved. This leaves 133 information element identifier values available for assignment.

It is possible to expand this structure to eight codesets of 133 information element identifier values each. One common value in the single octet format is employed in each codeset to facilitate shifting from one codeset to another. The contents of this shift item identifies the codeset to be used for the next information element or elements. The codeset in use at any given time is referred to as the “active codeset.” By convention, codeset 0 is the initially active (default) codeset.

Codeset 6 is reserved for information elements specific to the local network (either public or private).The coding rules specified in Section B.7.1, "Coding Rules", shall apply for information elements belonging to any active codeset.

Transitions from one active codeset to another (i.e. by means of the locking shift procedure) may only be made to a codeset with a higher numerical value than the codeset being left.

A user or network equipment shall have the capability to recognize a Locking shift information element and to determine the length of the following information element, although the equipment need not be able to interpret and act upon the content of the information element. This enables the equipment to determine the start of a subsequent information element.

B.7.3 Locking Shift Procedure

The locking shift procedure employs the Locking shift information element (single octet) to indicate the new active codeset. The specified codeset remains active until another Locking shift information element is encountered which specifies the use of another codeset. Codeset 0 is active at the start of message content analysis. If a locking shift to a higher codeset is encountered, the next information elements will be interpreted according to the information element identifiers assigned in the new codeset, until another Locking shift information element is encountered, or the end of the message is reached.

This procedure is used only to shift to a higher order codeset than the one being left.

The locking shift is valid only within that message which contains the Locking shift information element. At the start of every message content analysis, the active codeset is codeset 0.

The Locking shift information element uses the single octet information element format and coding shown in Figure 193, "Locking Shift INFOrmation Element," on page 680.

Figure 193 Locking Shift INFOrmation Element

8	7	6	5	4	3	2	1	
1	Shift 0	0	1 Identifier	0	New Codeset Identification			Octet 1

Shift Procedure (bit 4):

0 = locking shift

Codeset Identification:

3 2 1	
0 0 0	Codeset 0 (Q.931 information elements)
1 1 0	Codeset 6 (information elements specific to the local serving network)

B.7.4 Cause

The purpose of the Cause information element is to notify the terminal of an error condition or other conditions such as network congestion and service/option not available, to provide diagnostic information in the event of procedural errors, and to indicate the location of the cause originator.

The Cause information element is coded as shown in Figure 194, "Cause INFOrmation Element"and Figure 195, "Cause Values". Diagnostic information is not available for every cause. When available the coding of the diagnostic(s) is the same as for the corresponding information element in Section B.3, "MESSAGE STRUCTURE".

The Cause information element and diagnostic may be repeated in a message, to report multiple errors.

Figure 194 Cause INFOrmation Element

8	7	6	5	4	3	2	1	
0	Cause 0	0	0	1	0	0	0 Information Element Identifier	Octet 1
Length of Cause Information								2
Ext. 1	Coding Std 0	0	Spare 0	General Location 0	0	1	0	3
Ext. 1	Cause Value Class			Value				4
Diagnostics (if any)								5* 6*

*** This octet may be omitted**

Coding standard (octet 3)

Bits 7 6

0 0 CCITT standard

General location (octet 3)

Bits 3 2 1

0 1 0 local network

Cause Value (octet 4)

The cause value is divided in two fields, a class (bits 5–7) and a value within the class (bits 1–4).

The class indicates the general nature of the event.

class (000) : normal event
class (001) : normal event
class (010) : network congestion
class (011) : service or option not available
class (100) : service or option not implemented
class (101) : invalid message (e.g. parameter out of range)
class (110) : protocol error (e.g. unknown message)
class (111) : interworking

Figure 195 Cause Values

Cause value: Class 7 6 5	Cause value: Value 4 3 2 1	Cause Number	Cause	Diagnostics
0 1 0	0 0 1 0	34.	circuit/channel congestion	
1 0 0	0 1 0 1	69.	requested facility not implemented	
1 0 1	0 0 0 1	81.	invalid call reference value	
1 1 0	0 0 0 1	97.	message type non existent or not implemented	— message type
1 1 0	0 0 1 1	99.	information element non—existent or not implemented	info. elem. identifier
1 1 0	0 1 0 0	100.	invalid information element contents	info. elem. identifier
1 1 0	1 1 1 1	111.	protocol error, unspecified	

All other values are reserved.

Note: The diagnostics field must be included for cause values 97, 99, and 100.

The information element identifier or message type in the diagnostics field is one or two octets long. An information element identifier which is not in codeset 0 is preceded by a Locking shift information element which specifies the appropriate. codeset.

Definition of CCITT-standardized Causes

The following list contains definitions for each of the causes.

NETWORK CONGESTION CLASS

- Cause 34 - Circuit/channel congestion

  This cause indicates that there is no appropriate circuit/channel, presently available, to handle the call request.

SERVICE OR OPTION NOT IMPLEMENTED CLASS

- Cause 69 - Requested facility not implemented

  This cause indicates that the requested facility is not implemented and therefore cannot be accessed at this time.

INVALID MESSAGE CLASS

- Cause 81 - Invalid call reference value

This cause indicates that the equipment sending this cause has received a message with a call reference which is not currently in use on the user-network interface.

PROTOCOL ERRORS CLASS

- Cause 97 - Message type non-existent or not implemented

This cause indicates that the equipment sending this cause has received a message with a message type it does not recognize either because this is a message not defined or defined but not implemented by the equipment sending this cause.

- Cause 99 - Information element non-existent or not implemented

This cause indicates that the equipment sending this cause has received a message which includes the information elements not recognized because the information element identifier is not defined or it is defined but not implemented by the equipment sending the cause. However, the information element is not required to be present in the message in order for the equipment sending the cause to process the message.

- Cause 100 - Invalid information element contents
  This cause indicates that the equipment sending this cause has received an information element which it has implemented but the contents are invalid (e.g. truncated, invalid extension bit, invalid field values etc.)
- Cause 111 - Protocol error, unspecified

This cause is user to report a protocol error event only when no other cause in this class applies.

B.7.5 Keypad

The purpose of the Keypad information element is to convey an IA5 character that is, for example, entered by means of a terminal keypad. The Keypad information element is coded as shown in Figure 196, "Keypad INFOrmation Element".

Figure 196 Keypad INFOrmation Element

8	7	6	5	4	3	2	1	
0	Keypad Information Element Identifier: 0	1	0	1	1	0	0	Octet 1
Length of Keypad Information: 0	0	0	0	0	0	0	1	2
Keypad information (IA5 character)								3

Keypad information (octet 3)

Bits 7 6 5 4 3 2 1	Meaning
0 1 1 0 0 0 0	0
0 1 1 0 0 0 1	1
0 1 1 0 0 1 0	2
0 1 1 0 0 1 1	3
0 1 1 0 1 0 0	4
0 1 1 0 1 0 1	5
0 1 1 0 1 1 0	6
0 1 1 0 1 1 1	7
0 1 1 1 0 0 0	8
0 1 1 1 0 0 1	9
0 1 0 1 0 1 0	*
0 1 0 0 0 1 1	#

B.7.6 Feature Activation

The purpose of the Feature activation information element is for a terminal to provide information on actions at the man-machine interface; that is, to indicate that a feature activator has been activated. The feature activator may also be interpreted by the network as a softkey activator or a Directory Number activator.

The Feature activation information element is coded as shown in Figure 197, "Feature Activation INFOrmation Element".

Figure 197 Feature Activation INFOrmation Element

8	7	6	5	4	3	2	1	
0	Feature Activation 0 1 1 1 0 0 0 Information Element Identifier							Octet 1
Length of Feature Activation contents								2
0/1 Ext.	Feature Identifier Number							3
1	Feature Identifier Number (continuation)							3a*

***** this octet may be omitted.

```
Feature Identifier Number (octets 3 and 3a)
 Bits   7 6 5 4 3 2 1   Meaning
 ----   -------------   -------
        0 0 0 0 0 0 0   reserved
        0 0 0 0 0 0 1   feature number 1
    .      .
    .      .
    .      .
        1 0 0 0 0 0 0   feature number 64

All other values are reserved.
```

The network will ignore any values which are not in the range 1 to 64.

The feature identifier number is a unique number assigned to a feature. This number identifies the feature or Directory Number that is being requested or updated. The association of a particular number to a particular feature may be different for each user.

Bit 8 in octet 3 is used to extend the feature identifier number field. The identifier numbers for a one octet field range from 1 to 127. For a multi-octet field, the order of bit values progressively decreases as the octet number increases.

B.7.7 Feature Indication

The purpose of the Feature indication information element is for the network to optionally convey feature indications to a terminal. The feature indicator may also refer to a Directory Number indicator. If the terminal does not support the indicator specified in a Feature indication information element, the information element shall be ignored. This information element may be repeated in a message and should be coded as in Figure 198, "Feature Indication Information Element":

Figure 198 Feature Indication Information Element

8	7	6	5	4	3	2	1	
0	Feature Indication 0 1 1 1 0 0 1 Information Element Identifier							Octet 1
Length of Feature Indication Information								2
0/1 Ext.	Feature Identifier Number							3
1	Feature Identifier Number (continuation)							3a*
Spare 0 0 0 0				Status Indicator				4

**** This octet may be omitted.***

Feature Identifier Number (octets 3 and 3a)

This field is coded as described for the Feature activation information element.

Feature Identifier Number (octets 4, bits 1-4)

The status indicator field identifies the current status of the feature or Directory Number.

Bits 4 3 2 1	Status	Meaning
0 0 0 0	idle	feature is in an idle state
0 0 0 1	active	feature is in an active state
0 0 1 0	prompt	feature prompt (Note 1)
0 0 1 1	pending	feature is pending (Note 2)

Note 1. The recommended indicator state is flash (50% on, 50% off, at 60 cycles per minute)

Note 2. The recommended indicator state is wink (67% on, 33% off, at twice the flash rate - 120 cycles per minute)

B.7.8 Service Profile Identification

The purpose of the Service profile identification information element is to allow the user to initiate dynamic assignment of the user service identifier and terminal identifier.The structure of the Service profile identification information element is shown in Figure 199, "Service Profile Identification Information Element".

Figure 199 Service Profile Identification Information Element

8	7	6	5	4	3	2	1	
0	Service Profile Identification 0	1	1	1	0	1	0 Information Element Identifier	Octet 1
Length of service profile ident. contents								2
0 Spare	Service Profile Identifier (SPID) (IA5 characters)							3 etc.

Service Profile Identifier (SPID) (octets 3 etc.)

The SPID parameter is contained in octet 3, etc., and should be coded in IA5 characters. The SPID may have up to 20 characters.

B.7.9 Endpoint Identifier

The purpose of the Endpoint identifier information element is to indicate the user service identifier and terminal identifier for the purpose of terminal identification and to indicate a specific terminal for the purpose of terminal selection.

The Endpoint identifier information element is coded as shown in the following figure.

Figure 200 Endpoint Identifier Information Element

8	7	6	5	4	3	2	1	
0	Endpoint Identifier 0	1	1	1	0	1	1 Information Element Identifier	Octet 1
Length of endpoint identifier contents								2
1 Ext.	User Service Identifier							3
1 Ext.	Int.	Terminal Identifier						4*

**** This octet may be omitted.***

User Service Identifier (USID) (octet 3)

The USID is a selection parameter which identifies a group of terminals on a interface which share a common service profile and which may be addressed together. This parameter may have values from 0 to 127.

When used in the terminal initialization procedures, this parameter contains a value from 0 to 126 which is assigned by the switch and is uniquely associated with the identified service profile.

Interpreter (octet 4 - bit 7)

This bit indicates how the TID is to be interpreted. In the initialization procedure, this bit is set to “0”. To select a particular terminal, this bit is set to “0”, and the TID value is set to the value assigned to the terminal in the initialization procedure. To select all but a particular terminal associated with a service profile, the TID and USID parameters are set to the values which identify the particular terminal and service profile, and the Interpreter bit is set to “1”. When all terminals which share a service profile are to be selected, octet 4 is not necessary and may be omitted. However, if octet 4 is included, the Interpreter bit is set to “0”.

Terminal Identifier (TID) (octet 4 - bits 6-1)

The TID is a selection parameter which identifies a single terminal within a group designated by a USID value. It may have values from 0 to 63.

When used in the initialization procedures, it is coded from 0 to 62. To identify a particular terminal, the TID is coded with the value assigned in the initialization procedure. When all terminals which share a service profile are to be selected, octet 4 is not necessary and may be omitted. However, if octet 4 is included, the TID is coded as all “1”s

B.7.10 Date/time

The purpose of the Date/time information element is to provide the date and time to the user. It indicates the point in time when the message has been generated by the network.

The date and time are aligned with the local time at the switch location.

The Date/time information element is coded as shown in Figure 201, "Date/time Information Element". Octets 3 - 8 are binary coded (bit 1 being the least significant bit).

Figure 201 Date/time Information Element

8	7	6	5	4	3	2	1	
0	0	1	0	1	0	0	1	Octet 1
	Date/time Information Element Identifier							
Length of Date/time Information								2
year								3
month								4
day								5
hour								6
minute								7
second								8

The year field does not contain the century. That is, it is a number in the range 0 to 99 (e.g. “1991” sent as “91”).

The hour field is always sent in 24-hour clock format. Thus, the range is from 0 to 23.

B.7.11 Information Request

The purpose of the Information request information element is for the network to request additional information from the user during invocation of certain supplementary services.

The Information request information element is coded as shown in Figure 202, "Information Request".

Figure 202 Information Request

8	7	6	5	4	3	2	1	
0	Information Request 0	1	1	0	0	1	0 Information Element Identifier	Octet 1
Length of information request contents								2
1 Ext.	Info. Req. Ind	Type of Information						3

Information Request Indicator (octet 3 - bit 7)

```
Bit 7
----
    0    information request completed
    1    prompt for additional information
```

Type of Information (octet 3 - bits 1-6)

```
Bits 6 5 4 3 2 1
---- -----------
     0 0 0 0 1 1   terminal identification
```

All other values are reserved.

B.8 Network-Specific Information Elements (codeset 6)

The information elements defined in this section are network-specific and should be coded using the locking shift procedure to codeset 6.

B.8.1 B-Channel Control

The B-channel control information element is used by the network to request a stimulus terminal to connect or release a B-channel. In the latter case (release B-channel), a terminal echoing this information element is interpreted by the network as a confirmation of B-channel release.

The B-channel control information element is coded as shown in Figure 203, "B-Channel Control Information Element".

Figure 203 B-Channel Control Information Element

```
   8     7     6     5     4     3     2     1
 +-----+-----------------------------------------+
 |     |          B—Channel Control              |
 |  0  |  0     1     1     1     0     1     0  |   Octet 1
 |     |   Information Element Identifier        |
 +-----+-----------------------------------------+
 |      Length of Control Information            |         2
 |  0     0     0     0     0     0     0     1  |
 +-----------------------------------------------+
 |        B—channel Control Parameter            |         3
 +-----------------------------------------------+
```

B—channel Control Parameter (octet 3)

8 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0 0	Release B1
0 0 0 0 0 0 0 1	Release B2
0 0 0 0 0 0 1 0	Connect B1
0 0 0 0 0 0 1 1	Connect B2

Note: All other values are reserved.

B.8.2 Meridian Transparency

The Meridian transparency information element is used by both the network and the user to convey certain stimulus call control and feature operations.

The Meridian transparency information element is coded as shown in Figure 204, "Meridian Transparency Information Element".

Figure 204 Meridian Transparency Information Element

```
   8     7     6     5     4     3     2     1
 +-----+-----------------------------------------+
 |     |        Meridian Transparency            |
 |  0  |  0     1     1     1     1     0     0  |   Octet 1
 |     |   Information Element Identifier        |
 +-----+-----------------------------------------+
 | Length of Meridian Transparency Information   |         2
 +-----------------------------------------------+
 |     Meridian Transparency Information         |         3
 |                                               |         4
 =                                               =         etc.
 +-----------------------------------------------+
```

B.8.2.1 Meridian Transparency Information (Octets 3-4, etc.)

Each octet pair of Meridian transparency information conveys a separate operation. Multiple operations may be included, that is, octets 3 to 4 may be repeated. The operations in the network to user direction are independent from those in the user to network direction, so they can reuse the same codes without causing any conflicts. The codes have been grouped according to direction (u-->n and n-->u), mandatory groups, and optional groups. Mandatory codes must be supported. Optional codes, if not supported by the user or network, will be ignored. See Figure 204, "Meridian Transparency Information Element" for a description of the use of this information.

User-to-Network Meridian Transparency Information

All Meridian transparency information in the user to network direction has octet 3 coded 00000000. The codes for octet 4 are shown in Figure 205, "(Octet 4) User-to-Network Meridian Transparency Info".

Figure 205 (Octet 4) User-to-Network Meridian Transparency Info

8 7 6 5 4 3 2 1 Mandatory
0 0 0 1 1 1 0 0 Terminal Goes Off-Hook
0 0 0 1 1 1 0 1 Terminal Goes On-Hook

Optional
0 0 0 0 1 0 1 1 Hold Key Pressed
0 0 0 0 1 1 1 1 Release Key Pressed
0 0 1 1 0 0 0 0 Response to “TSM” (No powerfail since last query)
0 0 1 1 0 1 0 0 Response to “TSM” (Powerfail occurred since last query)

Note:* *All other values are reserved. *TSM Transmit Status Message*

Network-to-User Meridian Transparency Information

All Meridian transparency information in the network to user direction has octet 3 coded 00000000.The Octet 4 should be coded as shown in Figure 206, "(Oct 4) Network-to-User Meridian Transparency Info":

Figure 206 (Oct 4) Network-to-User Meridian Transparency Info

8 7 6 5 4 3 2 1 Mandatory
0 0 0 0 1 0 0 0 Soft Reset
0 0 0 0 1 1 0 1 Disconnect handset from B-Channel
0 0 0 0 1 1 1 0 Turn Off Buzzer
0 0 0 0 1 1 1 1 Turn Off Tone Ringer
0 1 0 0 1 0 0 0 Save Status
0 1 1 0 1 0 0 0 Hard Reset
0 1 1 0 1 1 0 1 Connect Handset to B-Channel
0 1 1 0 1 1 1 0 Turn On Buzzer
0 1 1 0 1 1 1 1 Turn On Tone Ringer

8 7 6 5 4 3 2 1 Handsfree Option
0 0 0 0 1 0 1 1 Turn Off Handsfree
0 0 0 0 1 1 0 0 Disconnect Speaker from B-Channel
0 0 1 1 0 1 0 1 Microphone On
0 0 1 1 0 1 1 1 Microphone Off
0 1 1 0 1 0 1 1 Turn On Handsfree
0 1 1 0 1 1 0 0 Connect Speaker to B-Channel

Figure 207 Network-to-User Meridian Display Option

8 7 6 5 4 3 2 1	Display Option
1 0 0 0 1 0 1 1	Disable digit echo
1 0 0 0 1 1 0 0	Disable cursor
1 0 0 0 1 1 0 1	Disable display, retain display memory
1 0 0 1 1 0 0 0	Start display low power mode
1 0 0 1 1 0 1 1	Enable digit echo; when first digit entered, clear display, cursor at start of line 1; if digit entered when line 1 full, clear line 0, shift display left 1 position, and echo digit
1 0 0 1 1 1 0 0	Enable cursor
1 0 0 1 1 1 0 1	Enable display (show display memory)
1 0 1 0 1 0 1 1	Enable digit echo; when first digit entered, clear line 1, cursor at start of line 1; if digit entered when line 1 full, clear line 0, shift display left 1 position, and echo digit
1 0 1 1 0 1 1 1	Transmit status message
1 0 1 1 1 0 0 1	Cursor at start of line 0; clear display after 12 seconds or when next display command received
1 0 1 1 1 0 1 1	Enable digit echo

B.8.3 Sequence

The Sequence information element is used by the user to assign a sequence number to messages sent to the network. The network uses this information element to request that the user send the network an INFOrmation message containing a Sequence information element immediately so that the network can check for lost messages.

The Sequence information element is coded as shown in Figure 208, "Sequence Information Element".

Figure 208 Sequence Information Element

8	7	6	5	4	3	2	1	
0	Sequence 0	1	1	1	1	0	1 Information Element Identifier	Octet 1
Length of Sequence Information 0	0	0	0	0	0	0	1	2
1 Ext.	Req. Ind.	Sequence Number						3

Sequence Request Indicator (Octet 3)

Bits 7	Meaning
0	Sequence number provided
1	Sequence number request

B.8.4 Sequence Number (Octet 3)

The sequence number is an unsigned binary value between 0 and 63 which the network uses to check for lost user to network messages.

B.8.5 Protocol Version

The Protocol version control (PVC) information element allows for different ISDN protocols to be identified and stored in the network. Terminals can query this stored PVC information and effect communication by tailoring their respective protocols to the protocol versions and issues in effect in the network.

NT BellCore TR-compliant Functional (NTTRF), NT Stimulus, and NT Meridian Feature Transparency (NTMFT) call control signaling methods are each identified with a distinct protocol version. Within a particular version, different issue numbers are used to identify variations of the same protocol version over time.

Figure 209 Protocol Version INFOrmation Element

8	7	6	5	4	3	2	1	
0	Protocol Version 0 1 1 1 1 1 0 Information Element Identifier							Octet 1
Length of Protocol Version Control Information								2
1 Ext.	Spare 0 0		Version Opcode					3
0/1 Ext.	Version Code							4*
0/1 Ext.	Version Code							4a* etc.
0/1 Ext.	Issue Code							5*
0/1 Ext.	Issue Code							5a* etc.

Note: *

1. Octet 3 - the spare bits may be used as a Coding Standard field, at a later date.

2. Octets 4 and 5 can be extended and octets 3, 4, and 5 can also be repeated as a whole. Octets 4 and 5 should be provided at the same time, and these octets are currently provided for the “version response” and “version query” version opcodes.

3. Octet 4 - the MSB is bit 7 of octet 4. The LSB is bit 1 of the last occurrence of octet 4a.

4. Octet 5 - the MSB is bit 7 of octet 5. The LSB is bit 1 of the last occurrence of octet 5a.

Figure 210 Version Operation Codes (Octet 3)

```
  Bits
5 4 3 2 1  Meaning
---------  ------------------------------------------------
0 0 0 0 0  Version query(u-->n), query current version-issue
0 0 0 0 1  Version request(u-->n), version issue negotiation +
0 0 0 1 0  Version response(n-->u), respond to version query
0 0 0 1 1  Version prompt(n-->u), prompt terminal to send
                                   in version query or request+

+ Not supported at this time.

All other values are reserved.
```

Figure 211 Version Code (Octet 4)

```
Bits
7 6 5 4 3 2 1    Meaning
-------------    -------
0 0 0 0 0 0 1    NT Meridian Feature Transparency (NTMFT)

All other values are reserved.
```

Figure 212 Issue Code (Octet 5)

```
  Bits
7 6 5 4 3 2 1    Meaning
-------------    -------
0 0 0 0 0 0 0    issue number 0
0 0 0 0 0 0 1    issue number 1
0 0 0 0 0 1 0    issue number 2
0 0 0 0 0 1 1    issue number 3
    to
1 1 1 1 1 1 1    issue number 127
```

Note: the MFT version and issue codes supported and the relevant NT specifications that apply to each version and issue code follow. Refer to Chapter 5 of this specification for information on other supported protocol version and issue codes.

B.8.6 Display Text

The purpose of the Display text information element is to supply network formatted display information that is to be displayed on a terminal supporting this information element and its associated procedures. The maximum length of the Display text information element depends on the maximum length of the message and the existence of other information elements within that message.

Figure 213 Display Text Information Element

8	7	6	5	4	3	2	1	
0	Display Text 0 1 0 1 0 1 0 information element identifier							Octet 1
Length of display text contents								2
1	Display Type							3
Display Information (Note)								4 etc.

Display type

Bits 8	7 6 5 4 3 2 1	Meaning
1	0 0 0 0 0 0 0	Normal

Note : One or more groups of display information may be included depending on specific service requirements. All other values are reserved.
All other values are reserved.

Display information

Each item in the display information field can be defined by ASN.1 (CCITT X.208) and is coded according to CCITT X.209. An overview of ASN.1 and coding rules can be found in Section 5.14, "Abstract Syntax Notation One (ASN.1)"of this specification.

There are three types of tags used in display information:

1 Mandatory control tags (Blank and Skip),

2 Display text tags, and

3 Optional control tags.

The codings of the supported mandatory control tags, display text tags, and optional control tags are shown in the figures below (Figure 214, "Coding of Supported Mandatory control tags" and Figure 215, "Range of tags allocated to the optional control tags.".

Figure 214 Coding of Supported Mandatory control tags

```
    Bits
8 7 6 5 4 3 2 1    ASN.1 Description
________________    __________________

1 0 0 0 0 0 0 0    Blank        ::=  [0] IMPLICIT OCTET STRING
1 0 0 0 0 0 0 1    Skip         ::=  [1] IMPLICIT OCTET STRING
1 0 0 0 0 0 1 0    Continuation ::=  [2] IMPLICIT OCTET STRING
1 0 0 1 1 1 1 0    Text         ::= [30] IMPLICIT OCTET STRING
1 0 C 1 1 1 1 1    Local field  ::= [69]... (see below)
0 1 0 0 0 1 0 1

C: primitive = 0, constructor = 1.

All other values are reserved.
```

Figure 215 Range of tags allocated to the optional control tags.

```
Bits      8    7    6    5    4    3    2    1      Octet
____     ______________________________________      _____

          1    0   0/1   1    1    1    1    1        1
         1/0   1    X    X    X    X    X    X        2
         1/0   X    X    X    X    X    X    X       etc.
```

Bit 6 of octet 1 is the primitive/constructor bit (see Section 5.14, "Abstract Syntax Notation One (ASN.1)"). Bit 8 of octet 2, and any subsequent octets, is an extension bit (“0” indicates this is the last octet of the tag. A “1” in bit 7 of octet 2 indicates that this is an optional control tag which the terminal may ignore if it is not supported.

Display Tag Definitions

Blank The data element with this tag always has a 1 octet length and the content is an unsigned integer ranging from 1 to 255 which specifies the number of blank characters to append to any previous text.

Figure 216 The following coding example specifies 23 blanks:

```
Bits   8 7 6 5 4 3 2 1
____   _______________

     1 0 0 0 0 0 0 0   Blank tag
     0 0 0 0 0 0 0 1   length of contents
     0 0 0 1 0 1 1 1   unsigned integer = 23
```

Skip The data element with this tag always has a 1 octet length and the content is an unsigned integer ranging from 1 to 255 which specifies the number of display positions to skip before operating on the next display tag.

Figure 217 Coding Example Skips 9 display positions:

```
Bits    8 7 6 5 4 3 2 1
____    _______________
        1 0 0 0 0 0 0 1   Skip tag
        0 0 0 0 0 0 0 1   length of contents
        0 0 0 0 1 0 0 1   unsigned integer = 9
```

Continuation

The contents of the data element with this tag are coded the same as for the Text tag, and is used to specify a continuation of the text specified in an immediately preceding display text tag. It is never the first tag in a Display text information element, and can not immediately follow another continuation tag.

Figure 218 Example of ASCII text “HELLO” in a continuation data element:

```
Bits    8 7 6 5 4 3 2 1
____    _______________
        1 0 0 0 0 0 1 0   Continuation tag
        0 0 0 0 0 1 0 1   length of contents
        0 1 0 0 1 0 0 0   ASCII “H”
        0 1 0 0 0 1 0 1   ASCII “E”
        0 1 0 0 1 1 0 0   ASCII “L”
        0 1 0 0 1 1 0 0   ASCII “L”
        0 1 0 0 1 1 1 1   ASCII “O”
```

Text The data element with this tag contains a string of characters which are to be appended to any previous text.

Figure 219 Example of ASCII text “HELLO” in a text data element:

```
Bits    8 7 6 5 4 3 2 1
____    _______________
        1 0 0 1 1 1 1 0   Text tag
        0 0 0 0 0 1 0 1   length of contents
        0 1 0 0 1 0 0 0   ASCII “H”
        0 1 0 0 0 1 0 1   ASCII “E”
        0 1 0 0 1 1 0 0   ASCII “L”
        0 1 0 0 1 1 0 0   ASCII “L”
        0 1 0 0 1 1 1 1   ASCII “O”
```

Local field

The local field tag is an optional control tag used to define terminal local fields.

Figure 220 ASN.1 definition of this element.

```
Local—field ::=
      CHOICE {
          [69] IMPLICIT NULL,
          [69] IMPLICIT SEQUENCE
             {local—field—length CHOICE {
                 [0] IMPLICIT NULL,
                 [0] IMPLICIT INTEGER }
              Information —type}
             }

Information —type ::=
      CHOICE {
          date        [1] IMPLICIT OCTET STRING,
          time        [2] IMPLICIT ENUMERATED
                           {colon24 (0),
                            colon12 (1),
                            colon—ampm (2)},
          call—timer  [3] IMPLICIT OCTET STRING}}
```

If the NULL choice for the Local-field is selected, all existing local fields on the terminal should be removed.

Figure 221 How the Data Element would be code

```
Bits   8 7 6 5 4 3 2 1

     1 0 0 1 1 1 1 1   Local—field tag
     0 1 0 0 0 1 0 1     — tag definition continued
     0 0 0 0 0 0 0 0   length
```

The local-field-length data element is the length in display positions of the local field being defined. The starting position of the local field is the current cursor position. The range of the local-field-length value is from 0 to 127. A value of 0, or if the local-field-length data element is NULL, indicates that the specified local field, if it exists, should be deleted.

If a local field definition overwrites an already active local field, either partially or completely, the old local field display should be suppressed, but not deleted by the terminal. When the most recently defined local field is specifically deleted, the terminal should again display the former local field. If the NULL choice for the Local-field is selected (as discussed above) all local fields, including suppressed local fields, should be removed by the terminal.

When a date local field is defined, text representing the current date may also be included. If the length of the date data element is 0, there is no date text included.

Figure 222 The data element specifying a date local field might be coded.

```
Bits   8 7 6 5 4 3 2 1

     1 0 1 1 1 1 1 1   Local—field tag
     0 1 0 0 0 1 0 1     — tag definition continued
     0 0 0 0 1 0 1 1   length
     1 0 0 0 0 0 0 0   local—field—length tag
     0 0 0 0 0 0 0 1     length
     0 0 0 0 0 1 1 0     local field length = 6
     1 0 0 0 0 0 0 1   Information—type = date
     0 0 0 0 0 1 1 0     length
     0 1 0 0 1 1 0 1     ASCII: “M”
     0 1 0 0 0 0 0 1            “A”
     0 1 0 1 0 0 1 0            “R”
     0 0 1 0 0 0 0 0            “ ”
     0 0 1 1 0 0 0 1            “1”
     0 0 1 1 0 1 1 1            “7”
```

The time local field can have one of the following formats:

Colon24 The time is displayed in 24-hour format with the hours and minutes separated by a colon (e.g. “23:18”).

Colon12 The time is displayed in 12-hour format with the hours and minutes separated by a colon (e.g. “11:18”).

Colon-ampm The time is displayed in 12-hour format with the hours and minutes separated by a colon, followed by an AM or PM indicator (e.g. “11:18 PM”).

The data element specifying a time local field with a 12-hour clock would be coded as follows:

Figure 223 Data element specifying a time local field with a 12-hour clock

```
Bits   8 7 6 5 4 3 2 1

     1 0 1 1 1 1 1 1   Local—field tag
     0 1 0 0 0 1 0 1     — tag definition continued
     0 0 0 0 0 1 1 0   length
     1 0 0 0 0 0 0 0   local—field—length tag
     0 0 0 0 0 0 0 1     length
     0 0 0 0 0 1 0 1     local field length = 5
     1 0 0 0 0 0 0 1   Information—type = time
     0 0 0 0 0 0 0 1     length
     0 0 0 0 0 0 0 1     colon12
```

The call timer local field is a fixed length field containing BCD (Binary Coded Decimal) digits representing the initial value of the timer. Six BCD digits are encoded where the first 3 are the minutes (from 0 to 999), the next 2 are the seconds (0 to 59), and the final digit is always coded 0.

The data element specifying a call timer local field with a start time of 43 minutes and 15 seconds would be coded as in Figure 224, "Example of a Data Element Specifying a Call Timer".

Figure 224 Example of a Data Element Specifying a Call Timer

```
Bits  8 7 6 5 4 3 2 1
____  _______________

     1 0 1 1 1 1 1 1   Local—field tag
     0 1 0 0 0 1 0 1     — tag definition continued
     0 0 0 0 1 0 0 0   length
     1 0 0 0 0 0 0 0   local—field—length tag
     0 0 0 0 0 0 0 1     length
     0 0 0 0 0 1 1 0     local field length = 6
     1 0 0 0 0 0 1 1   Information—type = call—timer
     0 0 0 0 0 0 1 1     length
     0 0 0 0 0 1 0 0     minutes (04_)
     0 0 1 1 0 0 0 1     minutes (__3), seconds (1_)
     0 1 0 1 0 0 0 0     seconds (_5), filler (0)
```

B.9 CALL CONTROL PROCEDURES

This section specifies the call control procedures for Meridian Feature Transparency.

GENERAL RULES FOR MESSAGE PROCESSING

The following rules are listed in order of precedence:

1 When a message is received that is less than three octets long, that message shall be ignored;

2 When a message is received with a protocol discriminator not in accordance with Section B.5, "Protocol Discriminator", that message shall be ignored;

3 When the user or network receives a message with a call reference value which is greater than one octet in length, that message shall not be acted upon. Furthermore, if such a message is received by the network, the network may return an INFOrmation message containing a Cause information element with the value #81, “invalid call reference value”;

4 When a truncated message is received (end of message occurs before the end of the message type) that message shall be ignored;

5 When the user or network receives a message with a truncated information element (end of message occurs before the end of the information element) that message shall be ignored;

6 When the user or network receives a message with an unknown message type, that message shall not be acted upon. Furthermore, if such a message is received by the network, the network may return an INFOrmation message containing a Cause information element with the value #97, “message type non-existent or not implemented”, and a diagnostic containing the message type;

7 When the user or network receives a message containing information elements which are not ordered according to the rules specified in Section B.7.1, "Coding Rules", that message shall be ignored;

8 When the user or network receives a message containing optional information elements that it does not know how to act upon, it shall act on the message and those information elements that it can act on. Furthermore, if such a message is received by the network, the network may return an INFOrmation message containing a Cause information element with the value #99, “information element non-existent or not implemented”, and a diagnostic containing the information element identifier;

9 When the user or network receives a message containing a particular information element repeated more times than the specified allowable maximum, the message shall be acted upon, ignoring the contents of occurrences of the information element beyond the maximum.

10 When the user or network receives a message containing information elements with invalid contents, that message shall not be acted upon. Furthermore, if such a message is received by the network, the network may return an INFOrmation message containing a Cause information element with the value #100, “invalid information element contents”, and a diagnostic containing the information element identifier;

GENERAL RULES FOR INFORMATION ELEMENT SENDING

a) User to Network.

If an INFOrmation message contains a Service profile identification information element, the message shall contain no other information elements. If an INFOrmation message contains a Protocol version information element it shall also contain a Locking shift information element, but no other information elements. If a message contains neither a Service profile identification nor a Protocol version information element, the message shall contain a Locking shift and a Sequence information element, and, optionally, one additional optional information element.

b) Network to User.

The network shall use the following rules when sending optional information elements within a message:

1 A message shall not exceed the maximum length of 260 octets.

2 A group of related information elements may be sent by the network in one or more messages. The user's interpretation of these information elements should be identical in both cases.

3 Repetition of a particular information element in a message shall not exceed a stated maximum for that information element (see descriptions of information elements for the maximum for each information element).

4 Only one call indicator on an abstract terminal (see description of abstract terminal in Section 1.8, "Abstract Terminal") shall be in state “active” (active call) at any one time. The Call Appearance whose call indicator is currently in state “active” is said to be the active call on the abstract terminal. This call will be the one using the B-channel currently allocated to that terminal.

5 Information elements generated in response to a single stimulus from the terminal may be sent in an arbitrary number of messages where necessary, subject to the rules above, unless otherwise specified.

B.10 Procedures for Circuit-Switched Calls

Circuit-switched calls are controlled by a sequence of “stimuli”, contained in information elements sent across the user-network interface.

The following sections describe the detailed application of the circuit-switched call control procedures to stimulus mode terminals. Time sequence diagrams to illustrate these procedures are shown in Figure 230, "Call Setup," on page 720 to Figure 234, "Call Clearing (Network Initiated)," on page 723.

B.10.1 Procedures for Call Establishment at the Origination Exchange

B.10.1.1 Call Request

The call is initiated by the user activating a call appearance “activator”, for example a call appearance key, on the originating terminal, which then generates an INFOrmation message. This message must contain a Feature activation or Meridian transparency information element corresponding to the activator.

The network responds with an INFOrmation message which may contain Feature indication, Meridian transparency, and B-channel control information elements to control appropriate indicators (i.e. lamps or equivalent), and to provide the terminal with the proper commands. For example, to connect the handset, or other apparatus, to the B-channel.

Note: A call can not be originated unless the terminal has an idle call appearance and there is an available B-channel.

B.10.1.2 Call Information Sending

The “dialed” digits are sent in Keypad information elements, in INFOrmation messages. When the network receives the first INFOrmation message containing a Keypad information element it turns off any network-generated dialing prompt.

The network determines that dialing has finished either by analysis of the digits, by receipt of an end of dialing indication as defined by the local network procedures (e.g. a “#”), or by expiry of timer T302S.

Call progress indicators are communicated to the user using the speech-path, and consist of conventional tones and announcements.

B.10.2 Procedure for Call Establishment at the Destination Exchange

The network will check if there are any compatible stimulus terminals that can accept the call. Compatibility will be checked against the bearer capability and Directory Number datafilled against each call appearance or each terminal at subscription time. Each of the selected terminals will receive an INFOrmation message which may contain Feature indication and Meridian transparency information elements to activate the proper indicator, update the terminal display, identify the calling party, and initiate local alerting.

When the terminal answers, an INFOrmation message will be sent to the network, containing a Feature activation or Meridian transparency information element corresponding to logical off-hook, (i.e. activating the call activator associated with the incoming call).

When a terminal has been awarded the call, the network sends an INFOrmation message which may contain Feature indication, B-channel control, and Meridian transparency information elements to update the terminal, stop local alerting, change the state of the call indicators, and connect the appropriate B-channel.

Any other terminals which were alerted will be sent an INFOrmation message, which may contain a Meridian transparency information element to turn off the tone ringer, and may be sent a Feature indication information element to update the call indicator. Other Meridian transparency information elements may be sent to update the terminal display. This may indicate that the call appearance is now idle, or that another terminal has been granted the incoming call (depending on the service subscribed).

Note: A called address is busy to a caller if, associated with that called address, there are no free call appearances or call waiting activators/indicators upon which the call can terminate. The caller will usually receive busy treatment unless, for example, the call can be forwarded.

B.10.3 Procedure for Call Clearing

B.10.3.1 Call Clearing by the Terminal

The user initiates call clearing by pressing the Release activator or by going on-hook. The user equipment generates an INFOrmation message containing a Meridian transparency information element corresponding to the Release activator or an on-hook indication. If there is an active call, the network responds to this message by sending an INFOrmation message to the user, which may contain a Feature indication information element to turn off the appropriate call indicator, and Meridian transparency information elements to update the terminal's display and to perform other terminal control functions.

If there are no outstanding calls associated with the terminal (for example, no calls on hold or calls waiting), this message will also contain a B-channel control information element instructing the terminal to release the appropriate B-channel. The user must acknowledge this action by sending an INFOrmation message echoing back the identical B-channel control information element (see Figure 233, "Call Clearing (User Initiated)," on page 723).

B.10.3.2 Call Clearing by the Network

The network initiates call clearing by sending an INFOrmation message to the user, which may contain a Feature indication information element to turn off the appropriate call indicator, and Meridian transparency information elements to update the terminal's display and to perform other terminal functions.

If there are no outstanding calls associated with the terminal (for example, no calls on hold or calls waiting), the network will also send a B-channel control information element instructing the terminal to release the B-channel. The user will acknowledge release of the B-channel by sending an INFOrmation message echoing back the identical B-channel control information element (see Figure 234, "Call Clearing (Network Initiated)," on page 723).

B.10.4 Interworking with Existing Networks

B.10.4.1 Answer Supervision

For calls outgoing to a non-ISDN user, the network will monitor the answer supervision signals in the non-ISDN network. For calls incoming from a non-ISDN user, the network will monitor INFOrmation messages from the ISDN user for a Feature activation information element corresponding to the appropriate call appearance activator, and the network will map this into the required answer supervision signal to the non-ISDN user.

In some situations answer supervision may not be offered from the non-ISDN network and consequently this information can not be conveyed to the user equipment.

B.10.4.2 Disconnect Procedures

In cases where an ISDN user is in communication with a non-ISDN user, the ISDN exchange will know that the call is not end-to-end ISDN. The ISDN user's release, or equivalent, indication will be mapped into disconnect supervision in the non-ISDN network, and vice-versa.

In some situations disconnect supervision may not be offered from the non-ISDN network and consequently this information can not be conveyed to the ISDN user.

B.10.5 Message Sequencing

All messages sent from the user to the network which do not contain either a Service profile identification or a Protocol version information element, shall contain a Sequence information element. The Sequence information element shall have the sequence request indicator coded as'0' and shall contain a sequence number. The sequence number shall be one higher than the sequence number sent in the most recent message which also contained a Sequence information element.

The sequence number field in the Sequence information element can be coded with a value from 0 to 63. If a message is assigned the sequence number 63, the next message containing a Sequence information element will be assigned the sequence number 0.

The terminal can begin sequence numbering at any value from 0 to 63, but shall not reset sequence numbering in response to a data link layer failure, reset, or establishment, or while there is an active or held call on the interface. If the terminal does not track any call states, sequence numbering should only be reset when powering up and when instructed to perform a hard reset by the network.

The network may request that the user report the current sequence number in order to ensure that no layer 3 messages sent by the user have been lost. This is typically done when the data link is reset or established after a failure. The network will send the user a Sequence information element with the sequence request indicator coded as'1', and the sequence number coded as 0. The user shall respond with an INFOrmation message containing a Sequence information element. The response message sent by the user is numbered normally, that is, the sequence number shall be one higher than in the preceding message.

B.10.6 Terminal Initialization

When requested by the network to initialize, the terminal shall return to a condition equivalent to terminal idle by taking the following actions:

- release any connected B-channel,
- clear information and address displays,
- return all indicators to an idle state,
- turn off any alerting or other tones.

In certain cases, such as the detection of an irrecoverable error, the network will request the terminal to initialize by sending an INFOrmation message containing a Meridian transparency information element. The Meridian transparency information will indicate “hard reset”, “soft reset”, or “save status”. Please refer to Section B.10.9, "Meridian Transparency Procedures" for specific procedures associated with each of the above types of reset instructions.

The terminal application may choose to withhold certain outstanding unsent messages, and send them after the network initiated initialization procedure is complete.

After the terminal performs initialization it may need to perform terminal identification and protocol version identification procedures before normal call processing can begin. These procedures are described in Figure 191, "Formats of Information Elements," on page 677 and Figure 209, "Protocol Version INFOrmation Element," on page 695.

Note: The initialization procedure applies only to calls related to a specific logical link, that is, a specific abstract terminal.

B.10.7 Terminal Identification

A specific terminal has to be associated with a specific terminal profile within the network. This can be accomplished by pre-assigning a Layer 2 TEI value for a terminal which the network will associate with the terminal profile. The network and the terminal will use this TEI for all messages. Use of a fixed terminal profile does not require any additional action during terminal initialization procedures.

All dynamic TEI terminals, and optionally for fixed TEI terminals, will communicate to the network their TEI and service profile identifier to the network. This is performed as part of terminal initialization for these terminals.

The terminal sends the network an INFOrmation message with a Service profile identification information element, which identifies the terminal's service profile. The Layer 2 TEI in this message identifies the terminal's TEI, for either fixed or dynamic TEI terminals. If the network accepts the sent TEI and SPID, the network sends the terminal an INFOrmation message with an Endpoint identifier information element. On receipt of this message, terminal initialization is complete and normal call processing can begin. The user may ignore the contents of the Endpoint identifier information element since it is not required for stimulus call control.

If the network receives an unsolicited Service profile identification information element for a terminal which has already been initialized, that is, associated with a service profile, then,

- If the SPID matches the value used in the previous initialization procedure for this TEI, the network returns successful acknowledgment to the terminal with an INFOrmation message containing no optional information element.
- If the SPID does not match the value used in the previous initialization procedure for this TEI, the network rejects the request by returning an INFOrmation message containing a Cause information element with value #100, “invalid information element contents”, and a diagnostic containing the information element identifier.

If, after TEI assignment, the terminal does not request initialization within timer TI-T1 (fixed at 20 seconds) the network will request that the terminal initialize its SPID. To do this, the network will send an INFOrmation message containing an Information request information element with the information request indicator coded as “prompt” and the type of information coded “terminal identification”. If the terminal initializes correctly, the network responds the same as for terminal initiated initialization, but the INFOrmation message will also contain an Information request information element with the information request indicator coded “complete”. If the terminal does not initialize correctly within timer TI-T1, the network will send an INFOrmation message containing an Information request information element with the information request indicator coded as “complete”, and the network may remove the terminal's TEI.

If the network receives a Service profile identification information element with a SPID that has already been associated on another dynamic TEI, the network will reject the request by returning an INFOrmation message with a Cause information element with value #100, “invalid information element contents”, and a diagnostic containing the information element identifier.

If an INFOrmation message containing a Service profile identification information element is received by the network from a terminal with an unassignable TEI or from a TEI with a fixed service profile, the network rejects the request by returning an INFOrmation message with a Cause information element with value #99, “information element non-existent not implemented”, and a diagnostic containing the information element identifier.

B.10.8 Protocol Version Control

This is an optional procedure which allows a terminal to query the network for the currently active protocol version-issue for that terminal, as defined in the terminal profile.

The terminal invokes this procedure by sending the network an INFOrmation message containing a Locking shift and a Protocol version information element. This message can be sent at any time for static TEI terminals, and after terminal identification is successfully completed for dynamic TEI terminals. The Protocol version information element shall specify the version operation “version query” and shall not contain a version code nor an issue code.

The network shall respond with an INFOrmation message containing a Locking shift and a Protocol version information element. The message may also contain a Sequence information element with the sequence request indicator coded as '1' and the sequence number coded as '0'. The Protocol version information element shall have the version operation coded as “version response” and the currently active protocol version code and issue code.

Terminal operation after receiving the version response is implementation dependent. The terminal, if it supports the indicated protocol version and issue, can continue with call processing.

B.10.9 Meridian Transparency Procedures

The following set of procedures describes the use of the Meridian transparency information element and the services which it can provide. Each pair of octets of Meridian transparency information describe an instruction from the network to the user, or a terminal:q.event:eq. sent to the network.

The set of Meridian transparency information codes has been separated into mandatory and optional sets. The mandatory set are those which the user must support in order to conform to this specification. If an optional set is not implemented by the user, it shall ignore all the codes in that set which are sent by the network. If the terminal does support an optional set, it must support all codes in that set. See Figure 229, "Clearing a 2X40 Display," on page 716 for a description of Meridian transparency information.

B.10.9.1 Mandatory Procedures

The mandatory set of Meridian transparency information sent by the network controls handset connection to the B-channel, operation of alerting and the buzzer, and instructs the terminal to perform reset operations. The terminal shall not perform any of the following operations unless specifically instructed to do so by the network.

Handset control instructs the terminal to connect and to disconnect the handset from the B-channel.

The network instructs the terminal when to connect and disconnect the B-channel to and from an alerting device (e.g. speaker) with the Meridian transparency information codes tone ringer on and tone ringer off, respectively. That is, the network sends alerting tone (e.g. normal ringing, distinctive ringing) in the B-channel which the terminal can then direct to a speaker so that the user can hear the tone. The volume of the alerting tone is terminal dependent.

The buzzer is used to notify the user of a network initiated feature event. The network instructs the terminal to turn the buzzer on or off as required. Typically, feature event information on the feature indicators or on the display accompanies the buzzer control.

Upon receiving a hard reset instruction, the terminal shall perform all the functions required for terminal initialization see (Section B.10.6, "Terminal Initialization"). Optionally, the terminal may reset the current message sequence number.

Upon receiving a soft reset instruction, the terminal shall perform all the functions required for terminal initialization but without disturbing any call in progress or disconnecting the B-channel.

Upon receiving a save status instruction, the terminal shall perform all the functions required for terminal initialization (see Section B.10.6, "Terminal Initialization"), but without disturbing the status of any indicators or the display.

The mandatory set of Meridian transparency information sent by the user is used to report when the terminal handset goes on-hook and off-hook.

B.10.9.2 Handsfree Option

Handsfree operation, if provided entirely by the terminal, will be transparent to the network. If the user activates handsfree when the terminal is off-hook, or deactivates it when on-hook, no indication is sent to the network. If handsfree is activated when the terminal is on-hook, the user shall send an off-hook indication to the network in a Meridian transparency information element.

Optionally, the network can completely control the handsfree operation of the terminal. To support this capability, the terminal shall perform the following procedures. In this mode of operation the terminal shall not itself act on any user actions other than to report these events to the network. The terminal should have assigned, via subscription, feature keys or softkeys for Handsfree and Mute activators.

If the user receives a handsfree on instruction from the network, the terminal shall connect the terminal loudspeaker and microphone to the speech path. If the handset is connected to the speech path, it shall be disconnected. If the user receives a handsfree off instruction from the network, the terminal shall disconnect the terminal loudspeaker and microphone from the speech path and reconnect the handset to the speech path.

If the user receives a microphone on instruction from the network, the terminal shall connect the microphone to the speech path. If the handset microphone is connected to the speech path, it shall be disconnected. If the user receives a microphone off instruction from the network, the terminal shall disconnect the microphone from the speech path.

If the user receives a connect handset to the B-channel instruction from the network, and the handsfree loudspeaker and microphone are connected to the speech path, the handsfree loudspeaker and microphone shall be disconnected.

One of the intents of the above procedures is to ensure that one of the following situations does not occur. First, that the handset microphone and handsfree microphone are connected to the speech path simultaneously. Second, that the handset receiver and the terminal loudspeaker are connected to the speech path simultaneously.

B.10.9.3 Display Option

The user's terminal display, as described in this specification, is updated by the network using Display text and Meridian transparency information elements. This section provides additional details on how the terminal must interpret these information elements to operate the display as defined for Meridian transparency.

Figure 225 **Meridian Transparency Display Format**

Positions

Line 0	0	1	2	. . .	39
Line 1	40	41	42	. . .	79

Meridian Transparency Display Format 1 (2x40)

Positions

Line 0	0	1	2	. . .	23
Line 1	24	25	26	. . .	47

Meridian Transparency Display Format 2 (2x24)

The display contains 2 lines, each with 40 or 24 positions, capable of displaying alphanumeric characters. The above diagram shows the line and position numbering referred to in the display procedures. For the purposes of cursor movement on 2x40 displays, display positions 39 and 40 are adjacent, as are positions 79 and 0. The same is true on 2x24 displays for display positions 23 and 24, and 47 and 0.

The terminal shall maintain a cursor and a display memory. Disabling of the cursor or the display should not clear the terminal's knowledge of the cursor's position or the display contents, unless specifically instructed to do so by the network. The network can update the cursor position and the display contents while they are disabled.

The normal operation of digit-echo mode, when enabled, is to show the keypad character entered and move the cursor to the next (higher) position. There are some special digit-echo modes which are described in the Meridian transparency information list (see Figure 225, "Meridian Transparency Display Format," on page 711).

To support the display option, the user shall support the mandatory control tags and display text tags described in Display Text Information Element on page 697 and the display option instructions described in Figure 225, "Meridian Transparency Display Format". Optional control tags in the Display text information element can be ignored by the user for the basic display option. Optional control tags shall not affect the current cursor position, even when the tag is understood by the terminal. If an INFOrmation message contains both Meridian transparency and Display text information elements, the user shall act on the Meridian transparency information element first.

Display instructions which alter the display are sent by the network in Display text information elements preceded by a locking shift to codeset 6. When the terminal begins decoding the display information, the cursor is assumed to be in position 0 (upper-left corner). The terminal shall then process the display information in sequence. See Figure 213, "Display Text Information Element," on page 697 for details on the types of display information which the network may send. If the terminal does not have a corresponding display item for a received character, a blank or other terminal-defined item shall be displayed in its place. See Section B.10.9.5, "Display Examples" for examples on the coding of display information.

If the terminal display does not have a low power mode, it shall ignore Meridian transparency information referring to this option. Display low power mode is exited when the terminal receives any display update information from the network.

B.10.9.4 Local Field Display Option

The intent of this display option is to allow the terminal and network to share the terminal display without overwriting the text displayed by the other. That is, the network informs the terminal which areas of the display the terminal may use, and the intended use of those areas. The terminal may format the content of the local fields itself or as directed by the network. The terminal may ignore local field types which it does not support.

If the terminal supports network defined local fields, the terminal must also support the display option described in Section B.10.9.3, "Display Option". The terminal shall act on local field tags in Display text information elements which are preceded by a locking shift to codeset 6. See for coding details, and Figure 213, "Display Text Information Element," on page 697 for coding examples.

The following types of local fields are supported by the network:

- date
- time
- call timer

When a date local field is defined, the network shall include a text representation of the current date.

When a time local field is defined, the network shall include the format of the displayed time: 24-hour, 12-hour, or 12-hour with an AM/PM indicator, where for each the hours and minutes are separated by a colon. The network may send the time to the user in a Date/time information element in the same or in a subsequent INFOrmation message.

When a call timer local field is defined, the network shall include a BCD (Binary Coded Decimal) representation of the start time in minutes and seconds. The start time can range from 0:0 to 999:59.

If the network sends the user a local field optional control tag with no contents (length of 0), the terminal shall remove all local fields. If the network sends a local field optional control tag with the local field length set to 0, the terminal shall remove the specified local field.

If the network sends the user a local field optional control tag for a local field which partly or completely overwrites a previously defined local field, the new local field shall have use of the display rather than the previously defined local field. If the new local field is removed, the previously defined local field shall again have use of the display.

If the network sends the user display text which partly or completely overwrites a previously defined local field, the local field shall be suppressed by the terminal. Any local field display positions not overwritten by the display text shall be blanked by the terminal. When the local field display area is completely overwritten by a blank mandatory control tag, the local field shall again have use of the display.

B.10.9.5 Display Examples

In Figure 226, "Date, Time, and Call Timer Local Fields" through Figure 229, "Clearing a 2X40 Display," on page 716 are examples of how to code the display information field of the Display text information element. Please refer to Section B.8.6, "Display Text" for the descriptions of the different types of display text supported, and to Section 5.14, "Abstract Syntax Notation One (ASN.1)" for an overview of ASN.1 and coding rules.

In each example the sequence of octets present in the display information field is determined by reading the tag, length, and contents from left to right, and progressing from the top line toward the bottom line. The tag, length, and contents of each data element are shown in hexadecimal with the corresponding ASN.1 reference.

The examples are shown in sequential time order, with an initially blank display. Each display text example acts on the display as left by the previous example. The sequence shown is intended to demonstrate a range of possible display operations and is not necessarily indicative of actual network operation.

Figure 226 Date, Time, and Call Timer Local Fields

TAG	LENGTH	CONTENTS	ASN.1 Reference
81	01	17	skip [1] IMPLICIT OCTET STRING= 23
BF45	0F		local–field [69] IMPLICIT SEQUENCE
80	01	0A	{local–field–length [0] IMPLICIT INTEGER = 10,
81	0A	54485520 4D415220 3134	Information –type = date [1] IMPLICIT OCTET STRING = "THU MAR 14"}
81	01	0C	skip [1] IMPLICIT OCTET STRING= 12
BF45	06		local–field [69] IMPLICIT SEQUENCE
80	01	05	{local–field–length [0] IMPLICIT INTEGER = 5,
82	01	01	Information –type = time [2] IMPLICIT ENUMERATED = colon12}
81	01	0C	skip [1] IMPLICIT OCTET STRING= 28
BF45	08		local–field [69] IMPLICIT SEQUENCE
80	01	06	{local–field–length [0] IMPLICIT INTEGER = 6,
83	03	015230	Information –type = call –timer [3] IMPLICIT OCTET STRING= 15m23s}

THU MAR 14 02:30
15:23

Note: Three local fields for the date, time, and call time are set up at the top right and bottom right of a 2X40 display. Text for the date is sent and displayed. The contents of the time local field could be derived from a Date/time information element in the current, or in a subsequent, message.The call timer is started at 15 minutes and 23

Figure 227 Feature Display

TAG	LENGTH	CONTENTS	ASN.1 Reference
9E	05	32383733 34	text [30] IMPLICIT OCTET STRING = "28734"
80	01	23	blank [0] IMPLICIT OCTET STRING=35
9E	13	464F5257 41524445 4420544F 20203238 393839	text [30] IMPLICIT OCTET STRING = "FORWARDED TO 28989"
80	01	0F	blank [0] IMPLICIT OCTET STRING=15

28734	THU MAR 14 02:34
FORWARDED TO 28989	19:44

Note: Call forwarding information on a 2x40 display is shown. Unused display positions are blanked, and date and time local fields are left active on the display.

Figure 228 Local Fields Overwritten

TAG	LENGTH	CONTENTS	ASN.1 Reference
80	01	1B	blank [0] IMPLICIT OCTET STRING=27
9E	09	47452545 54494E47 53	text [30] IMPLICIT OCTET STRING = "GREETINGS"
80	01	2B	blank [0] IMPLICIT INTEGER = 43

GREETINGS

Note: All previously displayed text is blanked and the local fields are overwritten. Unmodified portions of the local fields are blanked by the terminal.

Figure 229 Clearing a 2X40 Display

TAG	LENGTH	CONTENTS	ASN.1 Reference
80	01	50	blank [0] IMPLICIT OCTET STRING=80

THU MAR 14 02:36
21:50

Note: A single blank tag of length 80 will clear a 2x40 display. The local fields reappear since they have been completely blanked by the network.

B.10.10 Softkey Option

If the terminal has softkeys, the softkey option can be supported by the terminal to enable their use in Meridian transparency signaling. If the terminal supports this option, the terminal reports as a terminal event when a softkey is activated. These events are reported in Feature activation information elements.

Up to 5 softkeys are supported by Meridian transparency. Use of these softkeys must be arranged by subscription and are associated with a specific terminal service profile.

The softkeys shall be physically located under the bottom line of the display to accommodate a softkey label width of 8 display positions for each softkey on the bottom line of the display.

B.10.10.1 Other Meridian Transparency Options

If the terminal has Hold or Release keys, Meridian transparency information shall be used to report to the network when one of these keys has been activated.

If the terminal supports the Meridian transparency display option and receives a transmit status instruction from the network, the terminal can optionally respond with one of the Meridian transparency information codes for that purpose. These report to the network whether the terminal experienced a powerfail since the last transmit status instruction or terminal initialization, whichever occurred most recently.

B.10.11 End-To-End Signaling

To permit user signaling with an end-to-end application from a terminal supporting Meridian transparency, the following procedure is provided.

If the terminal sends the network a Keypad information element during an active call, the network generates a DTMF tone on the outgoing speech path, corresponding to the contents of the keypad information (see Section B.7.5, "Keypad"). The duration of the generated DTMF tone shall be no less than 100 milliseconds.

B.10.12 Exception Handling Procedure

Exception conditions may arise during or outside the lifetime of a call and these are handled as follows.

B.10.12.1 Information Element Errors

The network shall ignore:

- a B-channel control information element which is not in response to the same information element sent by the network.
- a Feature activation information element specifying a feature activator number which is not defined for that terminal.
- a Meridian transparency information octet pair in a Meridian transparency information element specifying a terminal event which is not defined for that terminal.
- a Meridian transparency information octet pair in a Meridian transparency information element which is not understood.
- a Feature activation information element reporting an activator usage which is not allowed in the current context. For example, call or feature already active.
- a Protocol version information element with the version operation coded as anything other than “version query”.
- The terminal should ignore:
- an information element which is unrecognized.
- a Meridian transparency information octet pair in a Meridian transparency information element which is not understood or not supported.
- a Feature indication information element for an undefined feature key or softkey.
- a Sequence information element which does not have the sequence request indicator coded as'1'.

B.10.12.2 B-Channel Selection

When there is no B-channel available for call origination, the caller will receive a Cause information element with value #34, “circuit/channel congestion”.

B.10.12.3 Sequence Errors

The network may check message sequence numbers, sent by the user in Sequence information elements, for lost messages. If the network detects a sequence number discontinuity, except immediately following a hard reset, the network may clear active and held calls, and instruct the user to perform a hard reset.

B.10.12.4 Data Link Reset

If the network side layer 3 entity is notified by its data link layer via the primitive DL-Release-Indication that there is a data link layer reset, the network may check for lost user messages by requesting that the user report the current message sequence number. The network makes this request using the procedure in Section B.10.5, "Message Sequencing".

If the user side layer 3 entity is notified by its data link layer via the DL-Release-Indication primitive that there is a data link layer reset, no action shall be taken.

B.10.12.5 Data Link Failure

If the network side layer 3 entity is notified by its data link layer via the primitive DL-Release-Indication that there is a data link layer failure, the following procedure shall apply:

1 If any timer is running, it shall be cancelled. Timer T309S is started.

2 Request layer 2 re-establishment by sending primitive DL-Establish-Request. When informed via the primitive DL-Establish-Confirm that the data link layer is re-established, timer T309S shall be stopped. The network may then request that the user report the current message sequence number using the procedure in Section B.10.5, "Message Sequencing".

3 If timer T309S expires prior to data link re-establishment, the network shall initiate clearing to the remote user. The network shall also clear the connections and calls to the local user by releasing any connected B-channel, returning all indicators to the idle state and turning off any tones or announcements. When informed via the primitive DL-Establish-Confirmation that the data link layer is re-established, the network shall instruct the user to perform a hard reset (see Section B.10.9.1, "Mandatory Procedures").

If the user side layer 3 is notified by its data link entity via the DL-Release-Indication primitive that there is a data link layer failure, no action shall be taken.

Legend For Figure 230, "Call Setup," on page 720 to Call Clearing (Network Initiated) on page 723

Abbreviations:

BCC B-channel control information element
FA Feature activation information element
FI Feature indication information element
KP Keypad information element
MT Meridian transparency information element

actv activator
indc indicator

B-ch B-channel

Note: 1 Multiple information elements, shown in the following figures as being contained in a single INFOrmation message, may in some cases be sent in multiple INFOrmation messages. See section 5 for general rules for information elements.

Note: 2 The notation “FA = z” represents a Feature activation information element with feature value=z where z ranges from 1 to 64.

Note: 3 The notation “FI = x, y” represents a Feature indication information element with feature value = x and state parameter = y. The value of x is in the range 1 to 64. The values of y are idle, active, prompt, and pending (see Feature Indication on page 685).

Note: 4 “MT=#nnnn” represents a Meridian transparency information element with a Meridian transparency information octet pair shown in hexadecimal. See Meridian Transparency on page 691 for further information the coding of this information element.

Note: 5 The single octet Locking shift information element and the Sequence information element are not shown in the user to network messages for the purpose of clarity, but must be included.

Note: 6 Display and certain other optional network-controlled terminal operations are not shown in these information flow diagrams. These are carried in Display text and Meridian transparency information elements (see Section B.10.9, "Meridian Transparency Procedures" for further information).

Figure 230 Call Setup

Scenario: Terminal is Idle. The user initiates a call on Feature Activator # 1, to address 4335, using overlap sending.

USER/TERMINAL	MESSAGE	NETWORK
call request on actv #1	INFO (FA=1) →	
indc #1,active connect B–channel dial tone on	INFO (FI=1,active ← BCC=conn B–ch)	connect B–channel dial tone on
user enters first address digit	INFO (KP=digit 4) →	dial tone off
user enters remaining digits	INFO (KP=digit 3) →	
	INFO (KP=digit 3) →	
	INFO (KP=digit 5) →	
		establish call to far end
		far end alerting ringback on
CALL ESTABLISHED		call established ringback off

Figure 231 Nested Call

Scenario: While a call to 4335 is active on Feature Activator #1. (indicator #1 shows state "active", the user initiates a second call to address 6525 on activator #2, putting the first call on hold. The user then returns to the first call by using activator #1. The second call is automatically put on hold.

USER/TERMINAL	MESSAGE	NETWORK
call request on actv #2	INFO (FA=2) →	
indc #1 pending	INFO (FI=1,pending) ←	hold call on CA actv #1
call indc#2 pattern prompt	INFO (FI=2,prompt) ←	dial tone on
user enters first address digit	INFO (KP=digit 6) →	
		dial tone off
user enters remaining digits	INFO (KP=digit 5) →	
	INFO (KP=digit 2) →	
	INFO (KP=digit 5) →	
		established call to far end
		far end alerting ringback on
SECOND CALL ESTABLISHED		call established ringback off
reconnection request on actv #1	INFO (FA=1) →	
indc #2 pending	INFO (FI=2,pending) ←	hold call on actv #2
indc #1 prompt	INFO (FI=1,prompt) ←	reconnect call on actv #1
CALL ON ACTIVATOR #1 RECONNECTED		

Figure 232 Incoming Call

Senario: An incoming call is offered to 2 idle terminals. First terminal to request connection is awarded the call. The incoming call address is 5824.

USER/TERMINAL — 1 2	MESSAGE	NETWORK
connect B—ch to speaker indc #1 prompt	← INFO (MT=#006F, FI=1,prompt)	determine terminal compatibility message to terminal 1
connect B—ch to speaker indc #1 prompt	← INFO (MT=#006F, FI=1,prompt)	determine terminal compatibility message to terminal 2
answer request on actv #1	INFO (FA=1) →	
disconnect B—ch from speaker indc #1 active connect B—ch	← INFO (MT=#000F, FI=1,active BCC=conn B—ch	connect B—ch for terminal 2 message to terminal 2
CALL CONNECTED		
disconnect B—ch from speaker indc #1, pending	← INFO (MT=#000F, FI=1,pending)	clear non—selected terminal message to terminal 1

Note: The terminals are assumed to belong to the same MADN (Multiple Appearance Directory Number) group with SCA (Single Call Arrangement). If MCA (Multiple Call Arrangement) is used, “FI=1,pending” in the last message will become “FI=1,idle”. State “pending” in FI indicates the call is in an associated call active state, i.e., another member is granted access to the group and only the talking member can use the call

Figure 233 Call Clearing (User Initiated)

Scenario: Terminal is active on call appearance activator #1 (indicator #1 shows state active).The user clears the call by pressing the Release activator. No other calls are outstanding at the terminal.

USER/TERMINAL	MESSAGE	NETWORK
disconnect request	INFO (MT=#000F)	
indc #1 idle	INFO (FI=1,idle BCC=release B–ch)	
release B–channel	INFO (BCC=release B–ch)	release B–channel

Note: The last 2 messages are present only if there are no outstanding calls at the terminal, otherwise the network sends instead INFO (FI=1,idle) only and will not release the B-channel.

Figure 234 Call Clearing (Network Initiated)

Scenario: Terminal is active on activator #1 (indicator #1 shows state "active"). The network initiates call clearing. No other calls are outstanding at the terminal.

USER/TERMINAL	MESSAGE	NETWORK
indc #1 idle	INFO (FI=1,idle BCC=release B–ch)	network disconnect
release B–channel	INFO (BCC=release B–ch)	release B–channel

Note: The B-channel control information elements are sent only if there are no outstanding calls at the terminal.

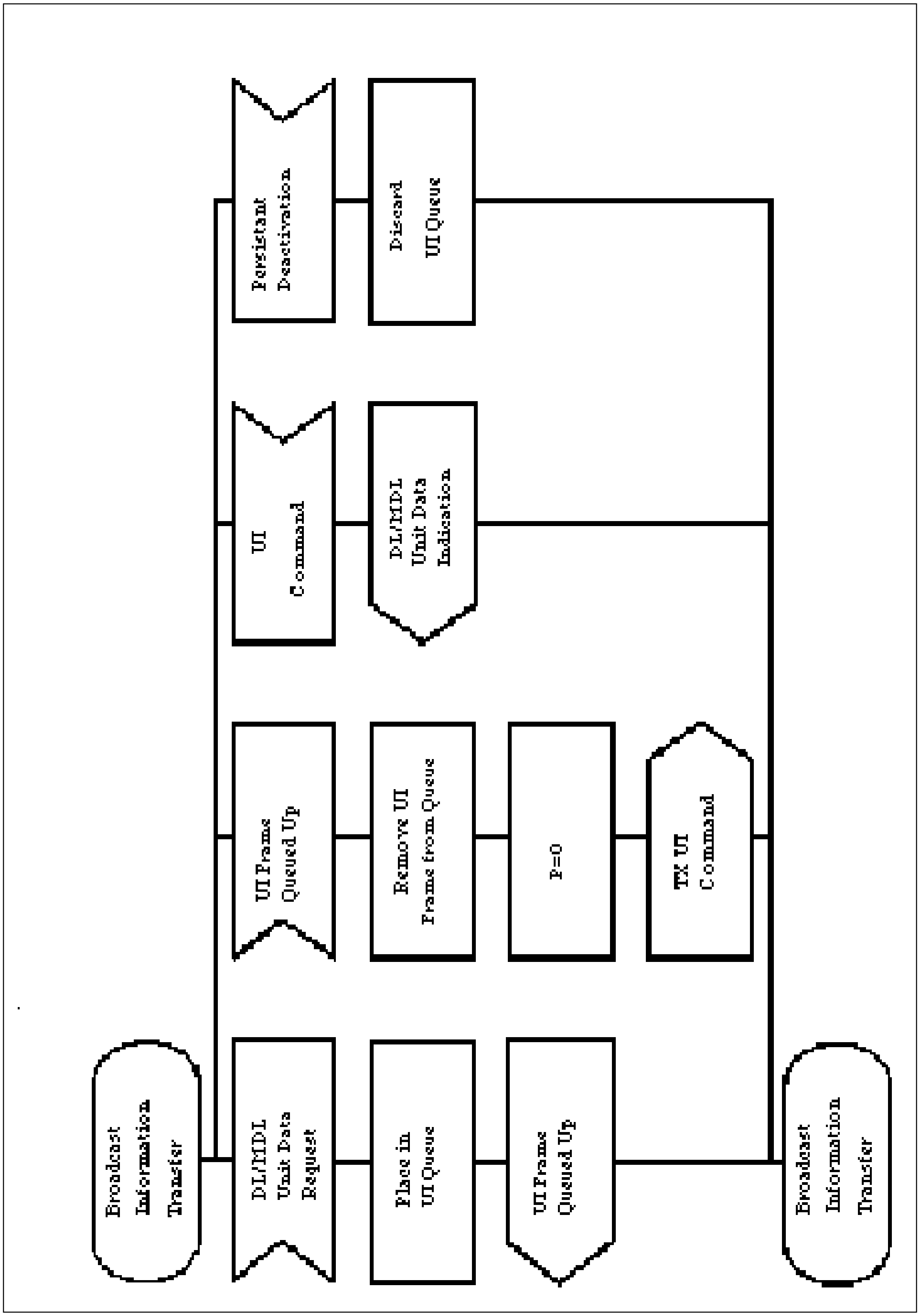
B.11 MFT System Parameters

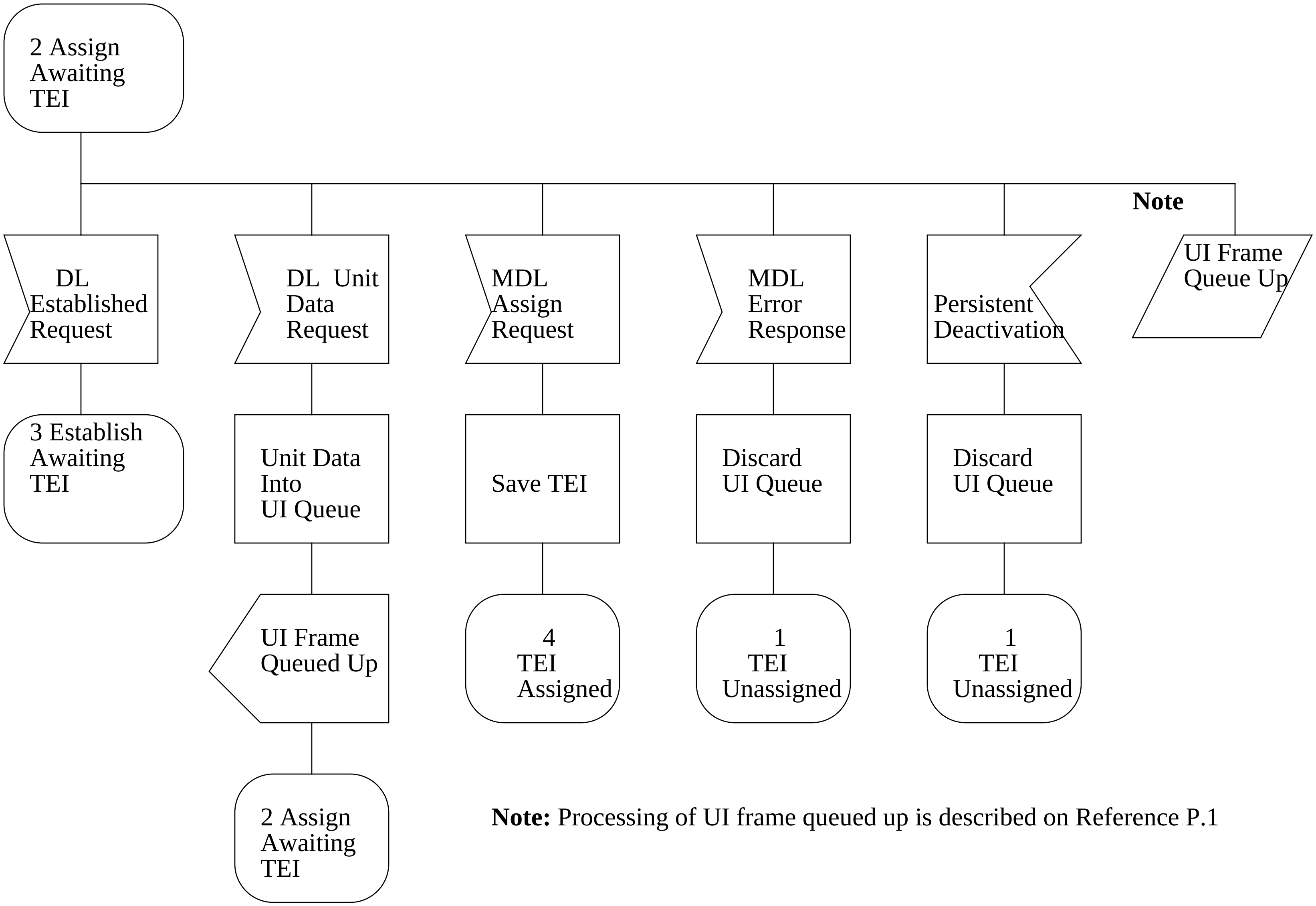
Table 181 System Timer Table

Timer Number	Timer Value Default	Started When	Normally Terminated When	Action to be Taken When Timer Expires
T302S	10 Sec. (maximum value depending on context of call)	Expecting info or further info from user (e.g., address digits).	Receiving info from user	Clear Call after custom tone or announcement.
T309S	30 Sec.	DL-Release-Indication received	DL-Establish Confirm Received	Initialize terminal

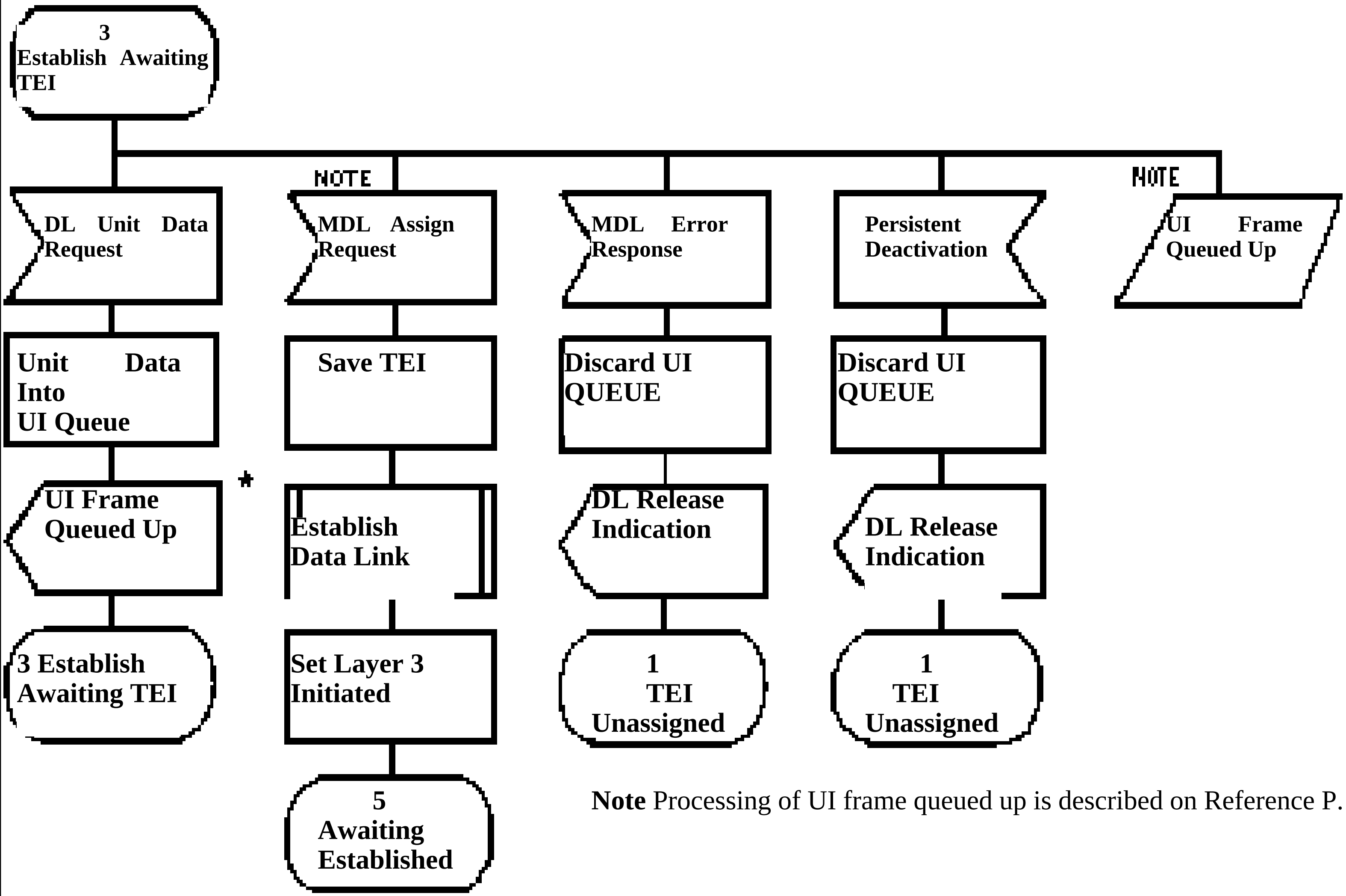
Note: These default times are office parameters, that is, they may be adjusted on an office basis.

Appendix C: Flows for Data Link Layer

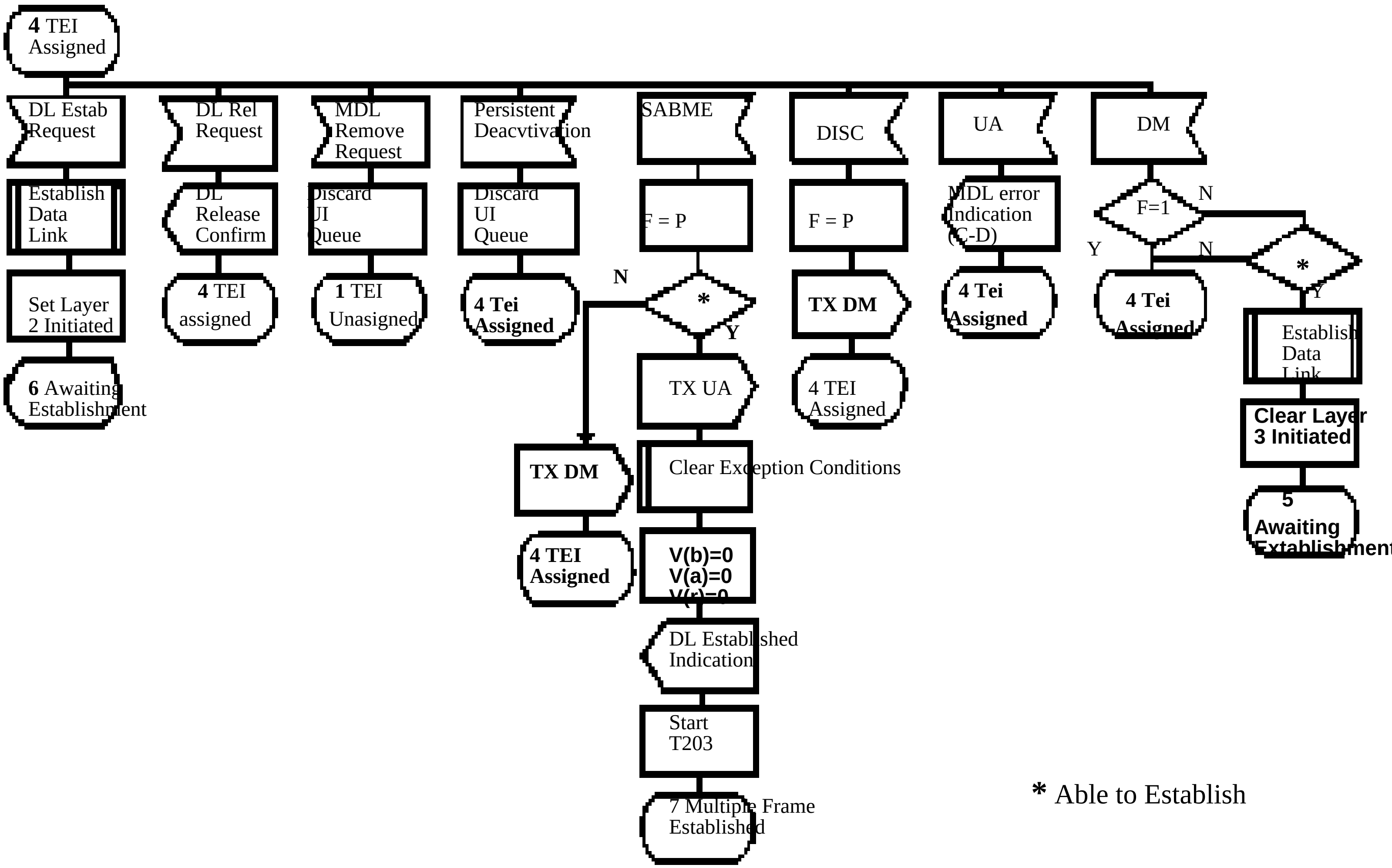

Broadcast Information Transfer
DL/MDL Unit Data Request
Place in UI Queue
UI Frame Queued Up
UI Frame Queued Up
Remove UI Frame from Queue
P=0
TX UI Command
UI Command
DL/MDL Unit Data Indication
Persistent Deactivation
Discard UI Queue
Broadcast Information Transfer

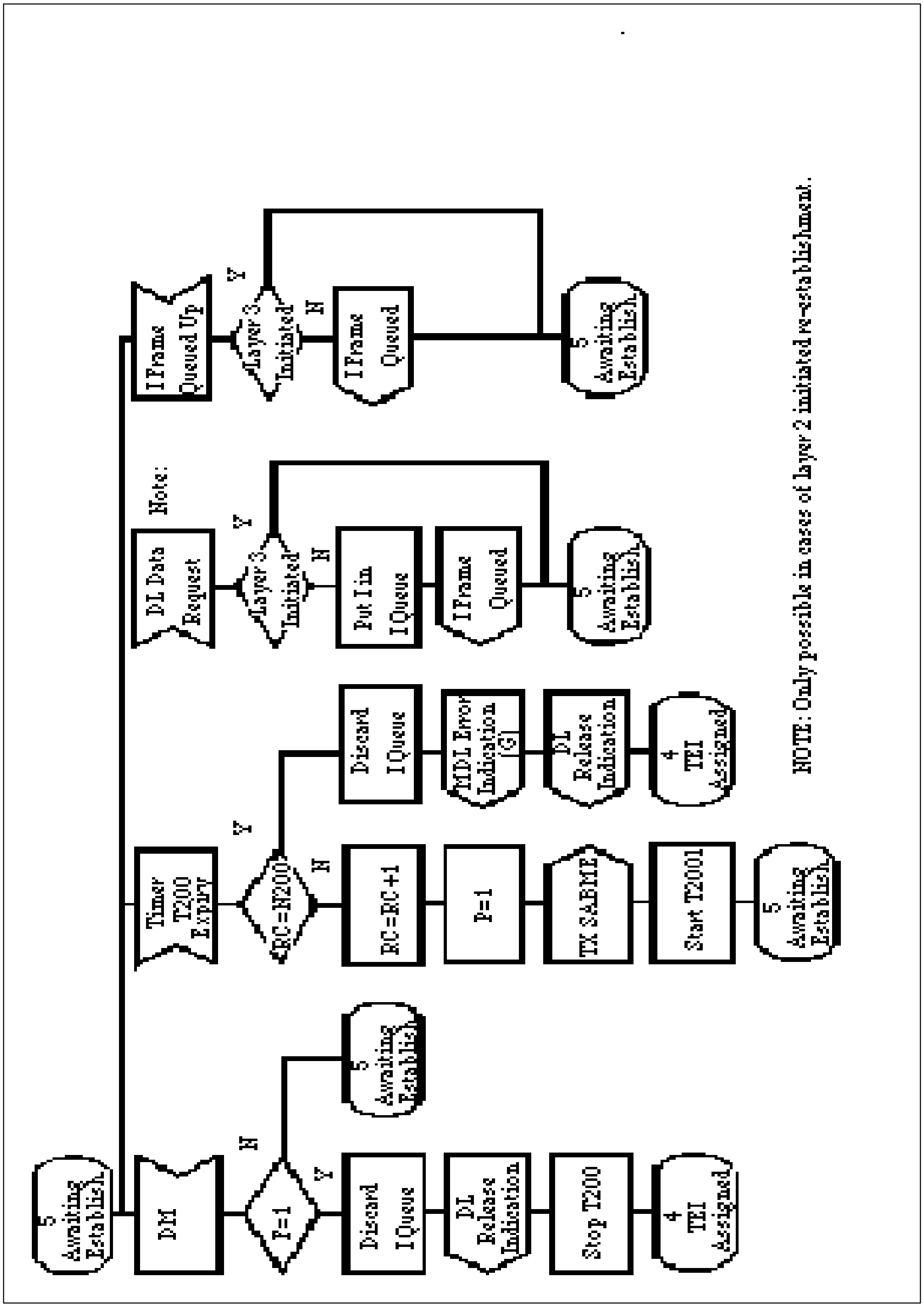


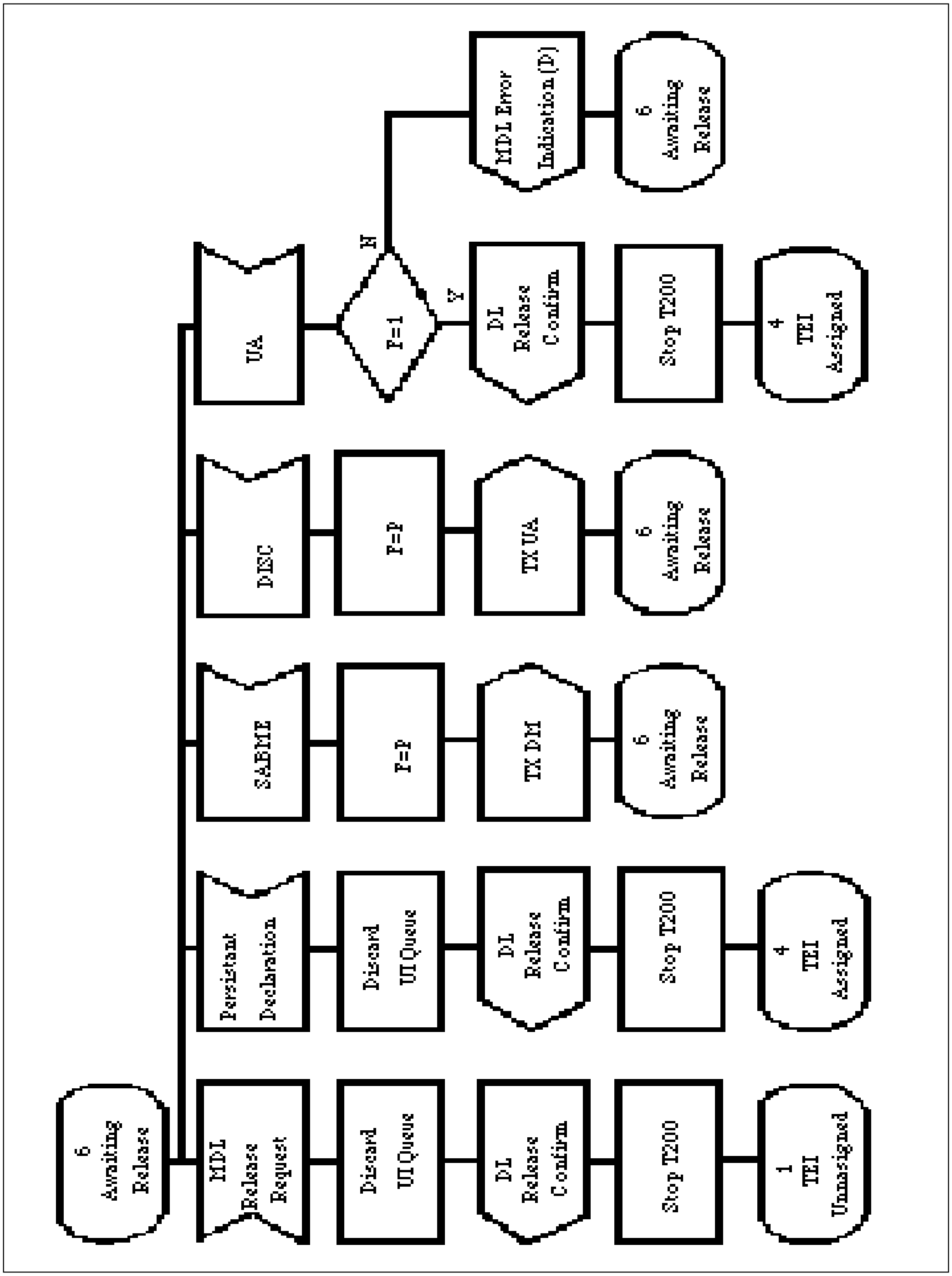
Note: Processing of UI frame queued up is described on Reference P.1

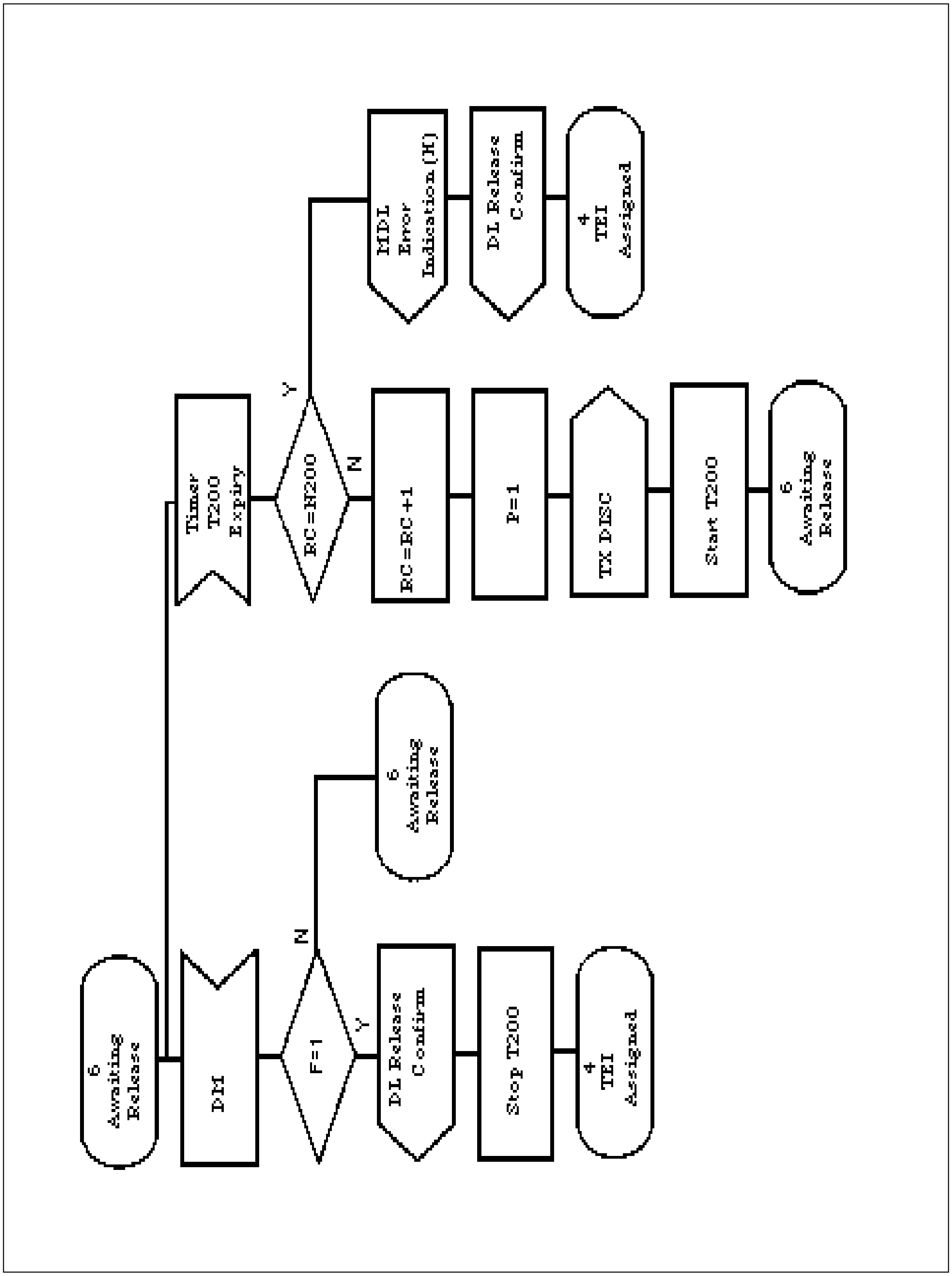


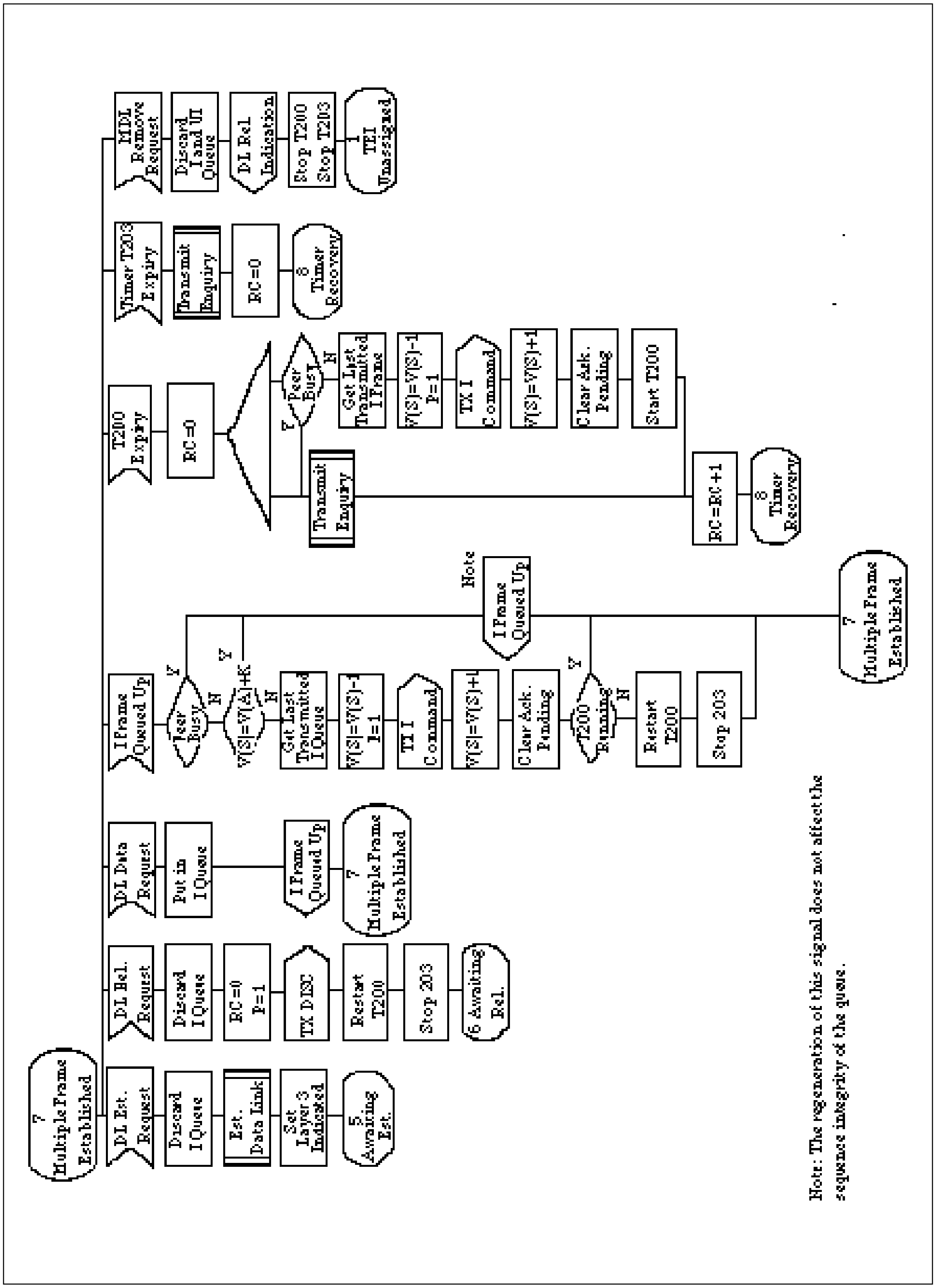
Note Processing of UI frame queued up is described on Reference P.1

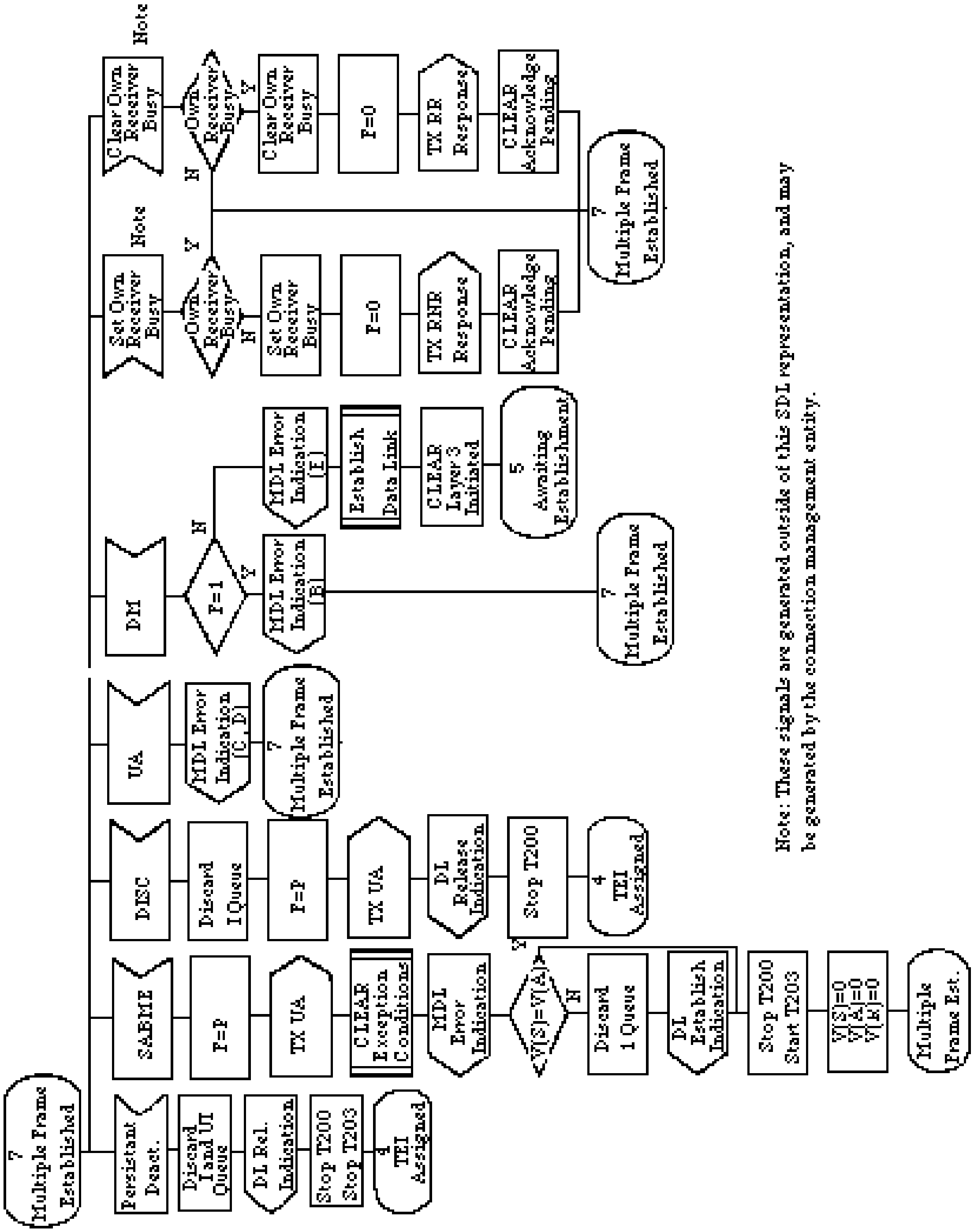

4 TEI Assigned
DL Estab Request
DL Rel Request
MDL Remove Request
Persistent Deacvtivation
SABME
DISC
UA
DM
Establish Data Link
DL Release Confirm
Discard UI Queue
Discard UI Queue
F = P
F = P
MDL error Indication (C-D)
F=1
N
Y
N
*
Y
Set Layer 2 Initiated
4 TEI assigned
1 TEI Unasigned
4 Tei Assigned
N
*
Y
TX DM
4 Tei Assigned
4 Tei Assigned
Establish Data Link
6 Awaiting Establishment
TX UA
4 TEI Assigned
Clear Layer 3 Initiated
TX DM
Clear Exception Conditions
5 Awaiting Extablishment
4 TEI Assigned
V(b)=0
V(a)=0
V(r)=0
DL Established Indication
Start T203
7 Multiple Frame Established
* Able to Establish


5 Awaiting Establish
DM
F=1
Y
N
Discard I Queue
DL Release Indication
Stop T200
4 TEI Assigned
5 Awaiting Establish
Timer T200 Expiry
RC=N200
Y
N
RC=RC+1
P=1
TX SABME
Start T200
5 Awaiting Establish
Discard I Queue
MDL Error Indication (G)
DL Release Indication
4 TEI Assigned
DL Data Request
Layer 3 Initiated
Y
N
Put I in I Queue
I Frame Queued
5 Awaiting Establish
Note:
I Frame Queued Up
Layer 3 Initiated
Y
N
I Frame Queued
5 Awaiting Establish
NOTE: Only possible in cases of layer 2 initiated re-establishment.

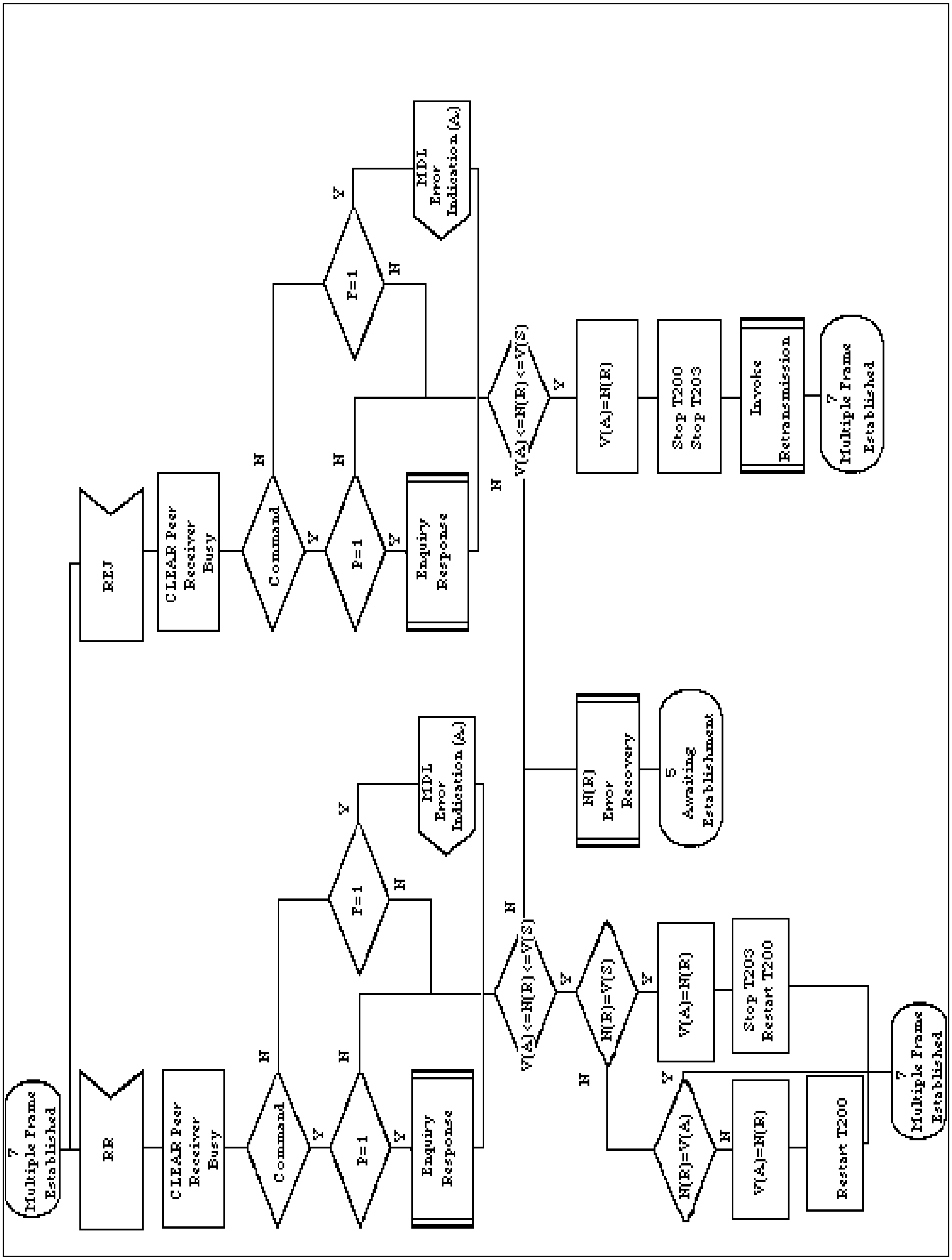

6 Awaiting Release
MDL Release Request
Discard UI Queue
DL Release Confirm
Stop T200
1 TEI Unassigned
Persistent Deactivation
Discard UI Queue
DL Release Confirm
Stop T200
4 TEI Assigned
SABME
F=P
TX DM
6 Awaiting Release
DISC
F=P
TX UA
6 Awaiting Release
UA
F=1
Y
N
DL Release Confirm
Stop T200
4 TEI Assigned
MDL Error Indication (D)
6 Awaiting Release

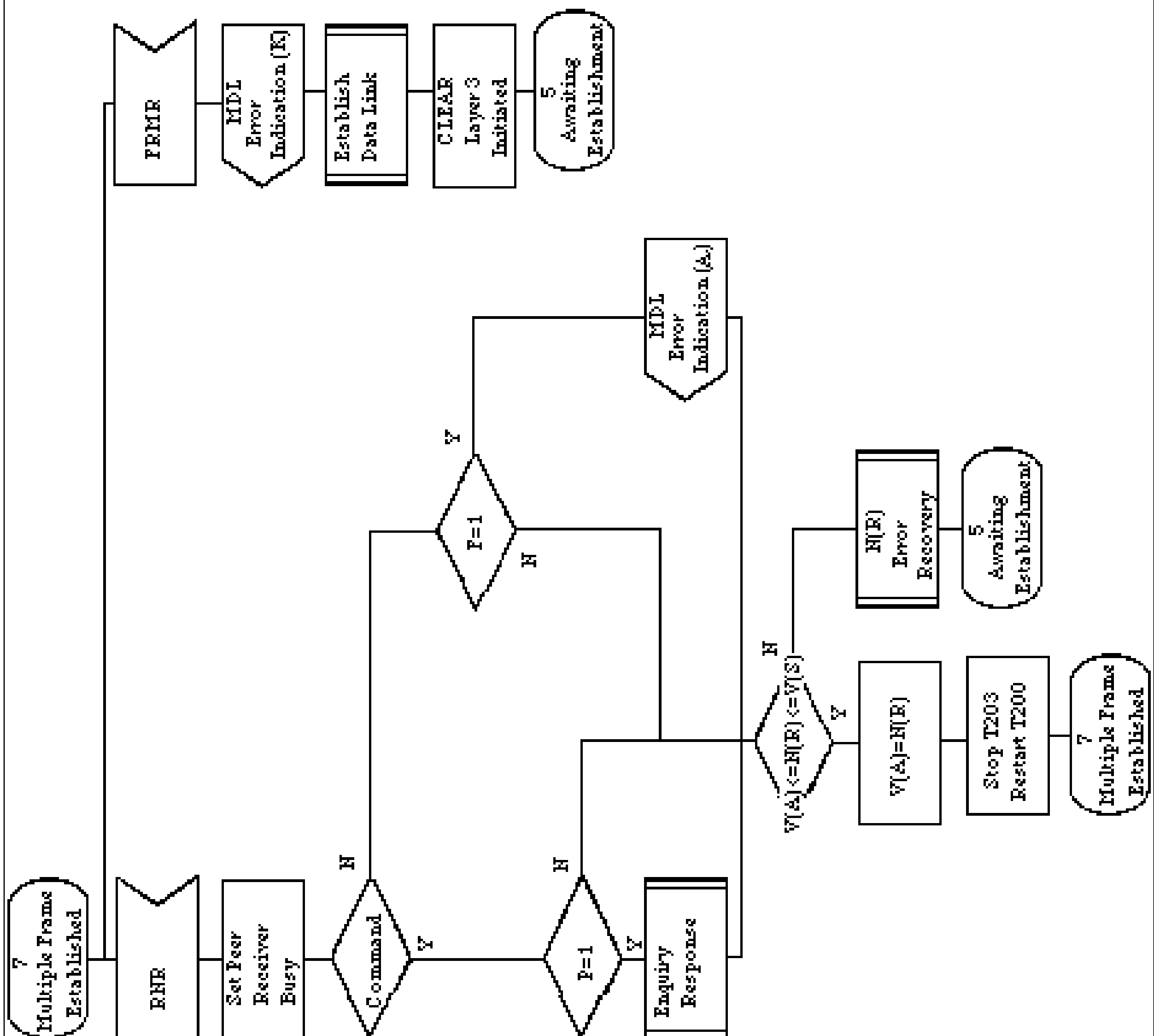

6 Awaiting Release
DM
F=1
N
Y
6 Awaiting Release
DL Release Confirm
Stop T200
4 TEI Assigned
Timer T200 Expiry
RC=N200
Y
N
MDL Error Indication (H)
DL Release Confirm
4 TEI Assigned
RC=RC+1
P=1
TX DISC
Start T200
6 Awaiting Release

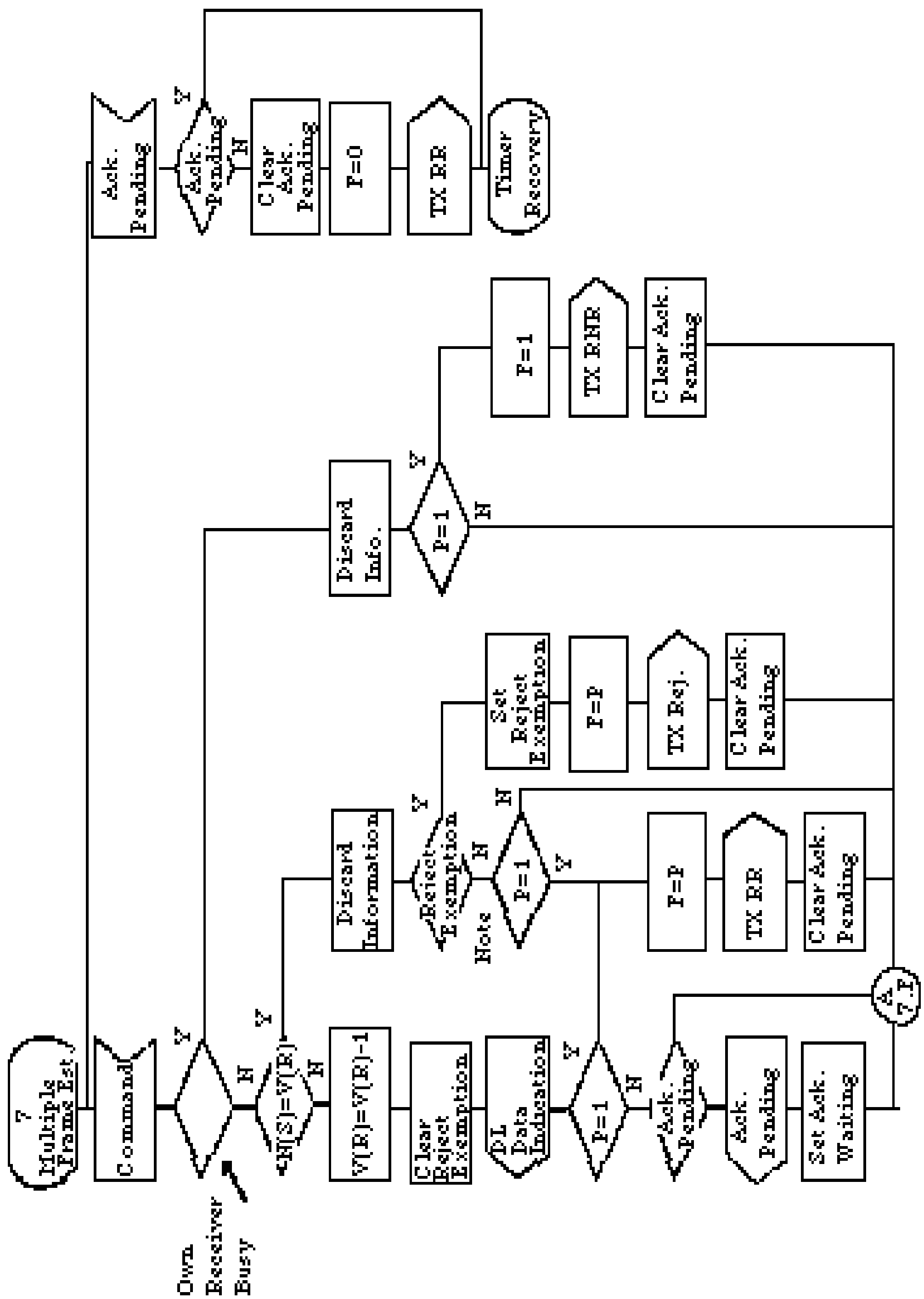

7 Multiple Frame Established
DL Est. Request
Discard I Queue
Est. Data Link
Set Layer 3 Indicated
5 Awaiting Est.
DL Rel. Request
Discard I Queue
RC=0 P=1
TX DISC
Restart T200
Stop 203
6 Awaiting Rel.
DL Data Request
Put in I Queue
I Frame Queued Up
7 Multiple Frame Established
I Frame Queued Up
Peer Busy
Y
N
V(S)=V(A)+K
Y
N
Get Last Transmitted I Queue
V(S)=V(S)-1 P=1
TX I Command
V(S)=V(S)+1
Clear Ack. Pending
T200 Running
Y
N
Restart T200
Stop 203
Note
I Frame Queued Up
7 Multiple Frame Established
T200 Expiry
RC=0
Peer Busy
Y
N
Transmit Enquiry
Get Last Transmitted I Frame
V(S)=V(S)-1 P=1
TX I Command
V(S)=V(S)+1
Clear Ack. Pending
Start T200
RC=RC+1
8 Timer Recovery
Timer T203 Expiry
Transmit Enquiry
RC=0
8 Timer Recovery
MDL Remove Request
Discard I and UI Queue
DL Rel Indication
Stop T200 Stop T203
1 TEI Unassigned
Note: The regeneration of this signal does not affect the sequence integrity of the queue.

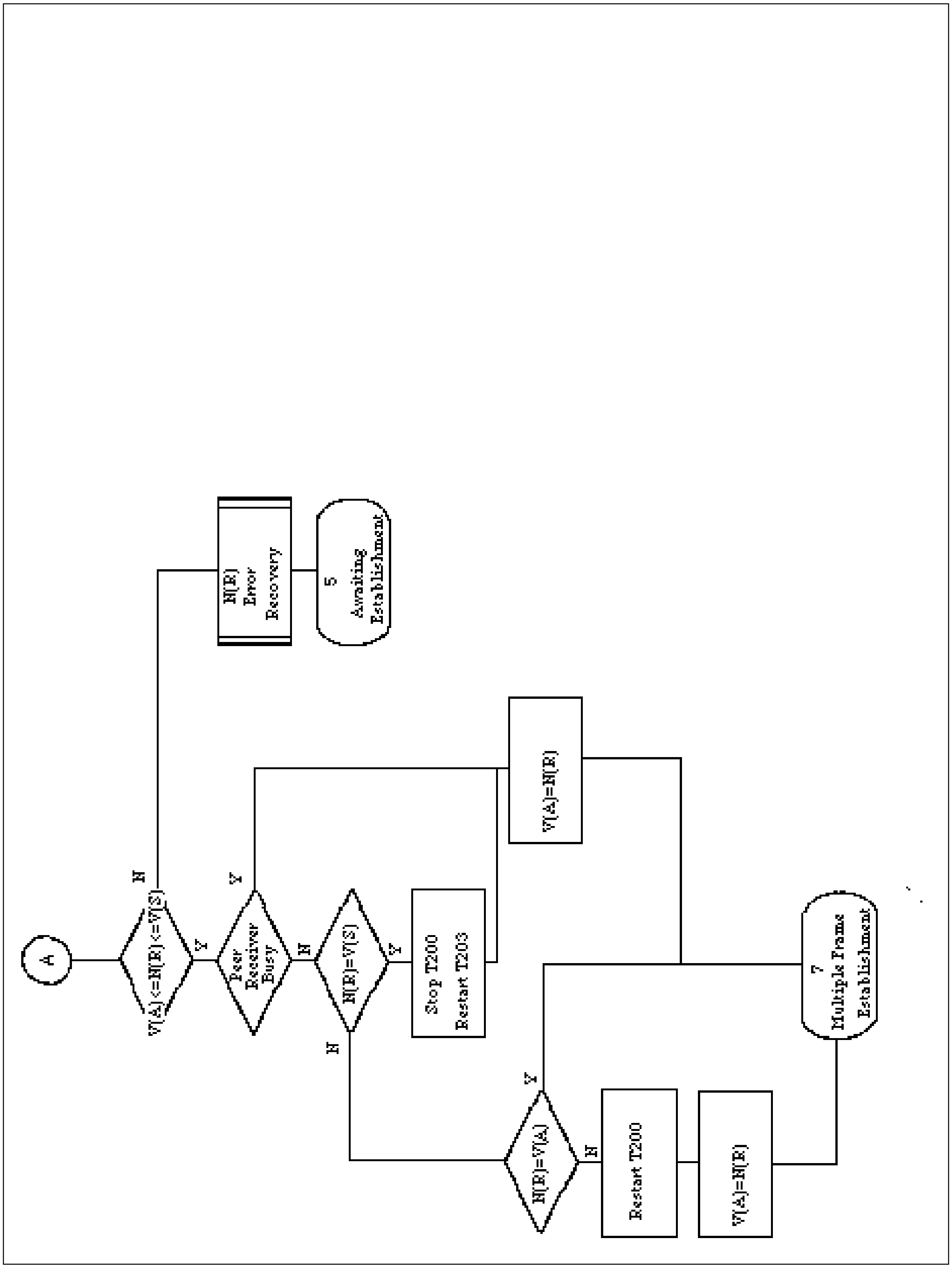


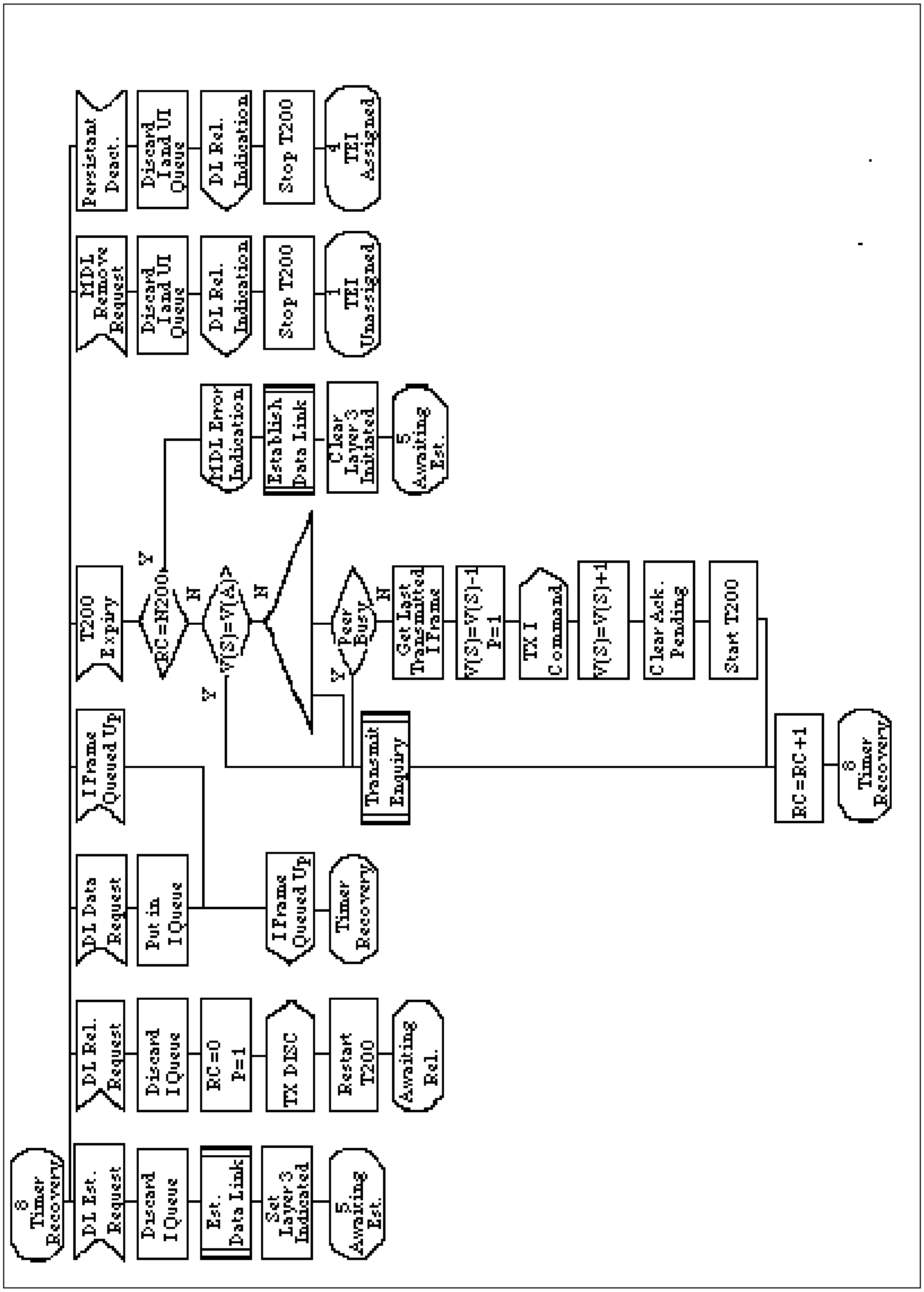
Note: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

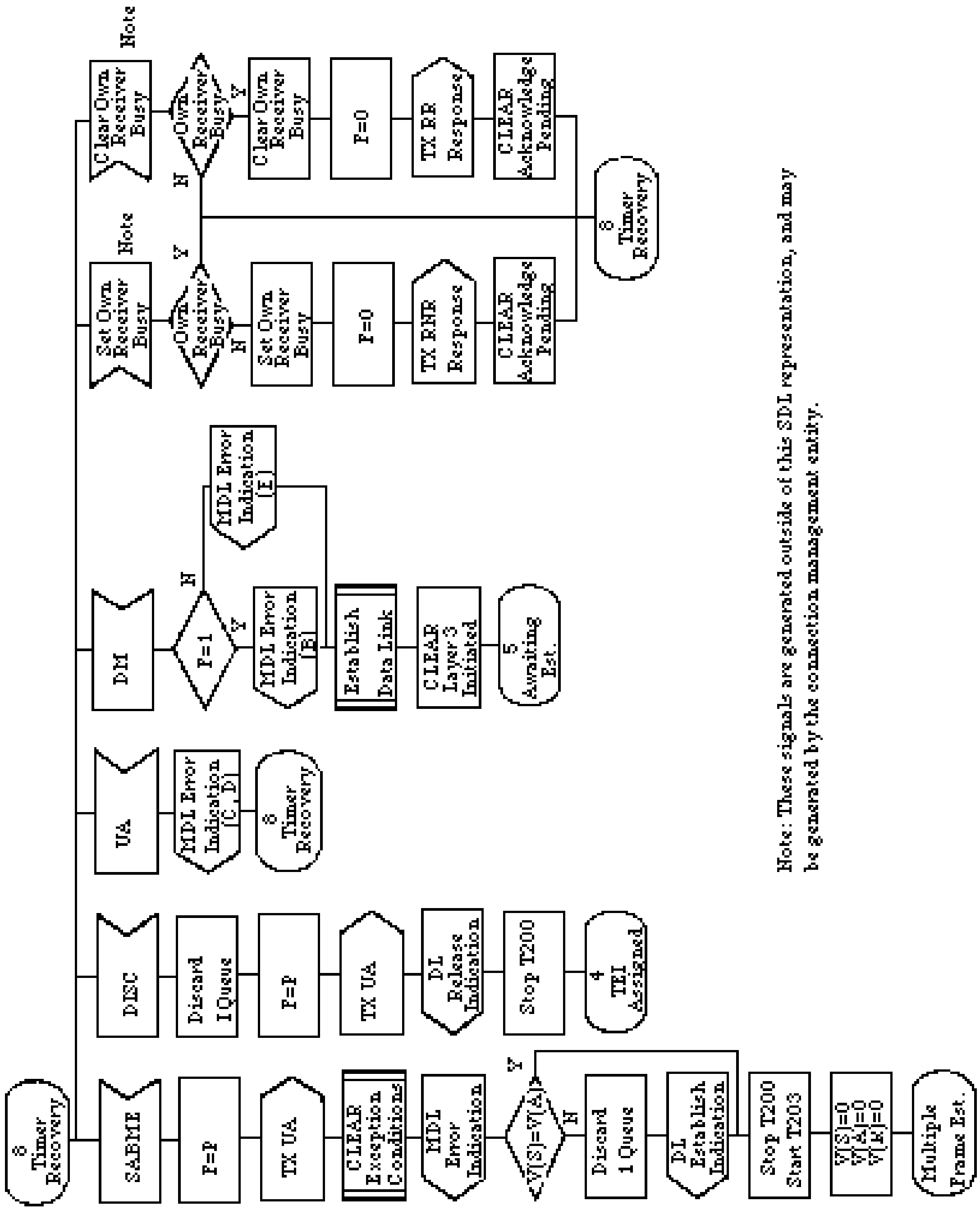

7
Multiple Frame
Established
RR
CLEAR Peer
Receiver
Busy
Command
P=1
Enquiry
Response
P=1
MDL
Error
Indication (A)
V(A)<=N(R)<=V(S)
N(R)=V(S)
V(A)=N(R)
Stop T203
Restart T200
N(R)=V(A)
V(A)=N(R)
Restart T200
7
Multiple Frame
Established
N(R)
Error
Recovery
5
Awaiting
Establishment
REJ
CLEAR Peer
Receiver
Busy
Command
P=1
Enquiry
Response
P=1
MDL
Error
Indication (A)
V(A)<=N(R)<=V(S)
V(A)=N(R)
Stop T200
Stop T203
Invoke
Retransmission
7
Multiple Frame
Established
Y
N

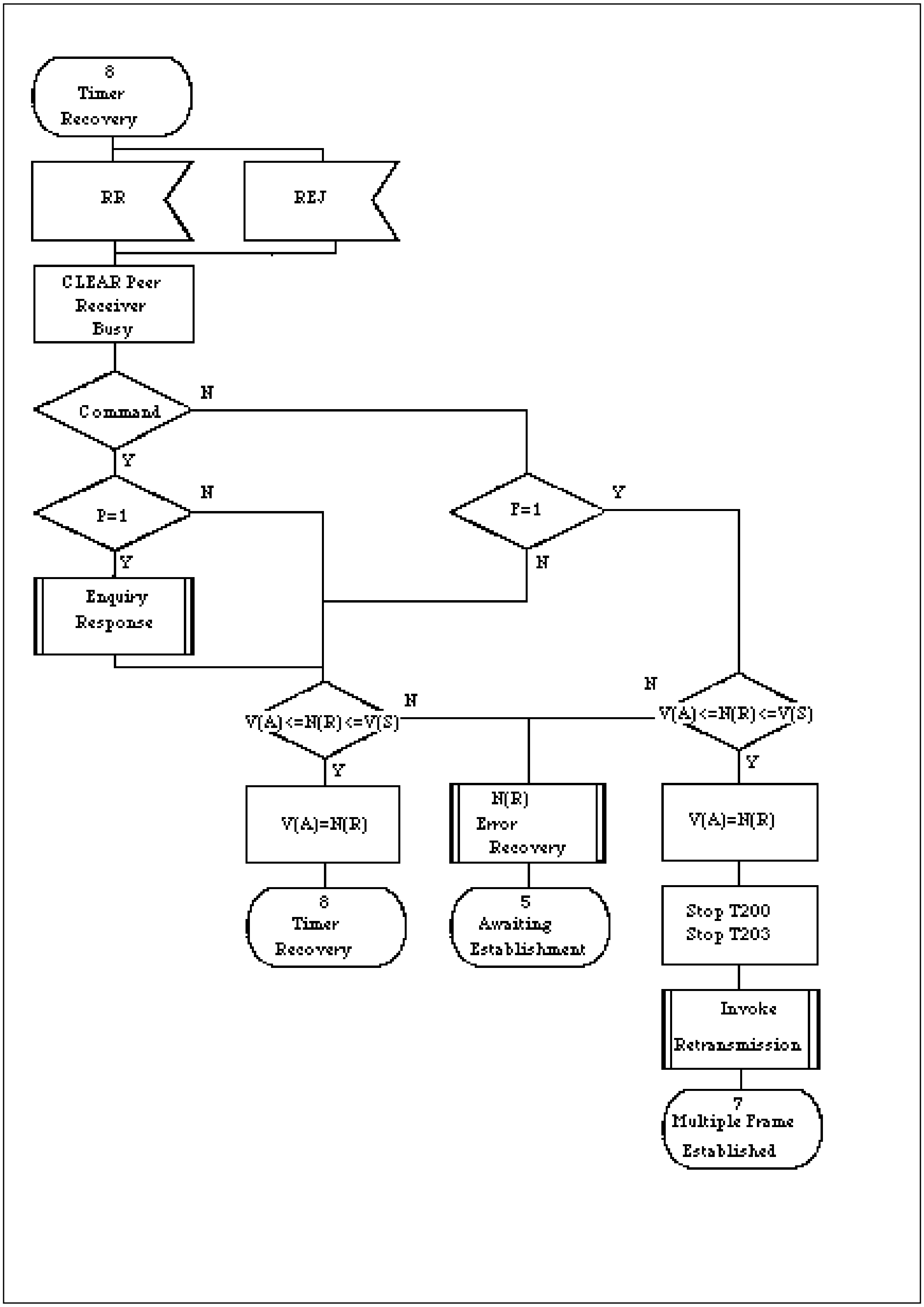

7
Multiple Frame
Established
RNR
Set Peer
Receiver
Busy
Command
Y
N
P=1
Y
N
Enquiry
Response
FRMR
MDL
Error
Indication (K)
Establish
Data Link
CLEAR
Layer 3
Initiated
5
Awaiting
Establishment
P=1
Y
N
MDL
Error
Indication (A)
V(A)<=N(R)<=V(S)
Y
N
N(R)
Error
Recovery
5
Awaiting
Establishment
V(A)=N(R)
Stop T203
Restart T200
7
Multiple Frame
Established

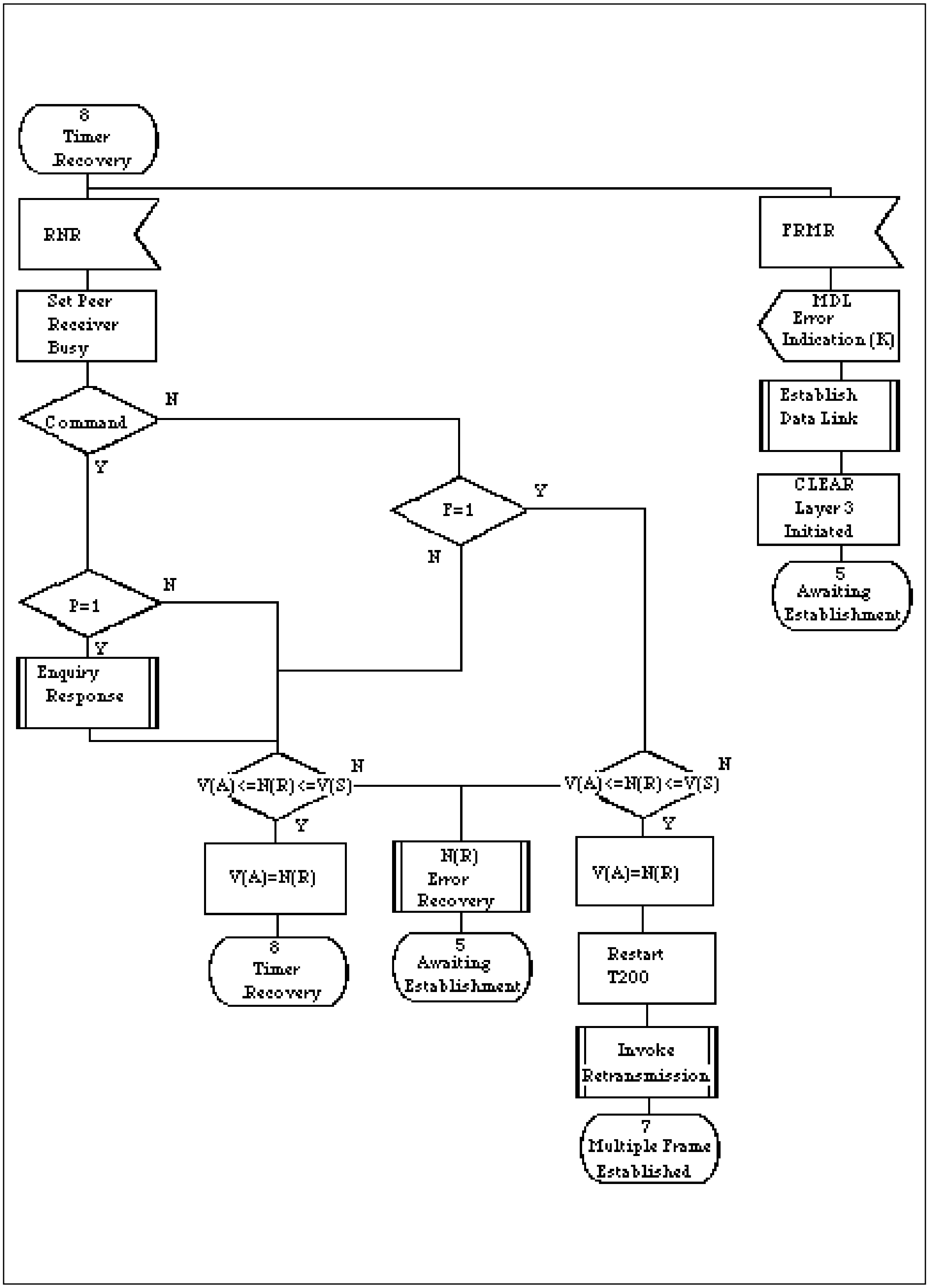

7 Multiple Frame Est.
Command
Own Receiver Busy
Y
N
N(S)=V(R)
V(R)=V(R)-1
Clear Reject Exemption
DL Data Indication
P=1
Ack. Pending
Ack. Pending
Set Ack. Waiting
A 7.F
Discard Information
Reject Exemption
Note
Set Reject Exemption
F=P
TX Rej.
Clear Ack. Pending
F=P
TX RR
Clear Ack. Pending
Discard Info.
P=1
F=1
TX RNR
Clear Ack. Pending
Ack. Pending
Ack. Pending
Clear Ack. Pending
F=0
TX RR
Timer Recovery

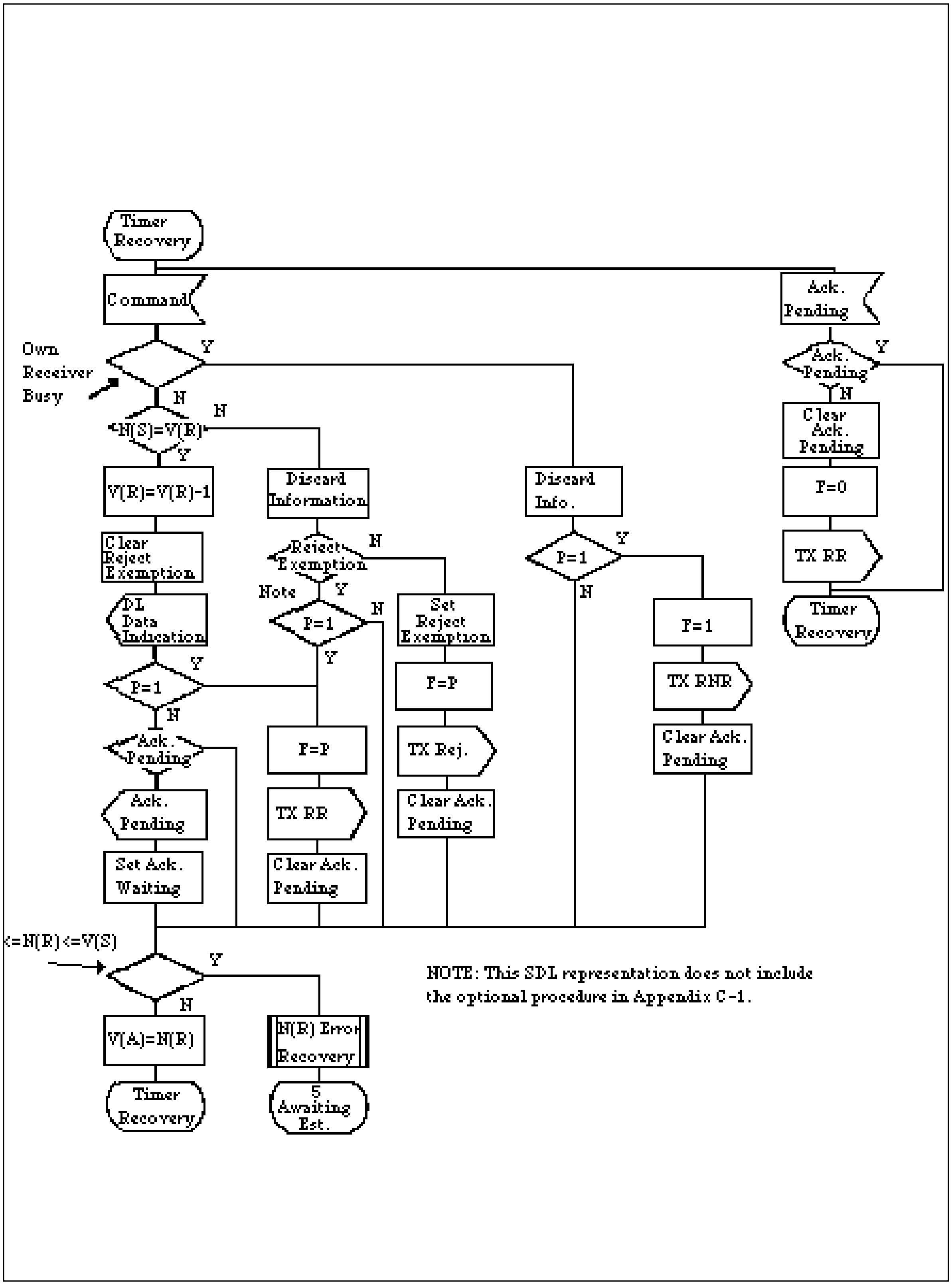

A
V(A)<=N(R)<=V(S)
N
Y
N(R) Error Recovery
5 Awaiting Establishment
Peer Receiver Busy
Y
N
N(R)=V(S)
Y
N
Stop T200 Restart T203
V(A)=N(R)
7 Multiple Frame Establishment
N(R)=V(A)
Y
N
Restart T200
V(A)=N(R)

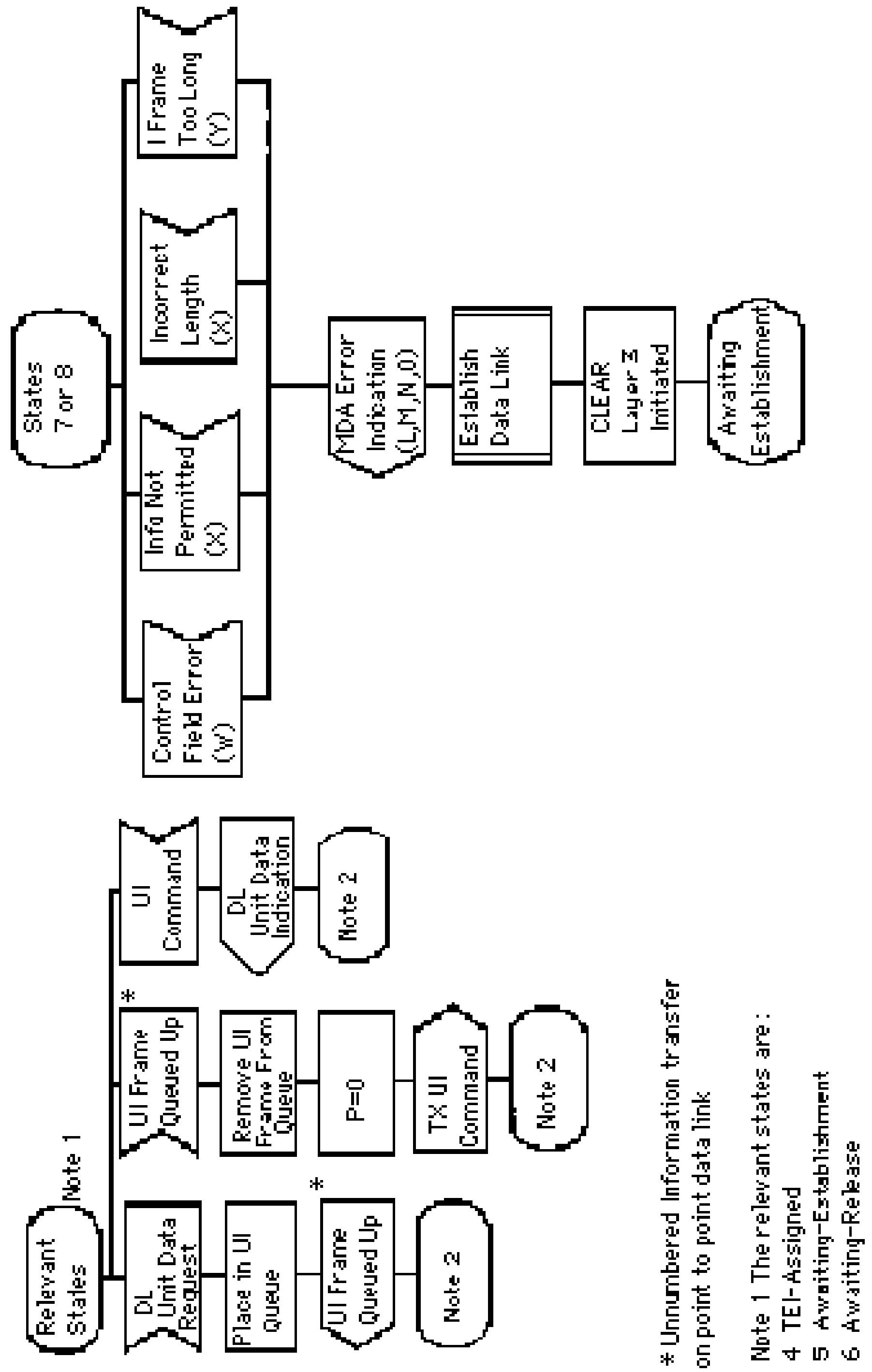

8 Timer Recovery
DL Est. Request
Discard I Queue
Est. Data Link
Set Layer 3 Indicated
5 Awaiting Est.
DL Rel. Request
Discard I Queue
RC=0 P=1
TX DISC
Restart T200
Awaiting Rel.
DL Data Request
Put in I Queue
I Frame Queued Up
Timer Recovery
I Frame Queued Up
Transmit Enquiry
RC=RC+1
8 Timer Recovery
T200 Expiry
RC=N200
Y
N
V(S)=V(A)?
Y
N
Peer Busy
Y
N
Get Last Transmitted I Frame
V(S)=V(S)-1 P=1
TX I Command
V(S)=V(S)+1
Clear Ack. Pending
Start T200
MDL Error Indication
Establish Data Link
Clear Layer 3 Initiated
5 Awaiting Est.
MDL Remove Request
Discard I and UI Queue
DL Rel. Indication
Stop T200
1 TEI Unassigned
Persistant Deact.
Discard I and UI Queue
DL Rel. Indication
Stop T200
4 TEI Assigned


8 Timer Recovery
SABME
F=P
TX UA
CLEAR Exception Conditions
MDL Error Indication
V(S)=V(A)
Y
N
Discard I Queue
DL Establish Indication
Stop T200 Start T203
V(S)=0 V(A)=0 V(R)=0
Multiple Frame Est.
DISC
Discard I Queue
F=P
TX UA
DL Release Indication
Stop T200
4 TEI Assigned
UA
MDL Error Indication (C, D)
8 Timer Recovery
DM
F=1
Y
N
MDL Error Indication (B)
MDL Error Indication (E)
Establish Data Link
CLEAR Layer 3 Initiated
5 Awaiting Est.
Set Own Receiver Busy
Note
Own Receiver Busy
Y
N
Set Own Receiver Busy
F=0
TX RNR Response
CLEAR Acknowledge Pending
Clear Own Receiver Busy
Note
Own Receiver Busy
Y
N
Clear Own Receiver Busy
F=0
TX RR Response
CLEAR Acknowledge Pending
8 Timer Recovery
Note: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.


8
Timer
Recovery
RR
REJ
CLEAR Peer
Receiver
Busy
Command
N
Y
P=1
N
Y
Enquiry
Response
P=1
Y
N
V(A)<=N(R)<=V(S)
N
Y
V(A)<=N(R)<=V(S)
N
Y
V(A)=N(R)
N(R)
Error
Recovery
V(A)=N(R)
8
Timer
Recovery
5
Awaiting
Establishment
Stop T200
Stop T203
Invoke
Retransmission
7
Multiple Frame
Established


8
Timer
Recovery
RNR
FRMR
Set Peer
Receiver
Busy
MDL
Error
Indication (K)
Command
N
Y
Establish
Data Link
P=1
Y
N
CLEAR
Layer 3
Initiated
5
Awaiting
Establishment
P=1
N
Y
Enquiry
Response
V(A)<=N(R)<=V(S)
N
Y
V(A)<=N(R)<=V(S)
N
Y
V(A)=N(R)
N(R)
Error
Recovery
V(A)=N(R)
8
Timer
Recovery
5
Awaiting
Establishment
Restart
T200
Invoke
Retransmission
7
Multiple Frame
Established

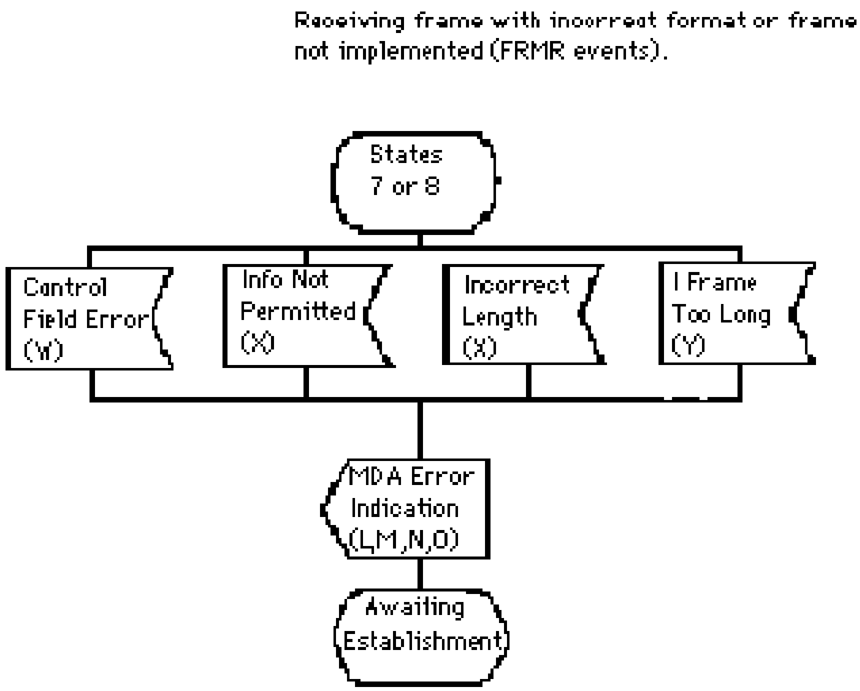

Timer Recovery
Command
Ack. Pending
Own Receiver Busy
Y
N
N(S)=V(R)
N
Y
Ack. Pending
Y
N
Clear Ack. Pending
V(R)=V(R)-1
Discard Information
Discard Info.
P=0
Clear Reject Exemption
Reject Exemption
N
P=1
Y
TX RR
Note
Y
N
DL Data Indication
P=1
N
Set Reject Exemption
Timer Recovery
P=1
Y
Y
P=1
F=P
TX RNR
N
Ack. Pending
F=P
TX Rej.
Clear Ack. Pending
Ack. Pending
TX RR
Clear Ack. Pending
Set Ack. Waiting
Clear Ack. Pending
V(A)<=N(R)<=V(S)
Y
N
V(A)=N(R)
N(R) Error Recovery
Timer Recovery
5 Awaiting Est.
NOTE: This SDL representation does not include the optional procedure in Appendix C-1.

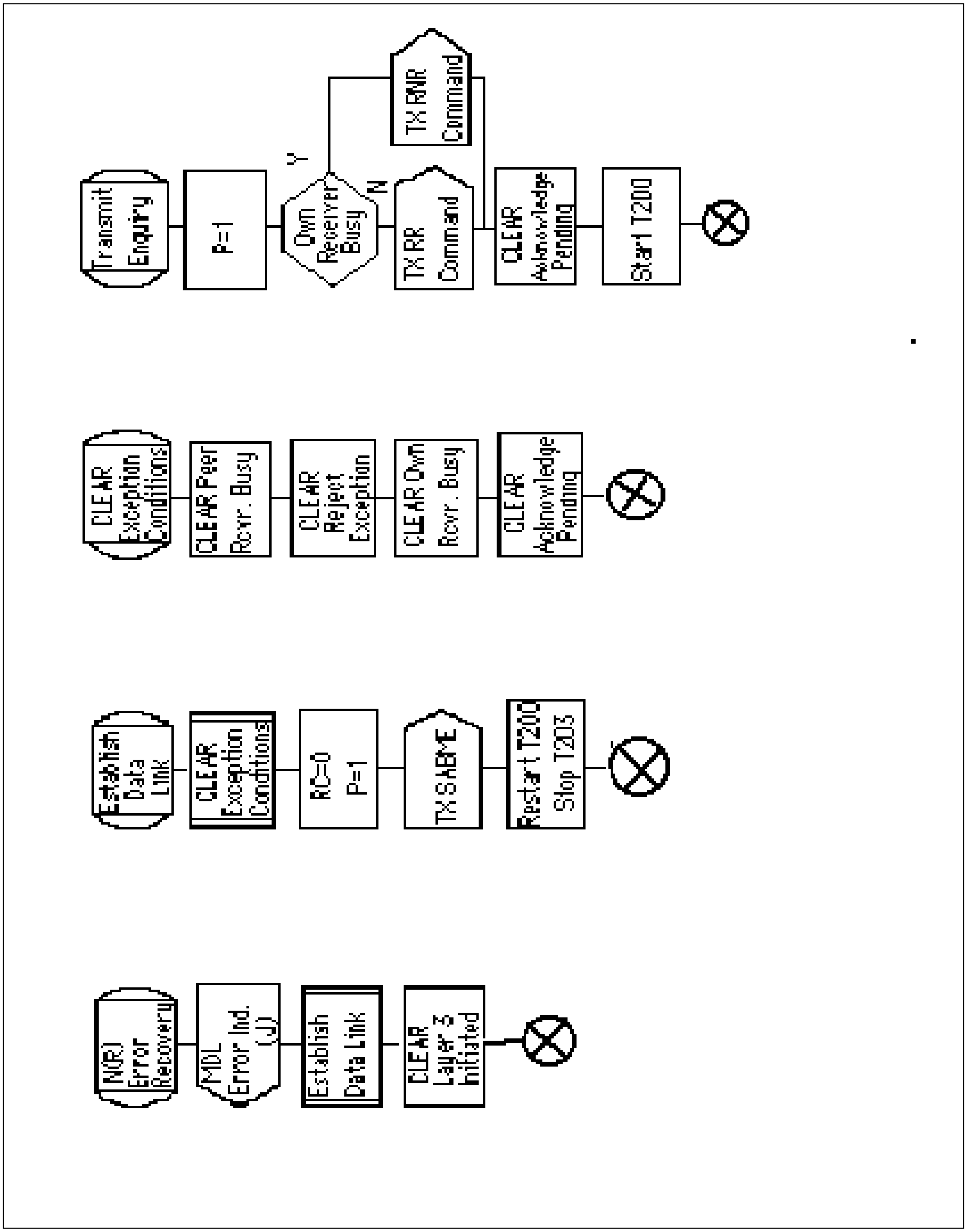


* Unnumbered Information transfer on point to point data link

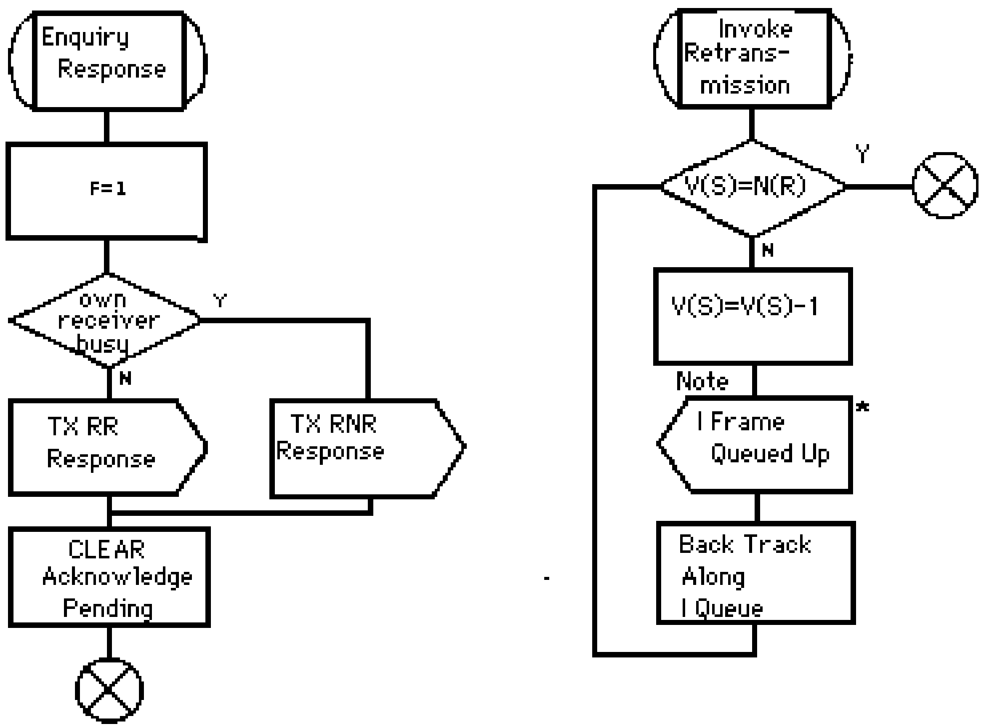
Note 1 The relevant states are :
4 TEI-Assigned
5 Awaiting-Establishment
6 Awaiting-Release
7 Multiple-Frame-Established
8 Timer Recovery

Note 2 The data link layer returns to the state it was in prior to the events shown


Receiving frame with incorrect format or frame not implemented (FRMR events).
States 7 or 8
Control Field Error (W)
Info Not Permitted (X)
Incorrect Length (X)
I Frame Too Long (Y)
MDA Error Indication (L,M,N,O)
Awaiting Establishment



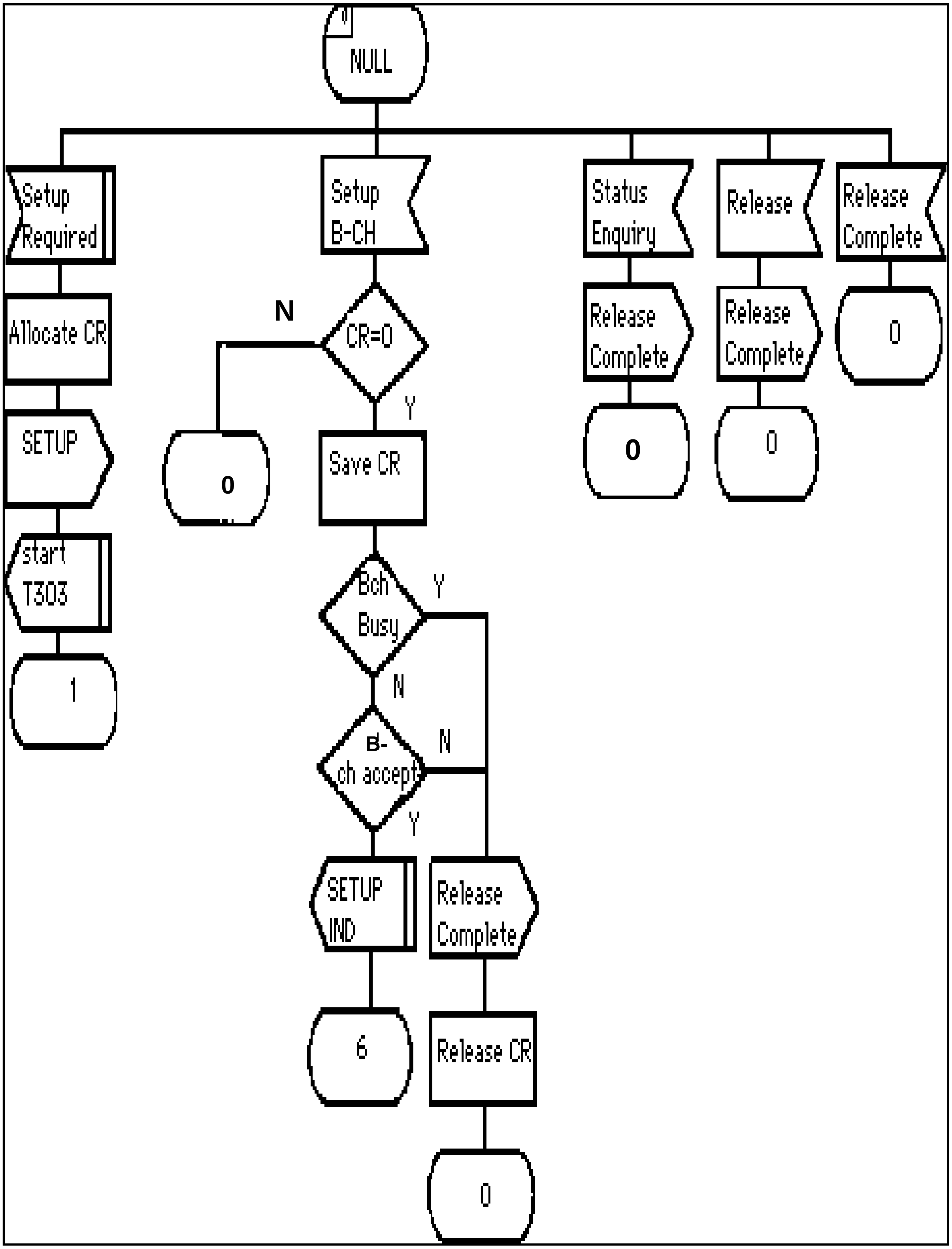
Transmit Enquiry
P=1
Own Receiver Busy
Y
N
TX RNR Command
TX RR Command
CLEAR Acknowledge Pending
Start T200
CLEAR Exception Conditions
CLEAR Peer Rcvr. Busy
CLEAR Reject Exception
CLEAR Own Rcvr. Busy
CLEAR Acknowledge Pending
Establish Data Link
CLEAR Exception Conditions
RC=0 P=1
TX SABME
Restart T200 Stop T203
N(R) Error Recovery
MDL Error Ind. (J)
Establish Data Link
CLEAR Layer 3 Initiated



Note : The generation of the correct number of signals in order to cause the required retransmission of I frames does not alter their sequence integrity

Appendix D: Flows for Functional Call Control Signaling

Figure 230 Call Control Diagrams - USER SIDE (1 of 19)



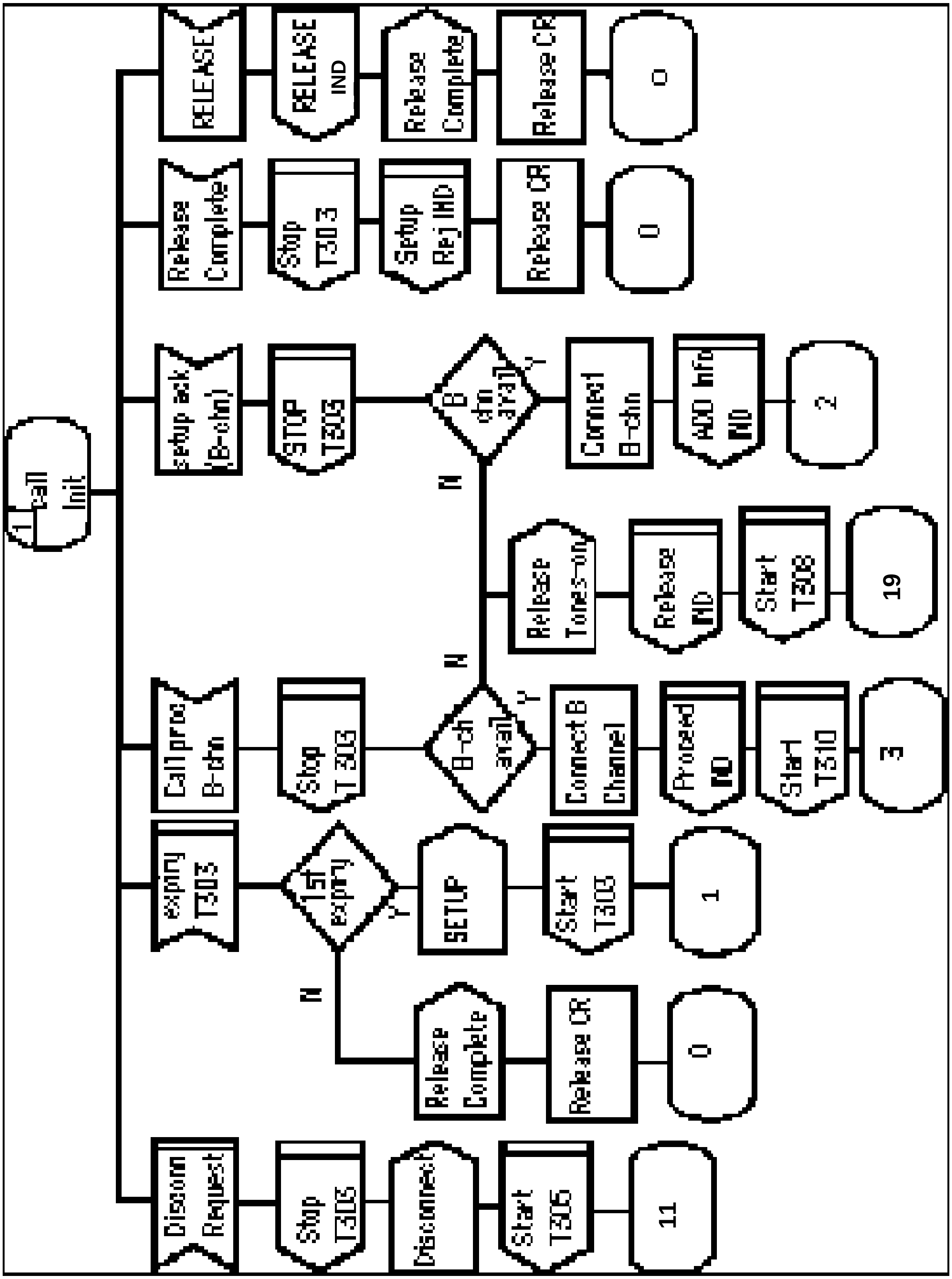


Figure 231 Call Control Diagrams - USER SIDE (2 of 19)

Figure 232 Call Control Diagrams - USER SIDE (3 of 19)

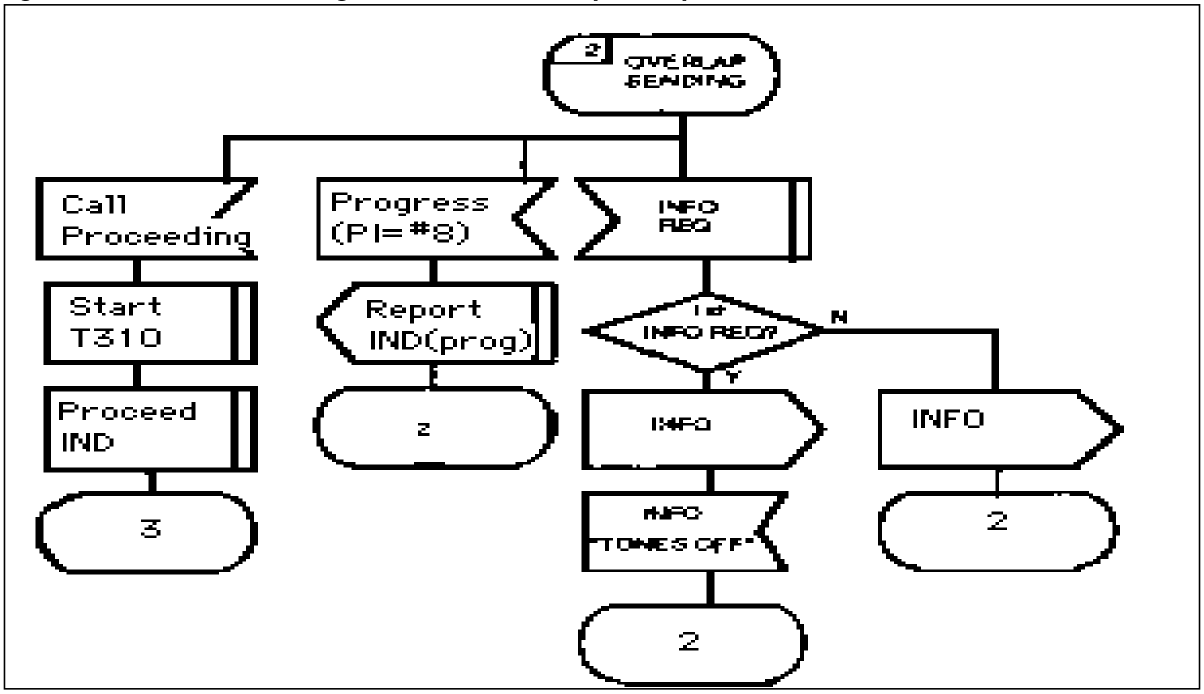


Figure 233 Call Control Diagrams - USER SIDE (4 of 19)

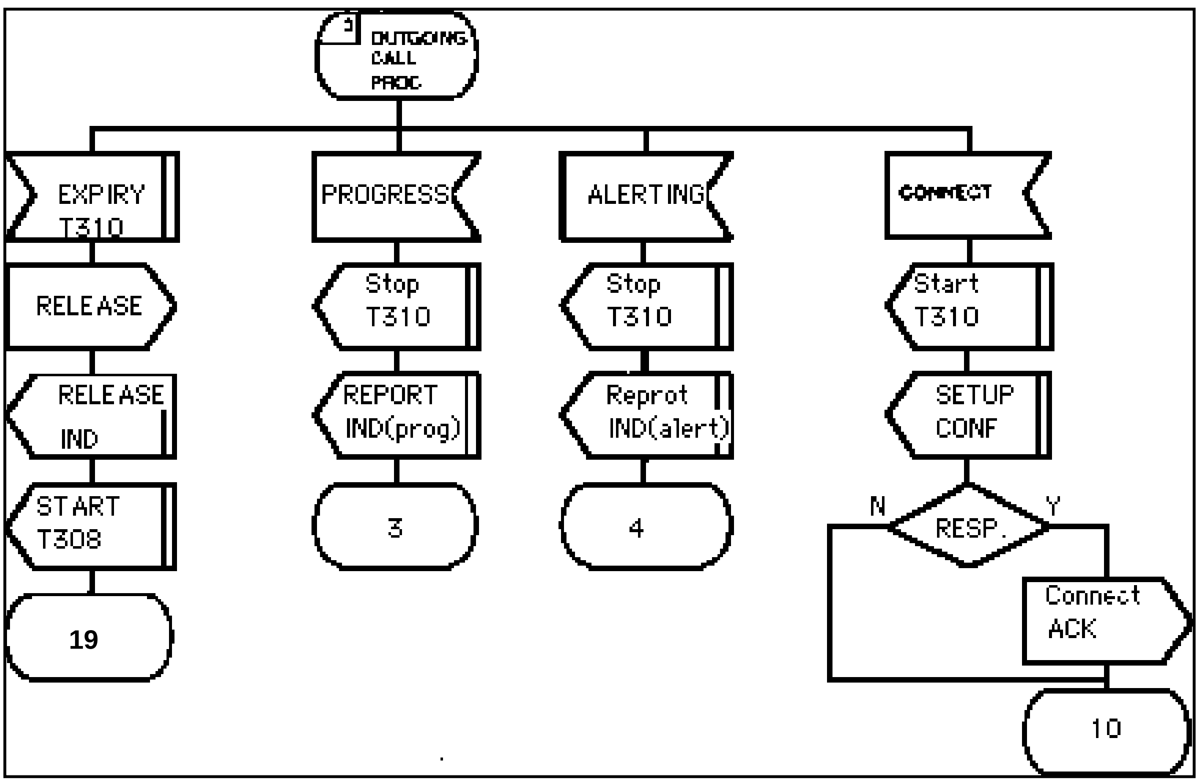


Figure 234 Call Control Diagrams - USER SIDE (5 of 19)

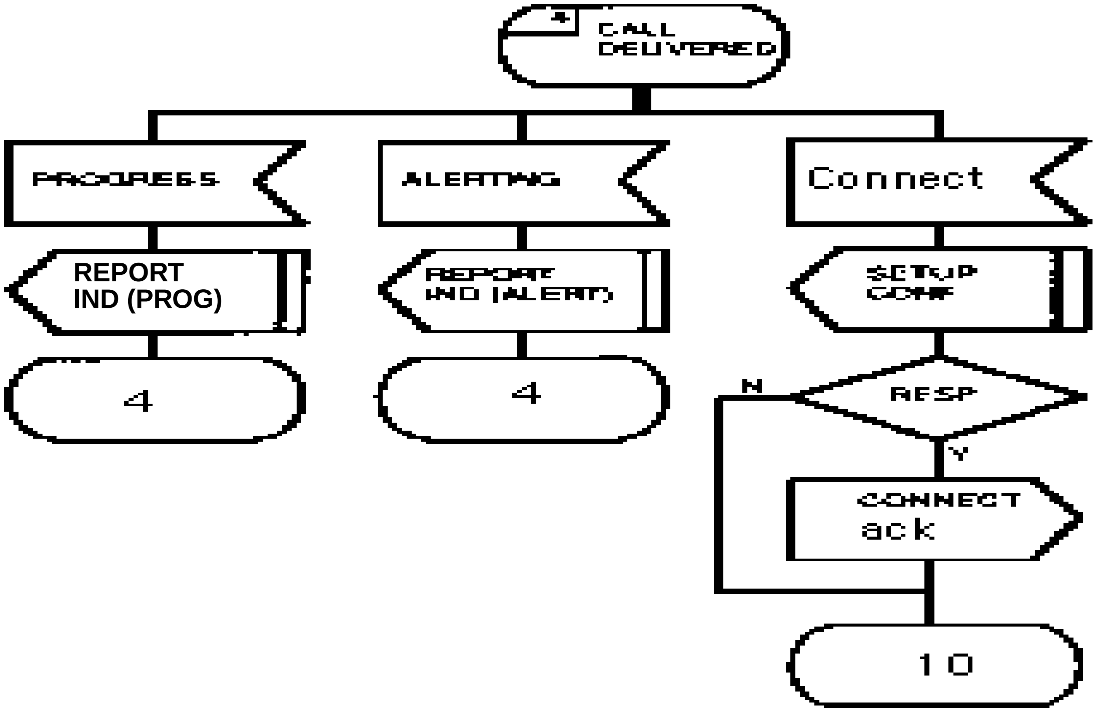


Figure 235 Call Control Diagrams - USER SIDE (6 of 19)

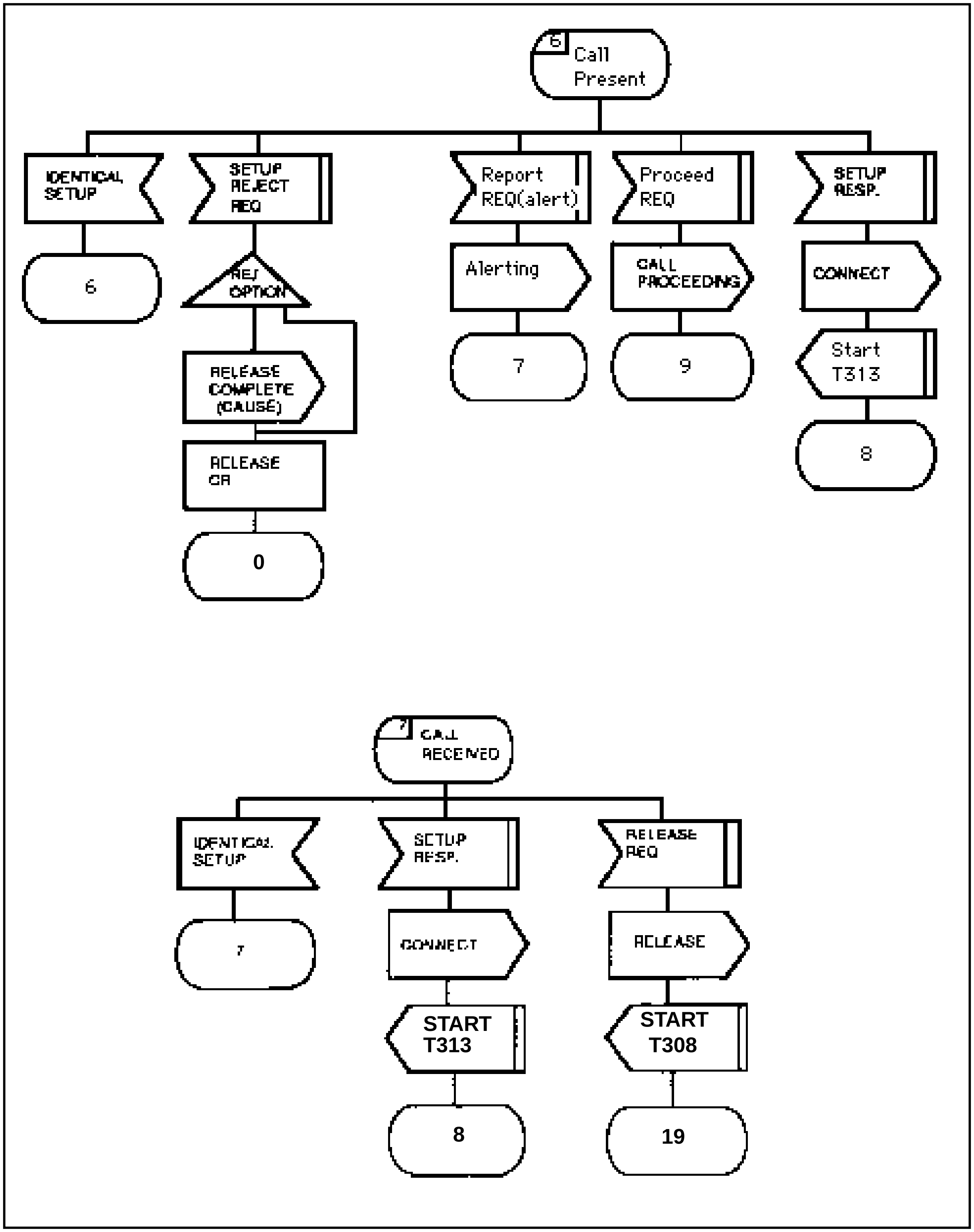


Figure 236 Call Control Diagrams - USER SIDE (7 of 19)

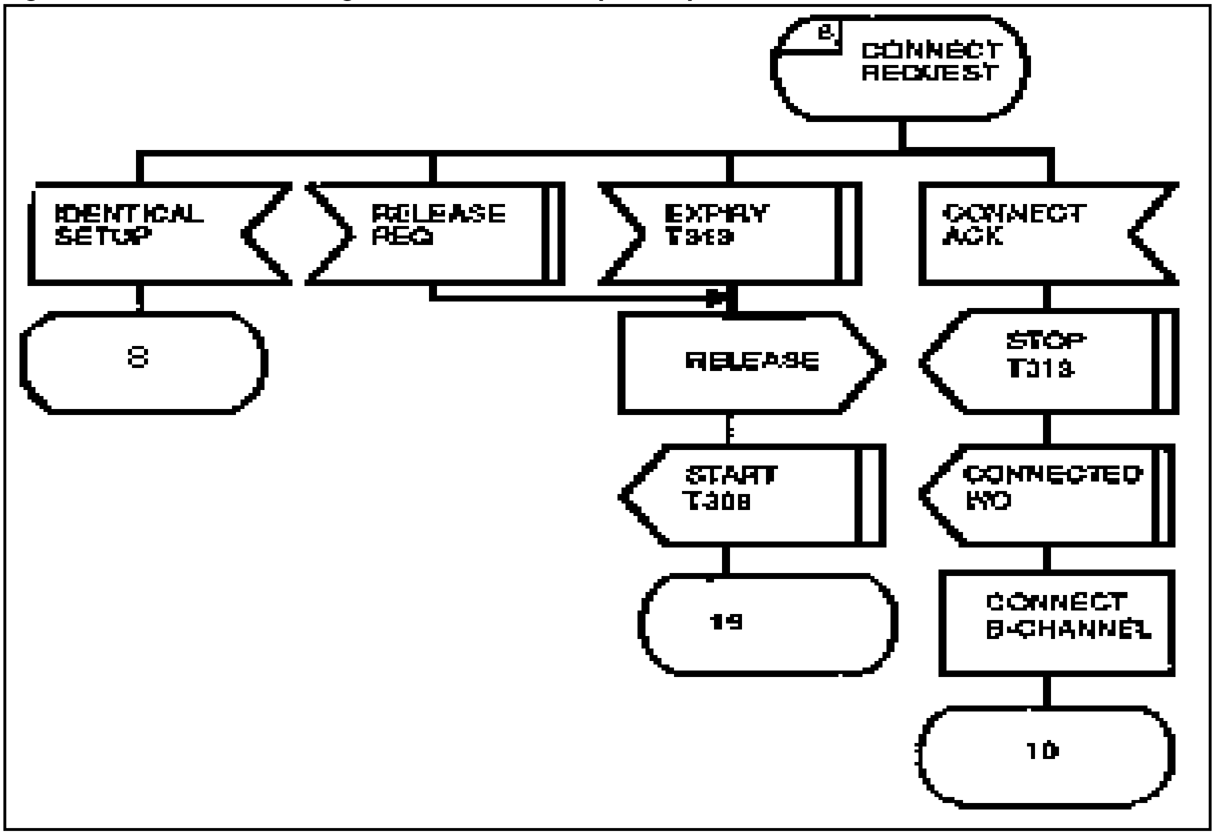


Figure 237 Call Control Diagrams - USER SIDE (8 of 19)

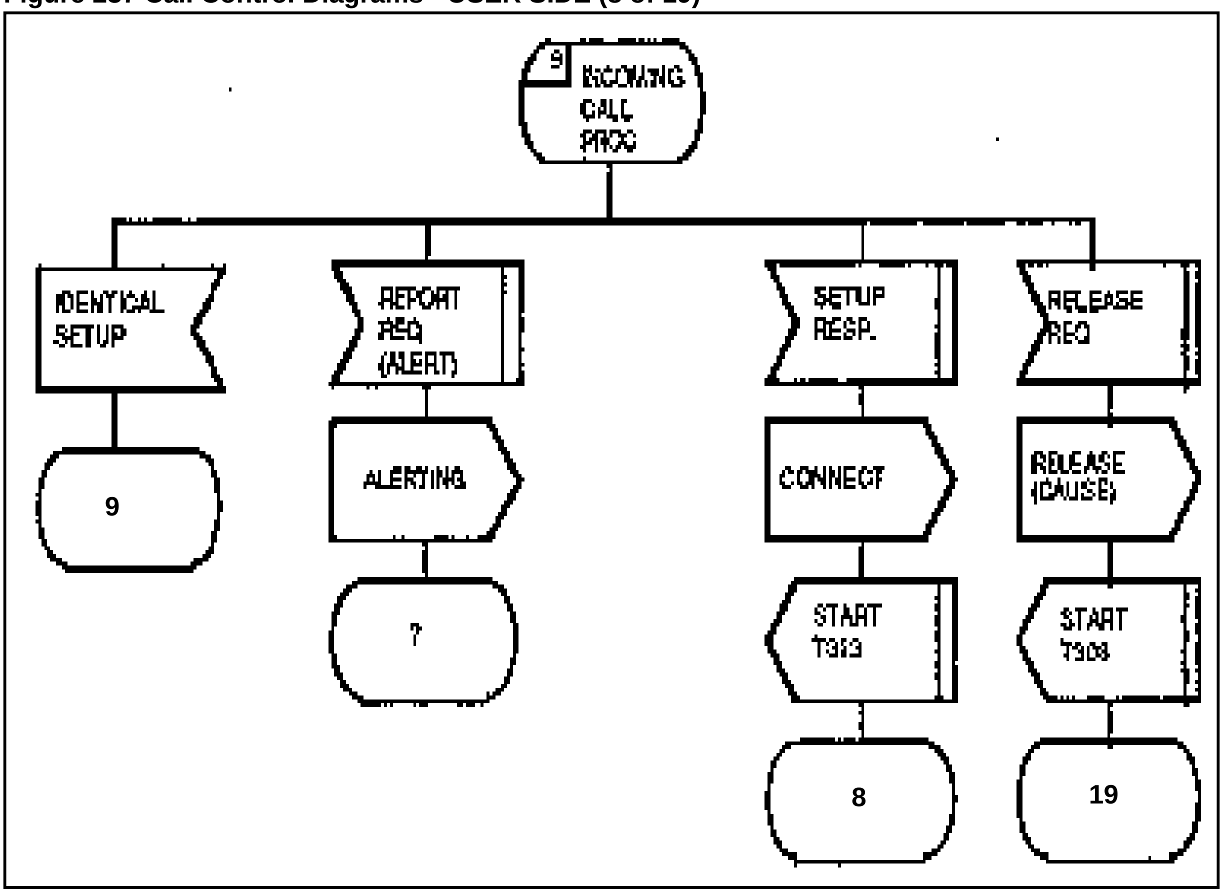


Figure 238 Call Control Diagrams - USER SIDE (9 of 19)

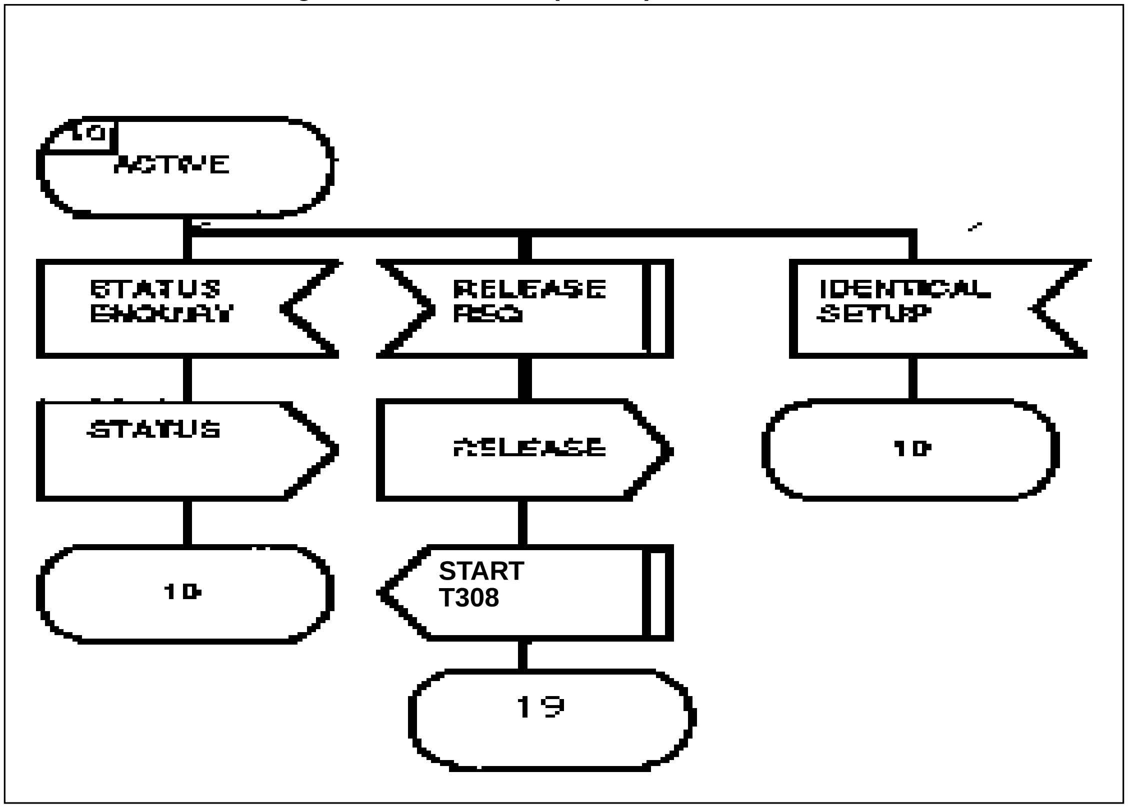
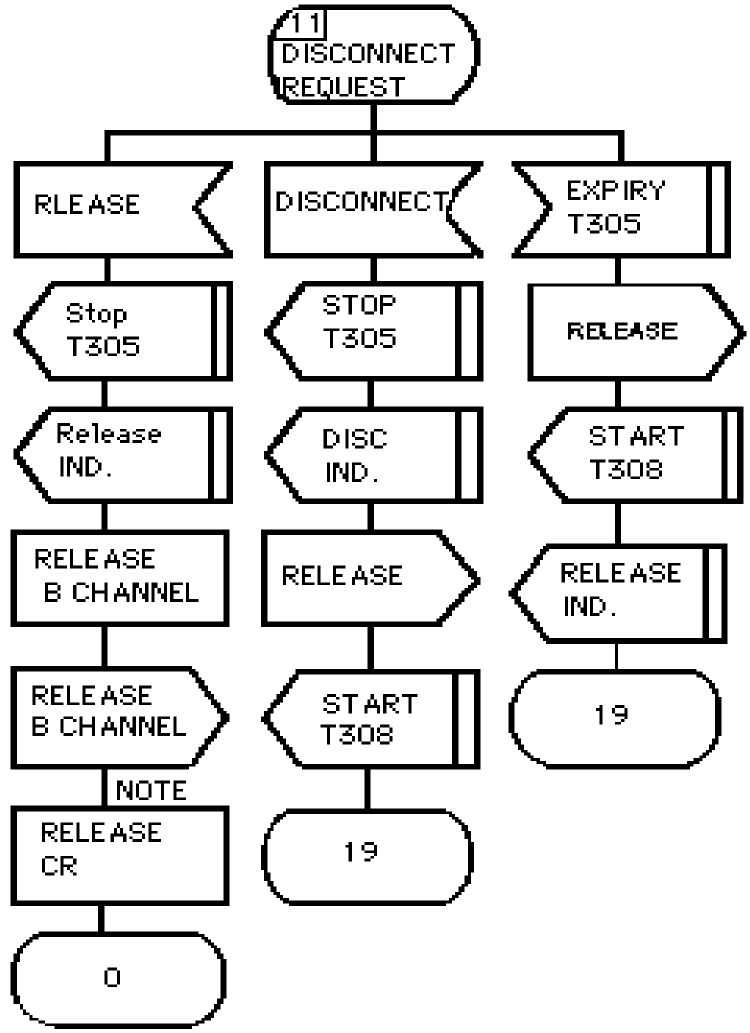
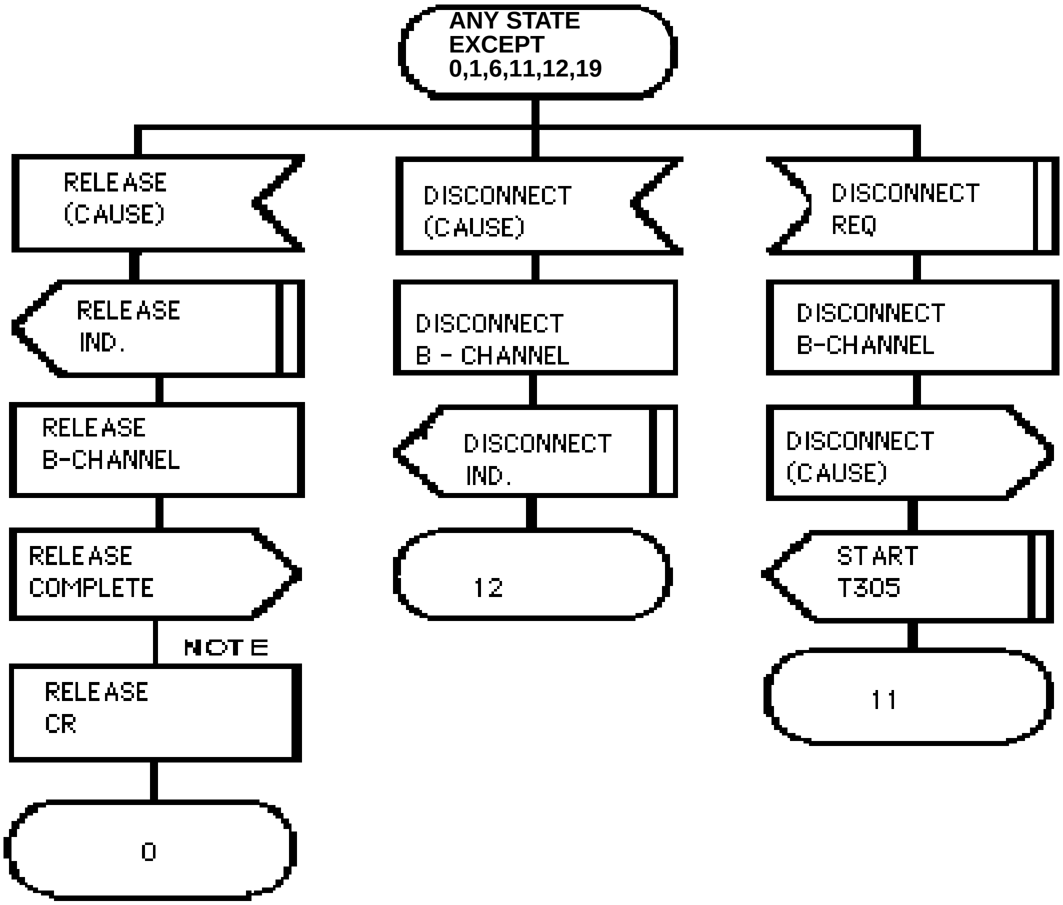


Figure 239 Call Control Diagrams - USER SIDE (10 of 19)



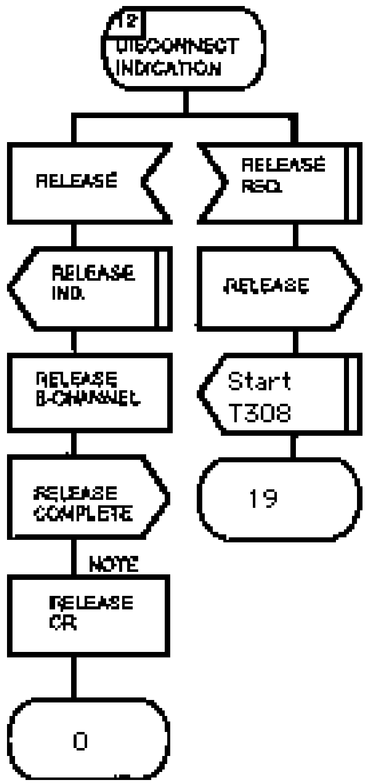
The CR should not be reused until internal clearing actions have been completed

Figure 240 Call Control Diagrams - USER SIDE (11 of 19)



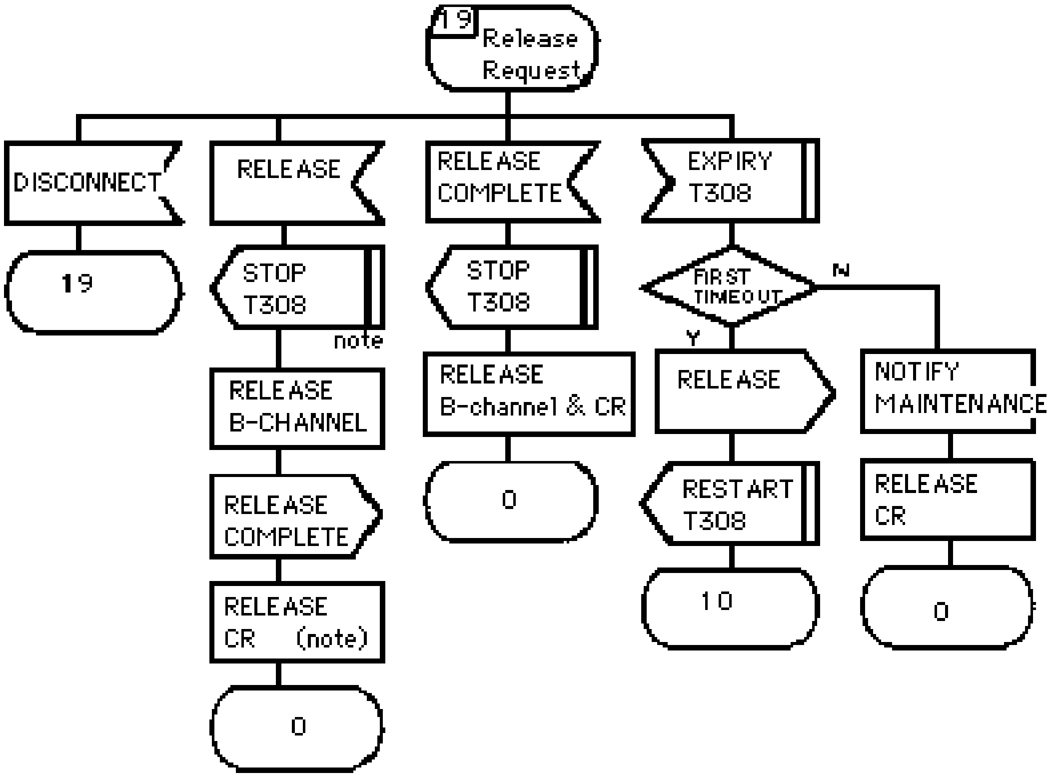
The CR should not be reused until internal clearing actions have been completed.

Figure 241 Call Control Diagrams - USER SIDE (12 of 19)



The CR should not be released until internal learning actions have been completed

Figure 242 Call Control Diagrams - USER SIDE (13 of 19)



NOTE: The CR should not be reused right away for making a new call otherwise. The release complete from the network would be mistaken as a rejection for the new call.

Figure 243 Call Control Diagrams - USER SIDE (14 of 19)

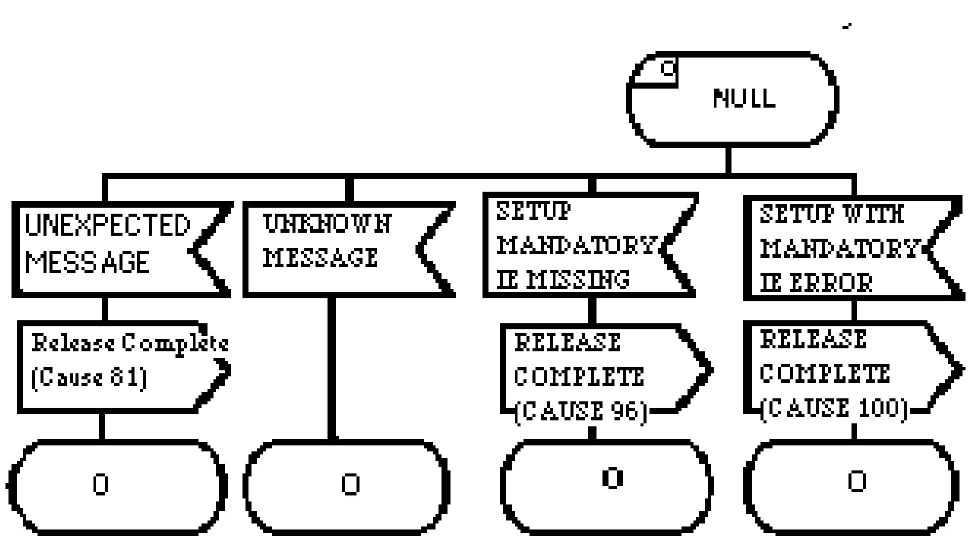
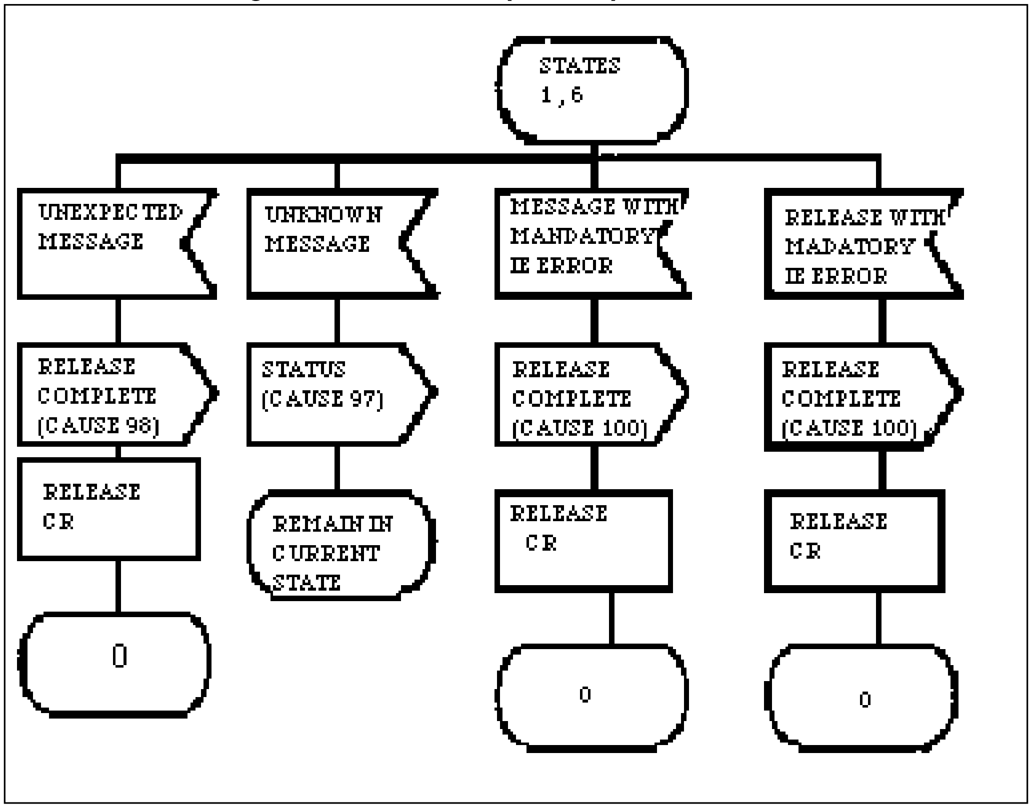


Figure 244 Call Control Diagrams - USER SIDE (15 of 19)



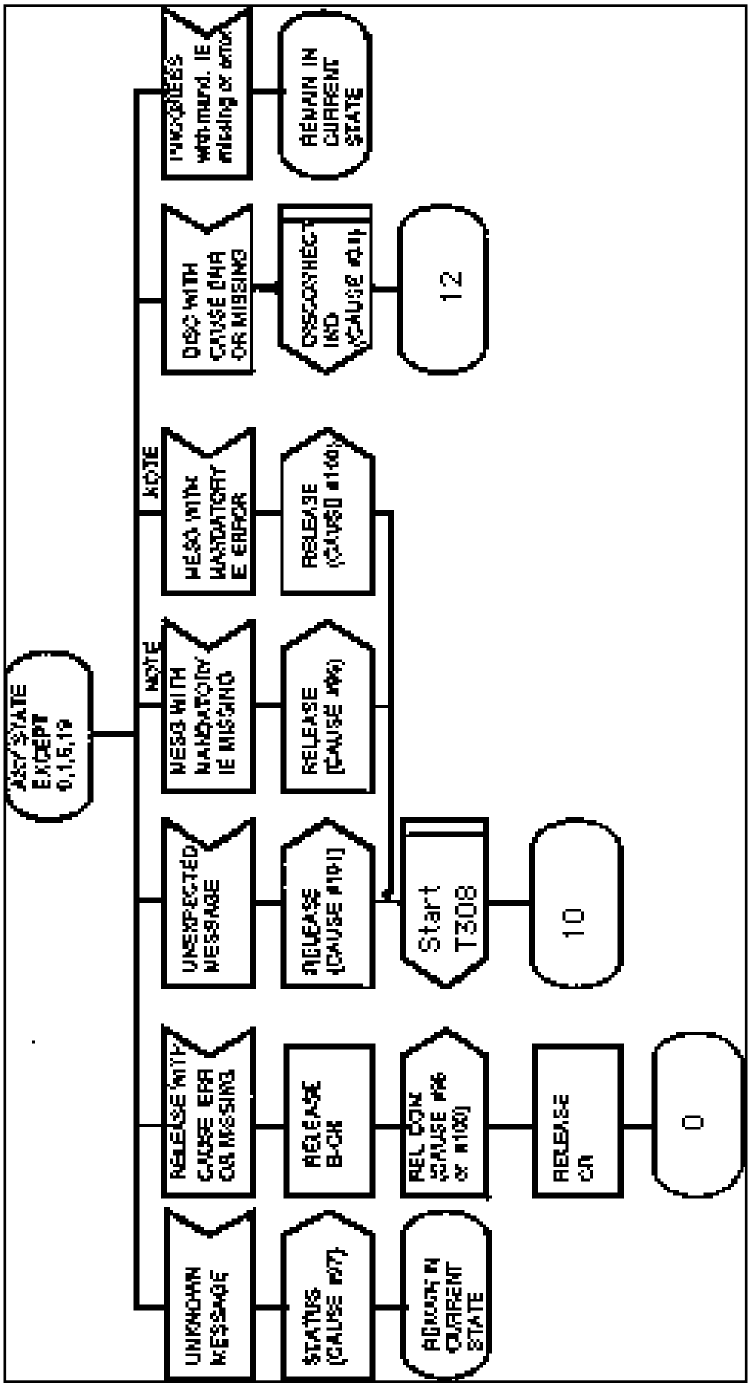


Figure 245 Call Control Diagrams - USER SIDE (16 of 19)

Figure 246 Call Control Diagrams - USER SIDE (17 of 19)

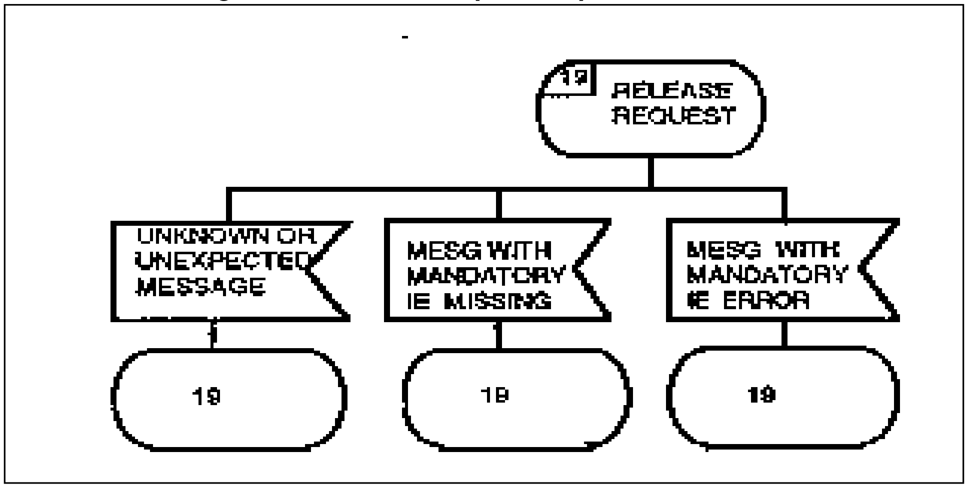


Figure 247 Call Control Diagrams - USER SIDE (18 of 19)

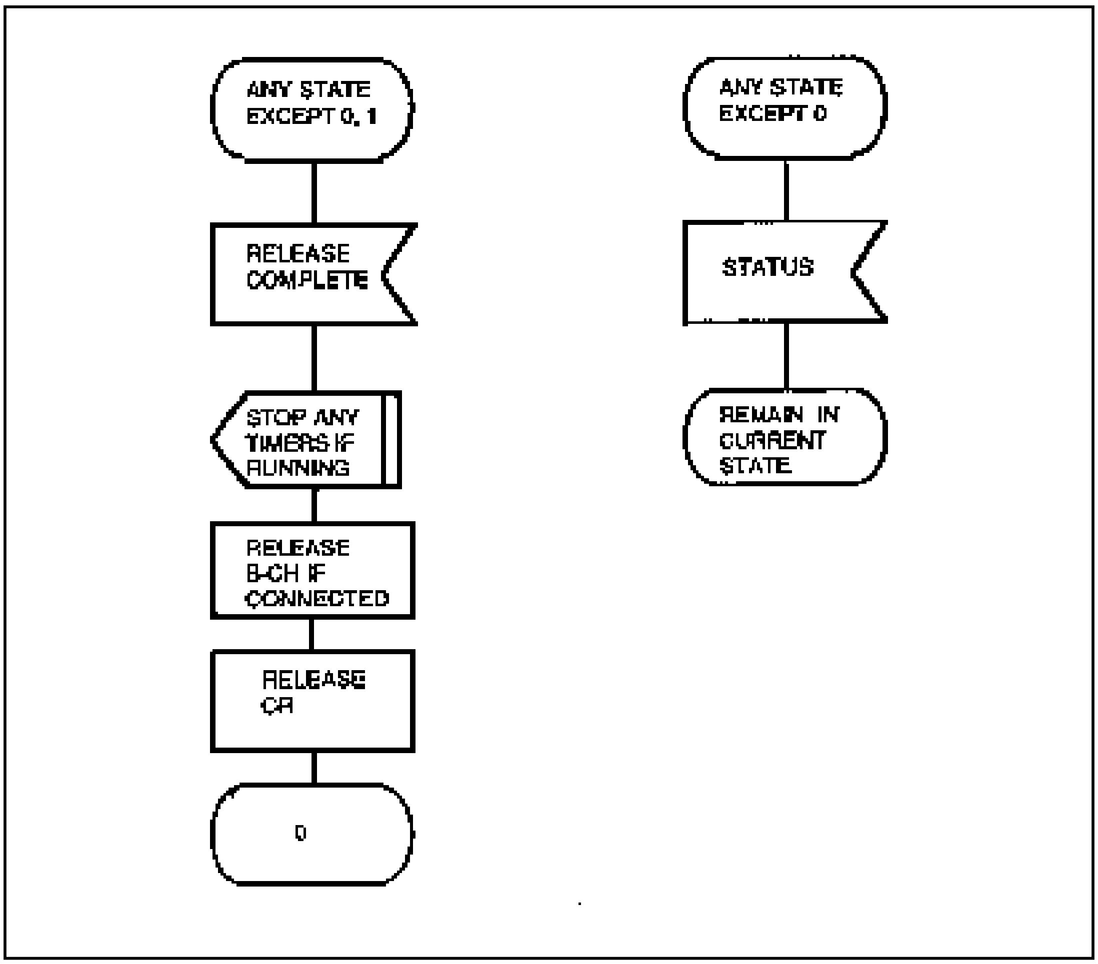


Figure 248 Call Control Diagrams - USER SIDE (19 of 19)

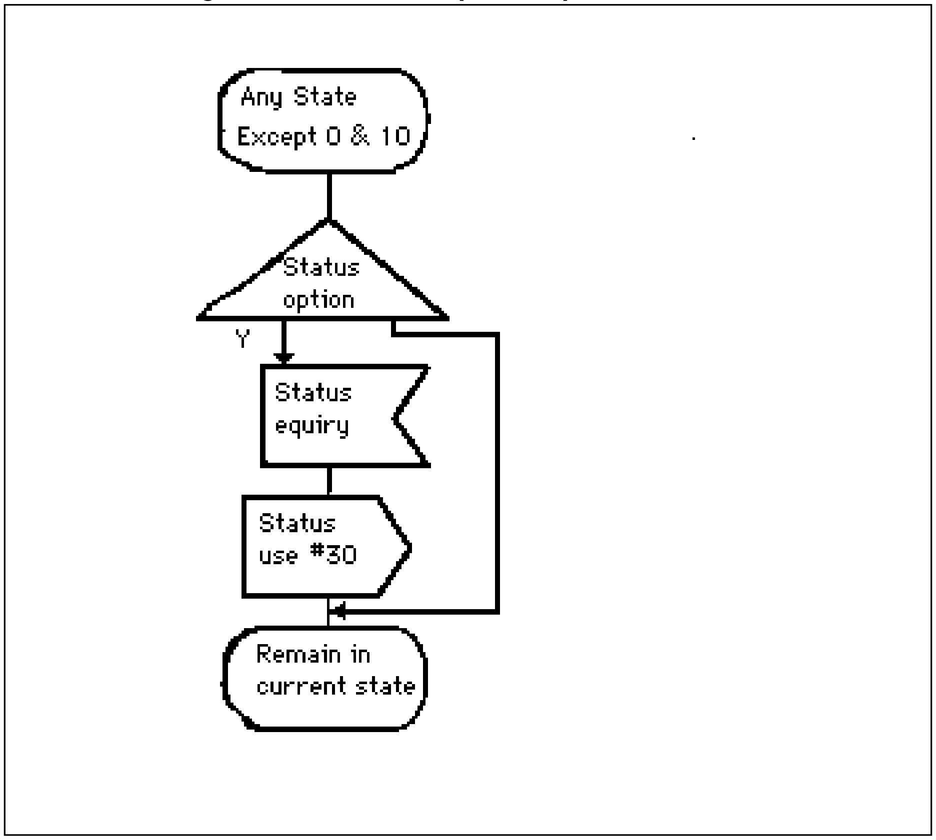


Figure 249 Call Control Diagrams - NETWORK SIDE (1 of 19)

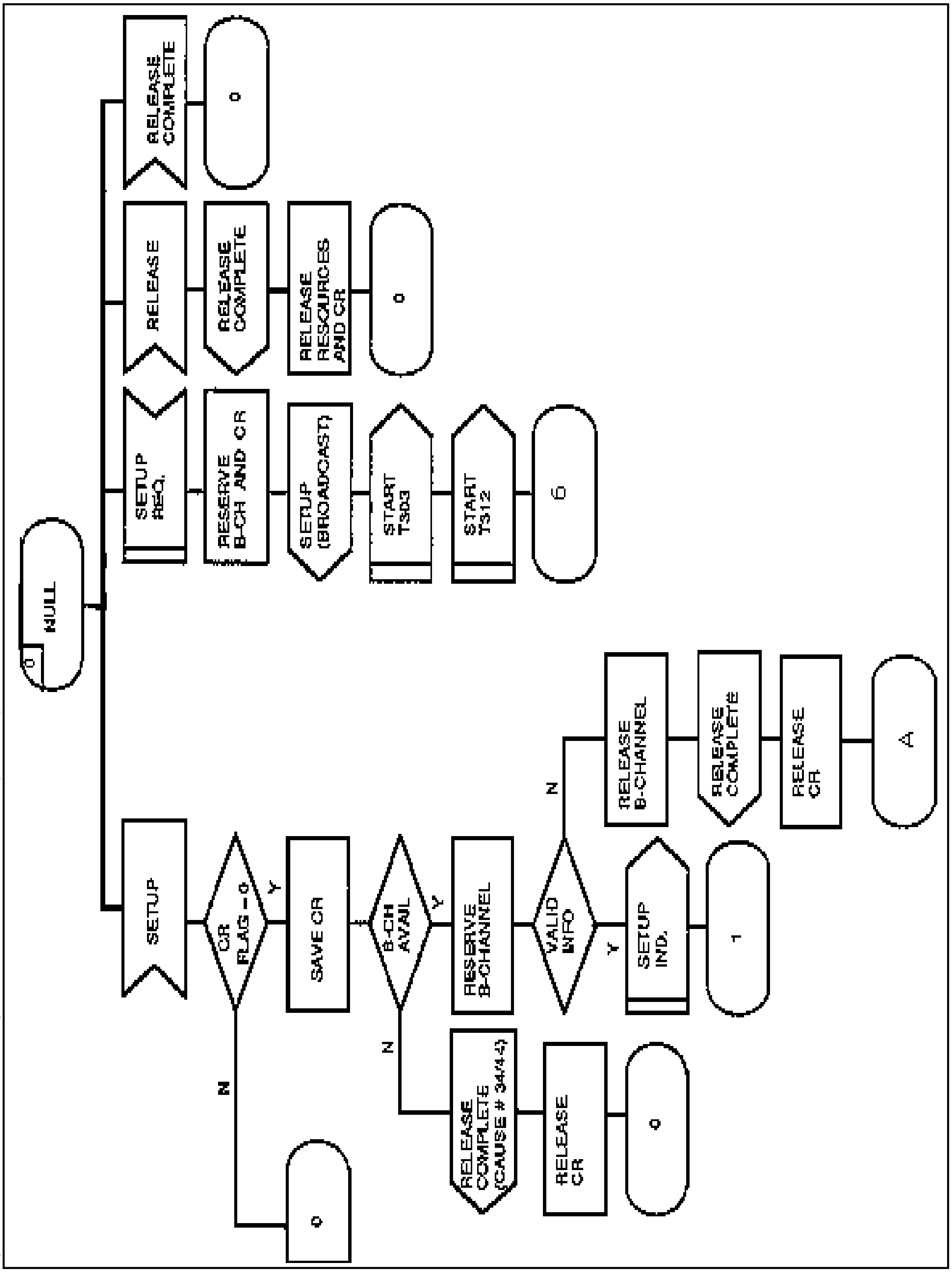


Figure 250 Call Control Diagrams - NETWORK SIDE (2 of 19)

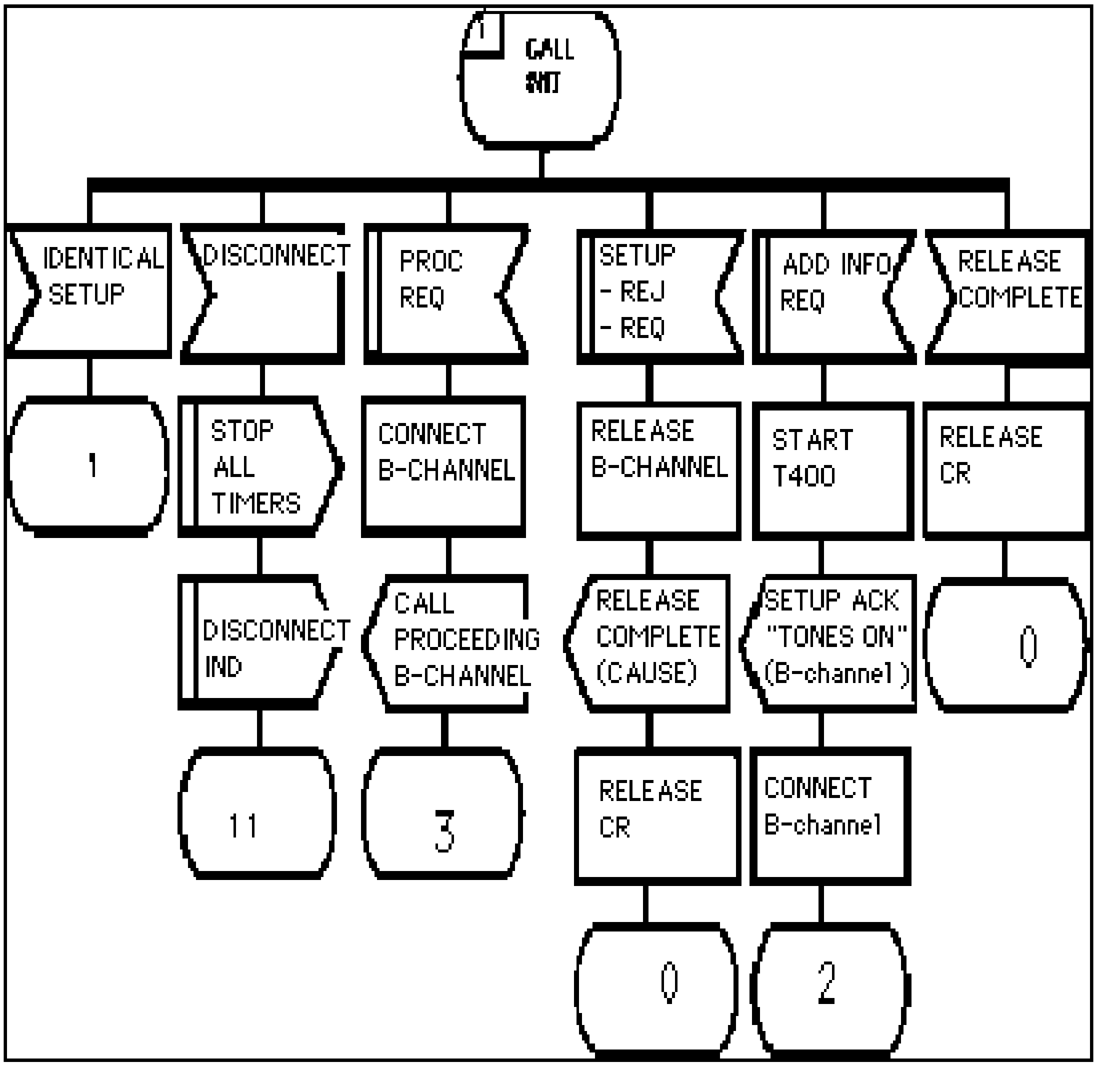
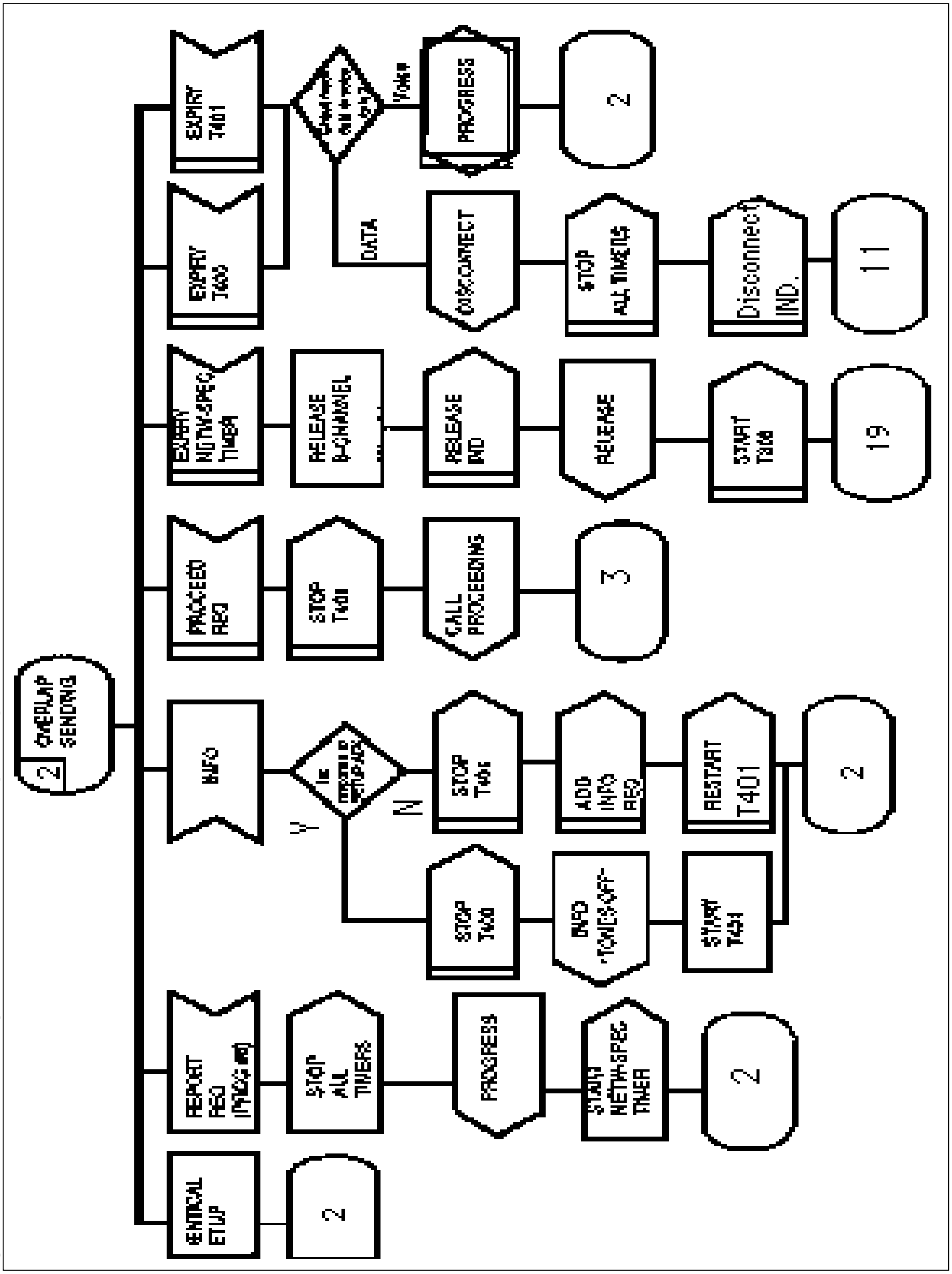


Figure 251 Call Control Diagrams - NETWORK SIDE (3 of 19)



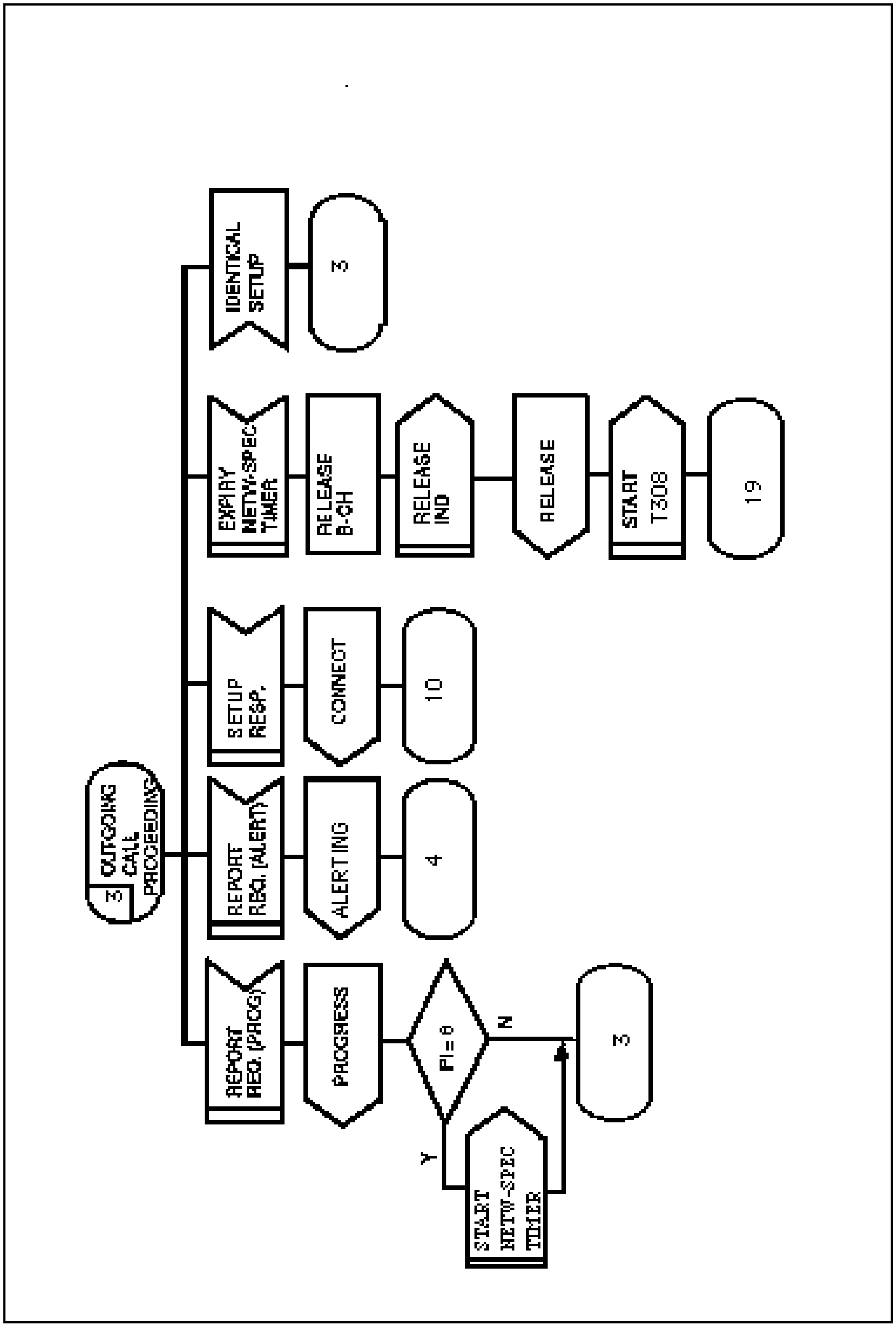


Figure 252 Call Control Diagrams - NETWORK SIDE (4 of 19)

Figure 253 Call Control Diagrams - NETWORK SIDE (5 of 19)

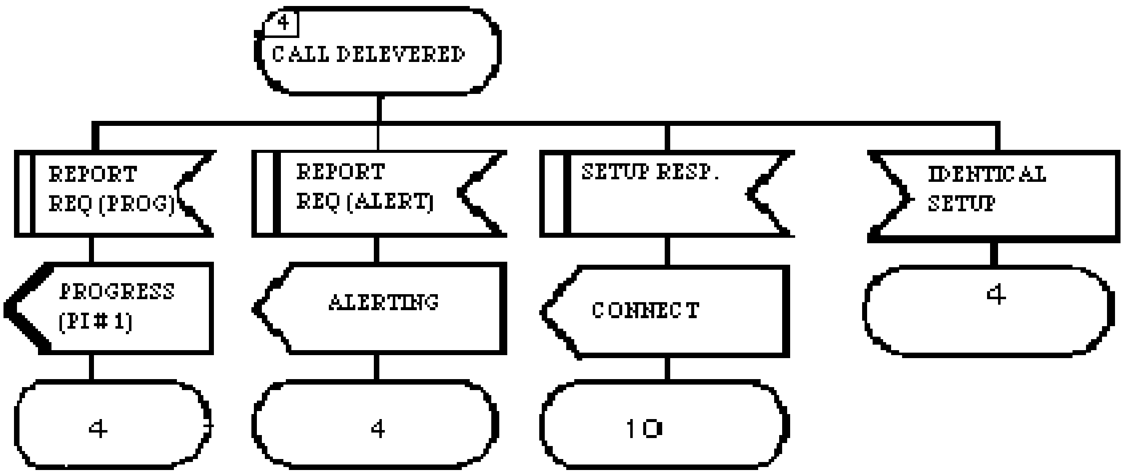


Figure 254 Call Control Diagrams - NETWORK SIDE (6 of 19)

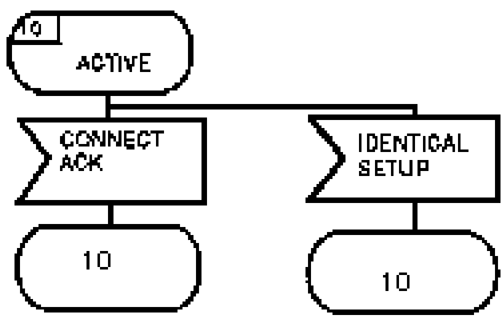
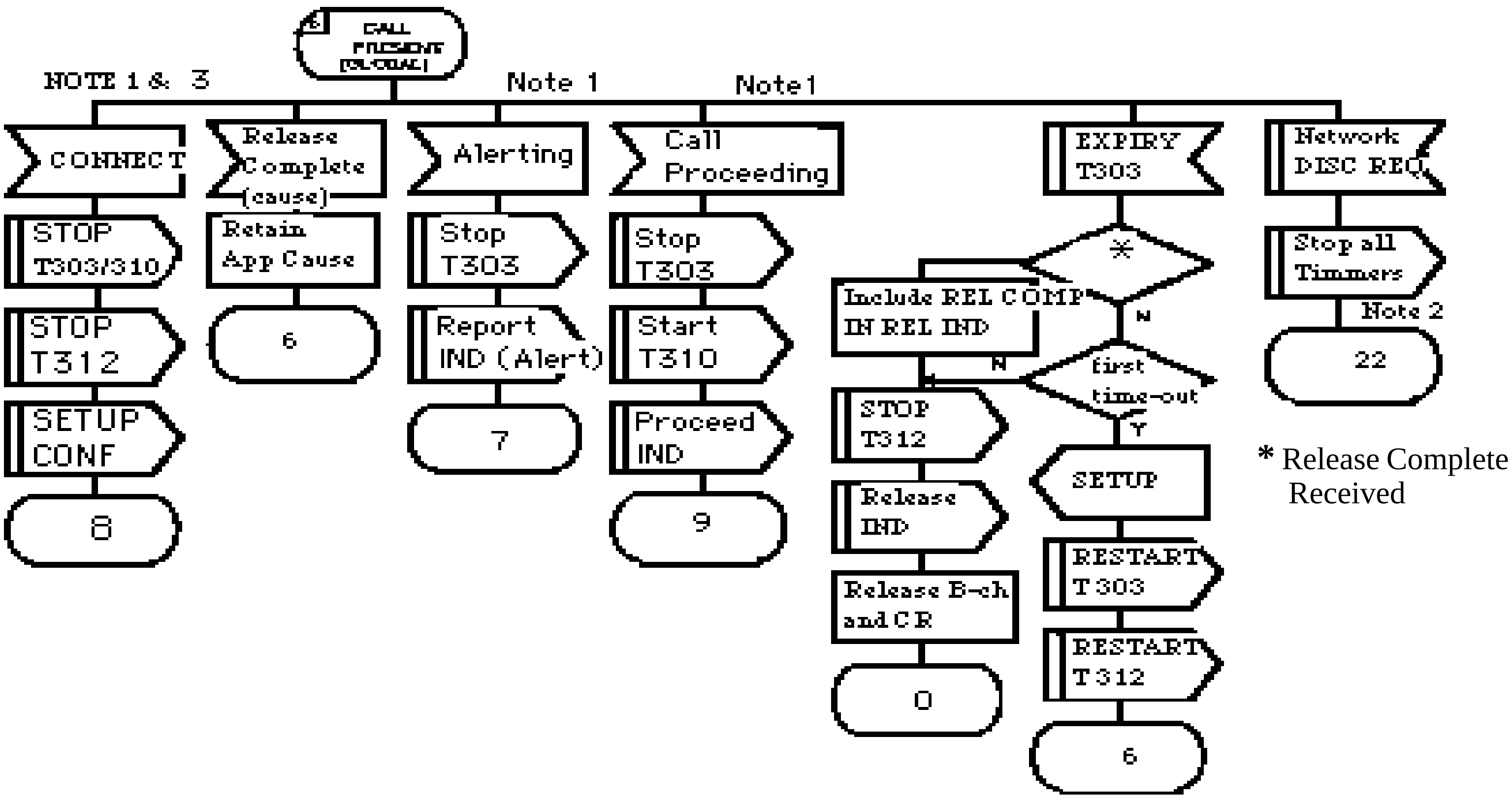


Figure 255 Call Control Diagrams - NETWORK SIDE (7 of 19)

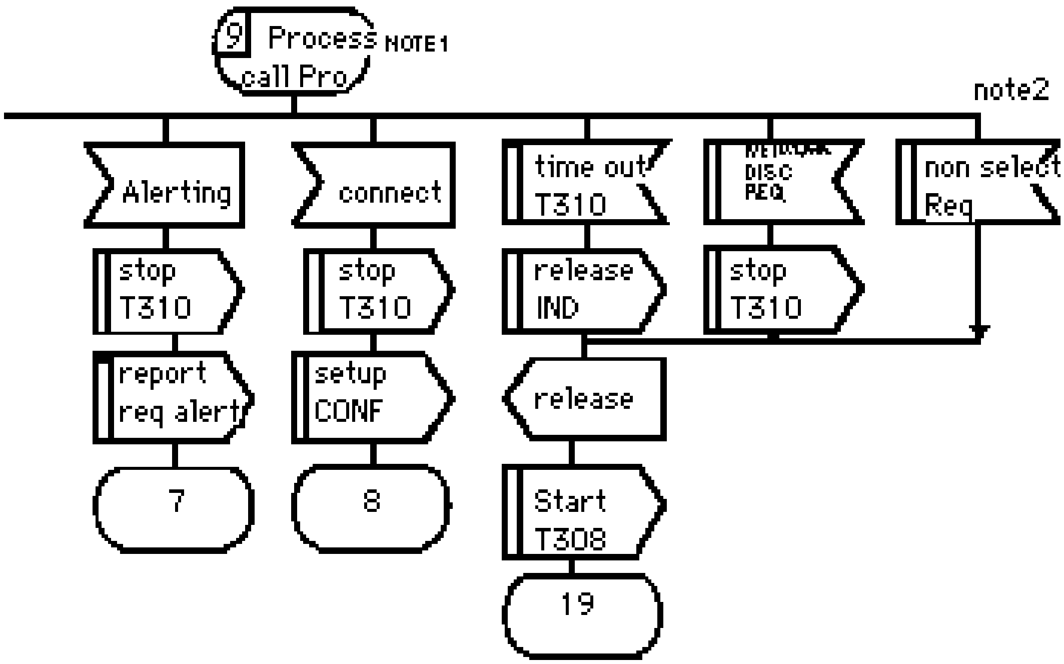


NOTE:1 CALL PROC, ALERT and CONNECT are received on a specific Datalink A new state machine for the indicated terminal has to be set up.

2 Call Clearing shall be indiatied for each terminal which has responded by sending a network DISConnect Request.

3 When the first connect message is received the network should initiate non-selected user clearing for other users which have responded by sending a non-select request.

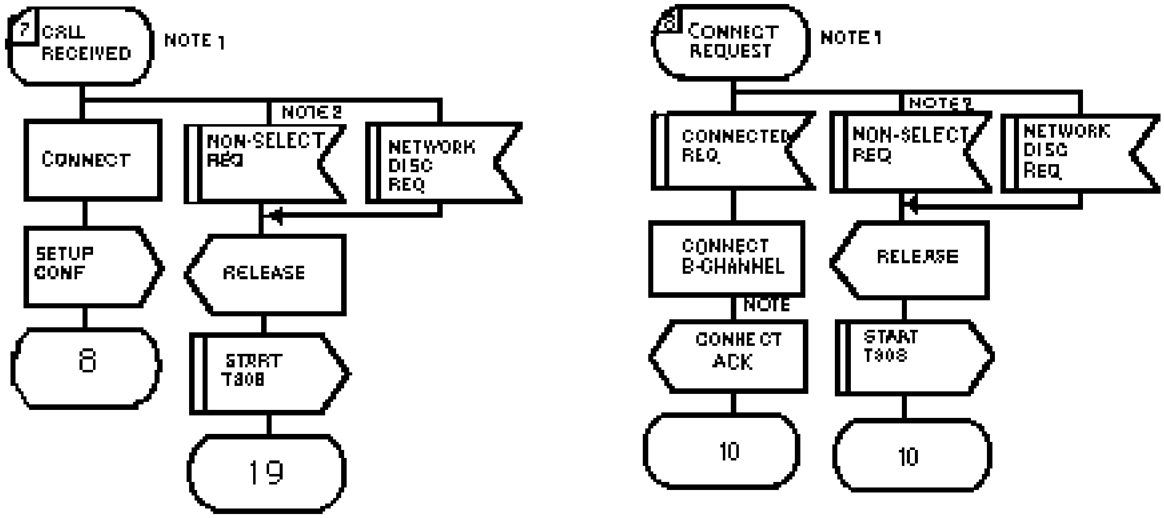
Figure 256 Call Control Diagrams - NETWORK SIDE (8 of 19)



Note: 1 A separate state machine exists for each user which has responded to the incoming setup with a call proc.

2. Network will initiate non-selected user clearing if another user has responded with the first connect message.

Figure 257 Call Control Diagrams - NETWORK SIDE (9 of 19)



Notes: 1 A separate State Machine exists for each user on a PT-to multipoint interface
2. Network will intiate non-selected user clearing if another user has sent a first connect message to the network

Figure 258 Call Control Diagrams - NETWORK SIDE (10 of 19)

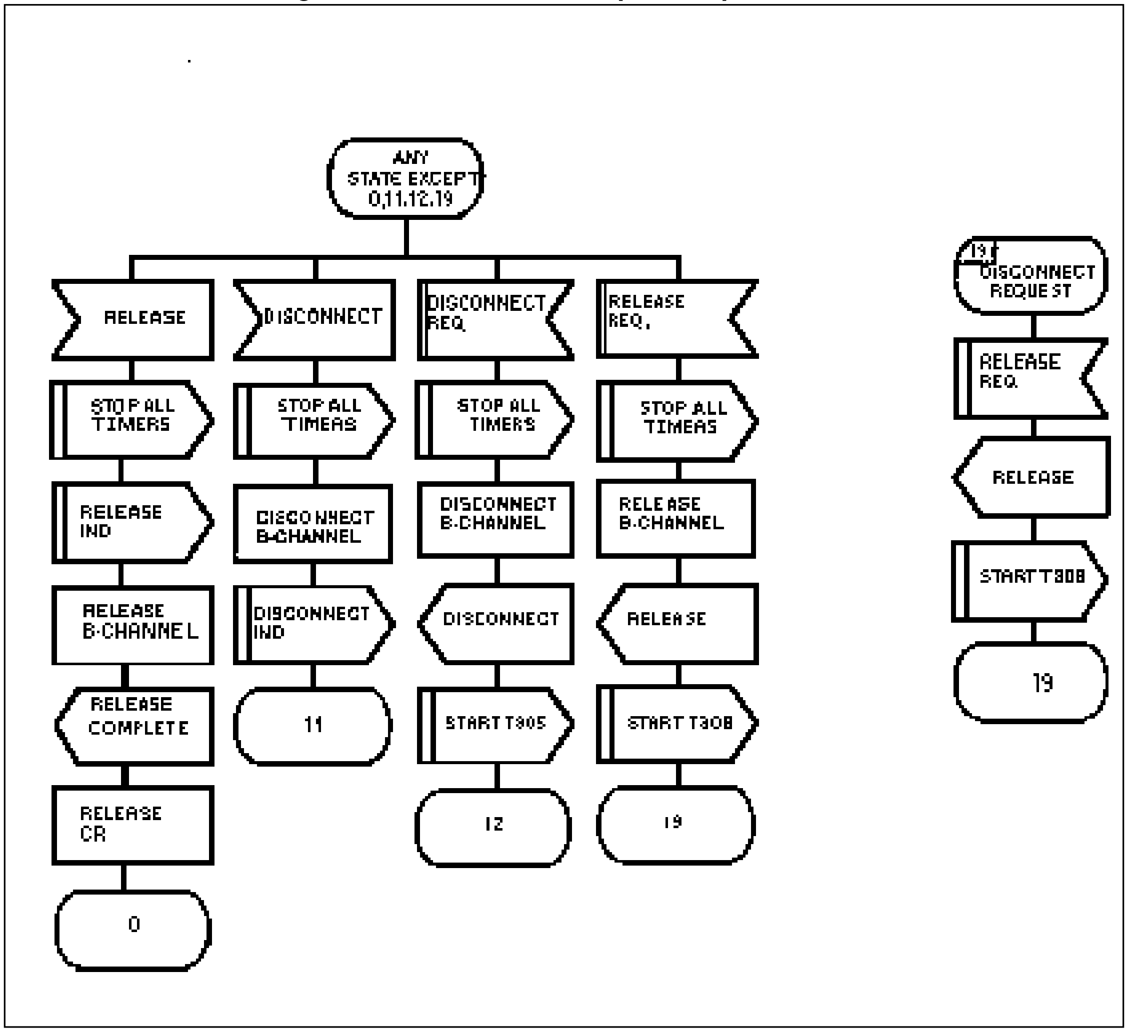


Figure 259 Call Control Diagrams - NETWORK SIDE (11 of 19)

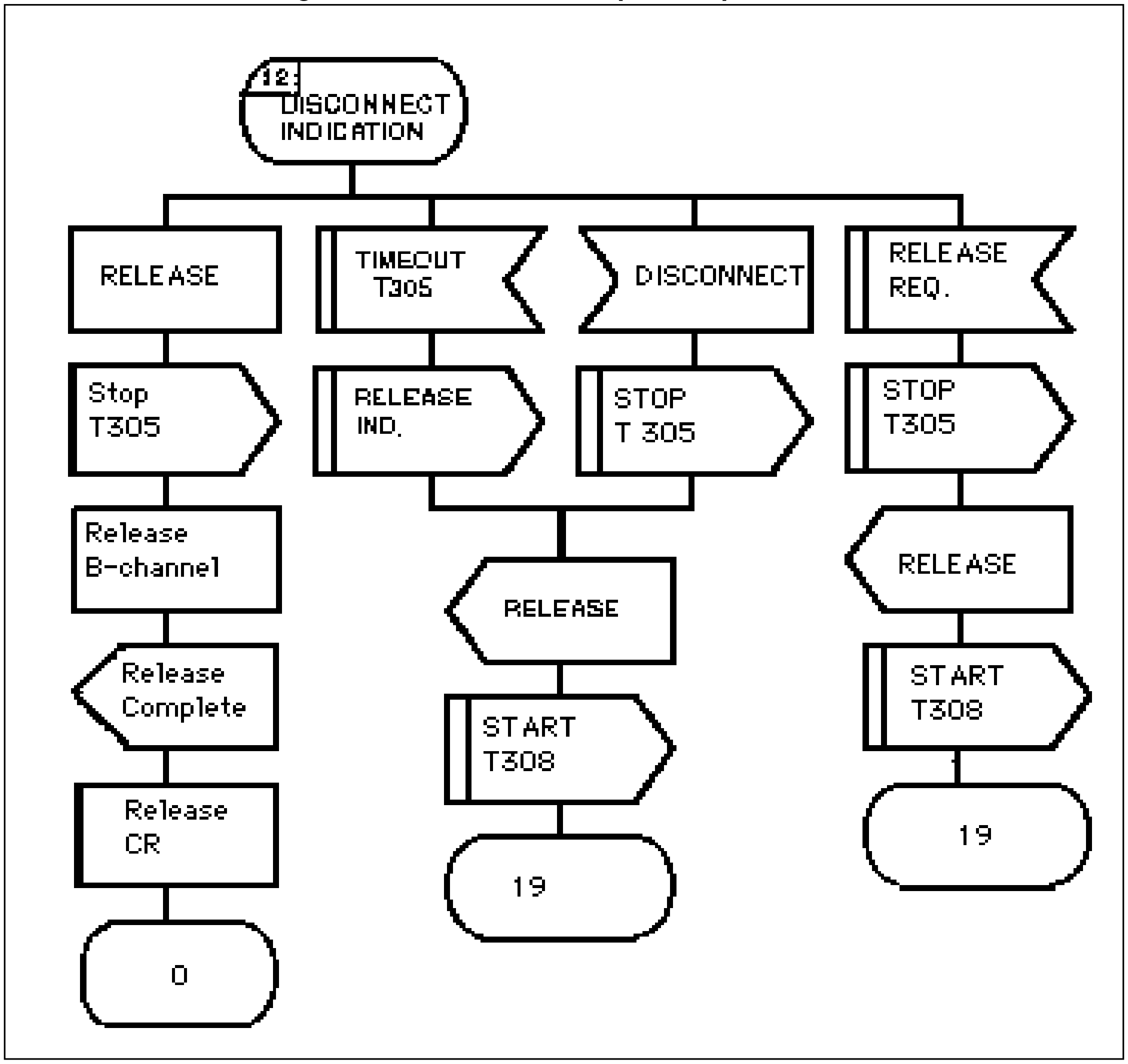


Figure 260 Call Control Diagrams - NETWORK SIDE (12 of 19)

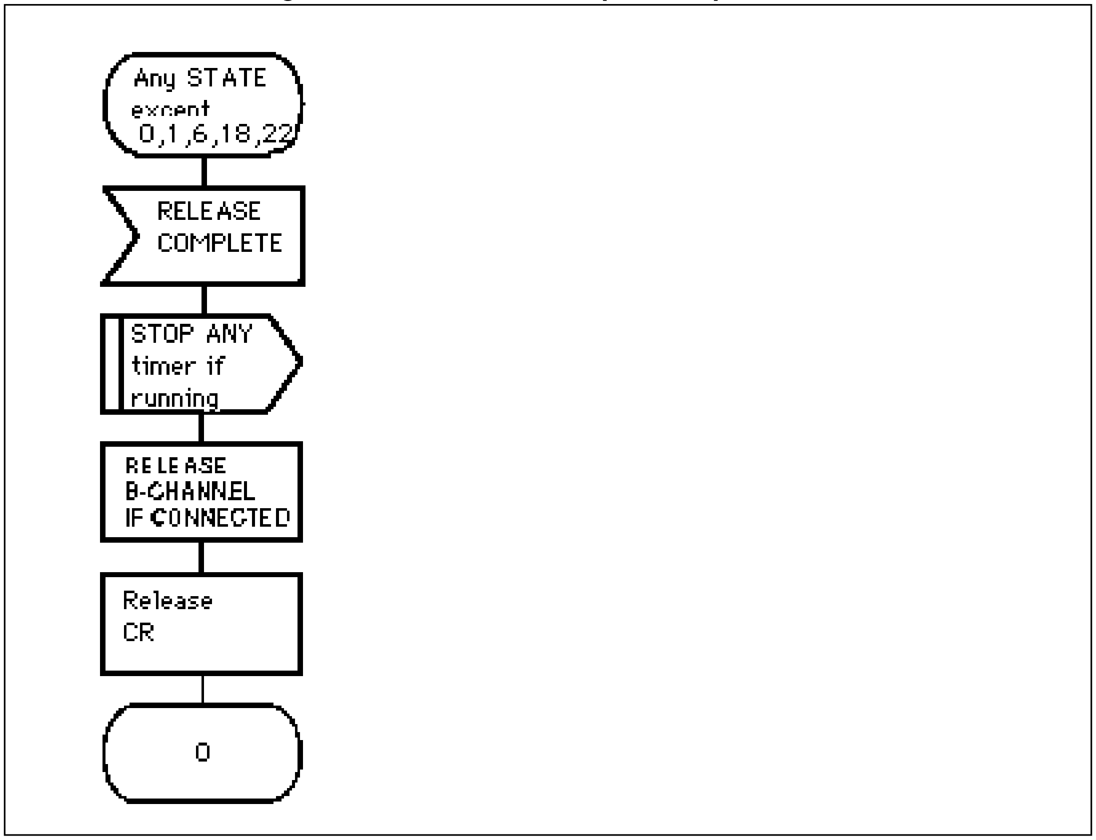
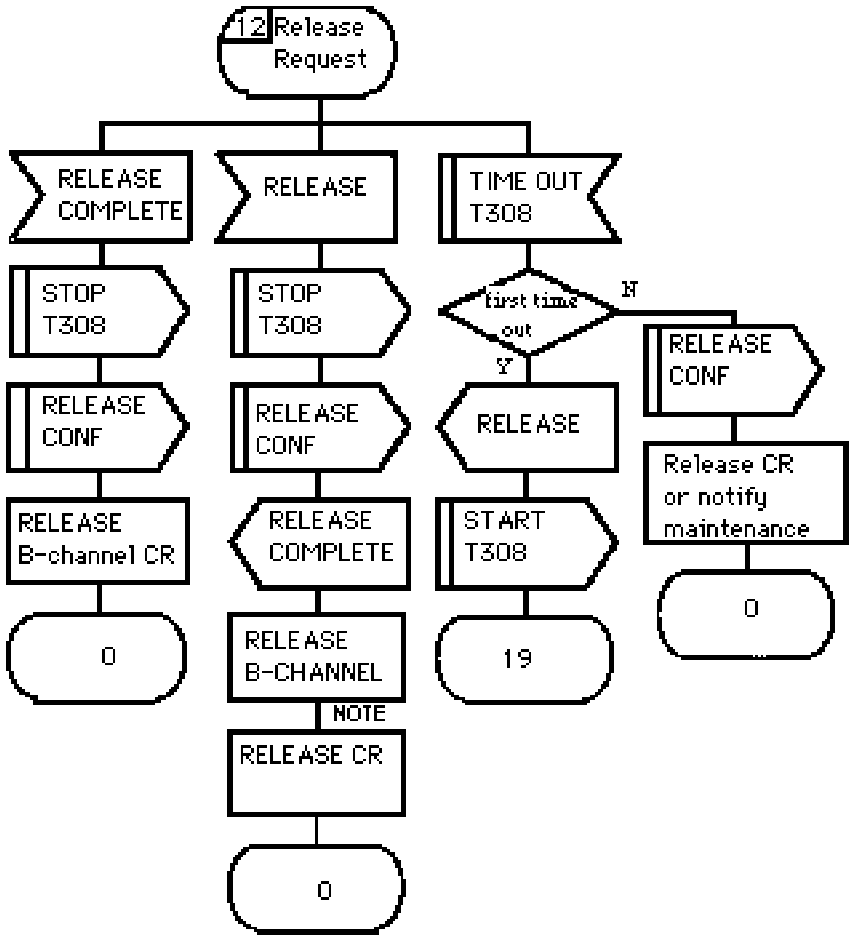
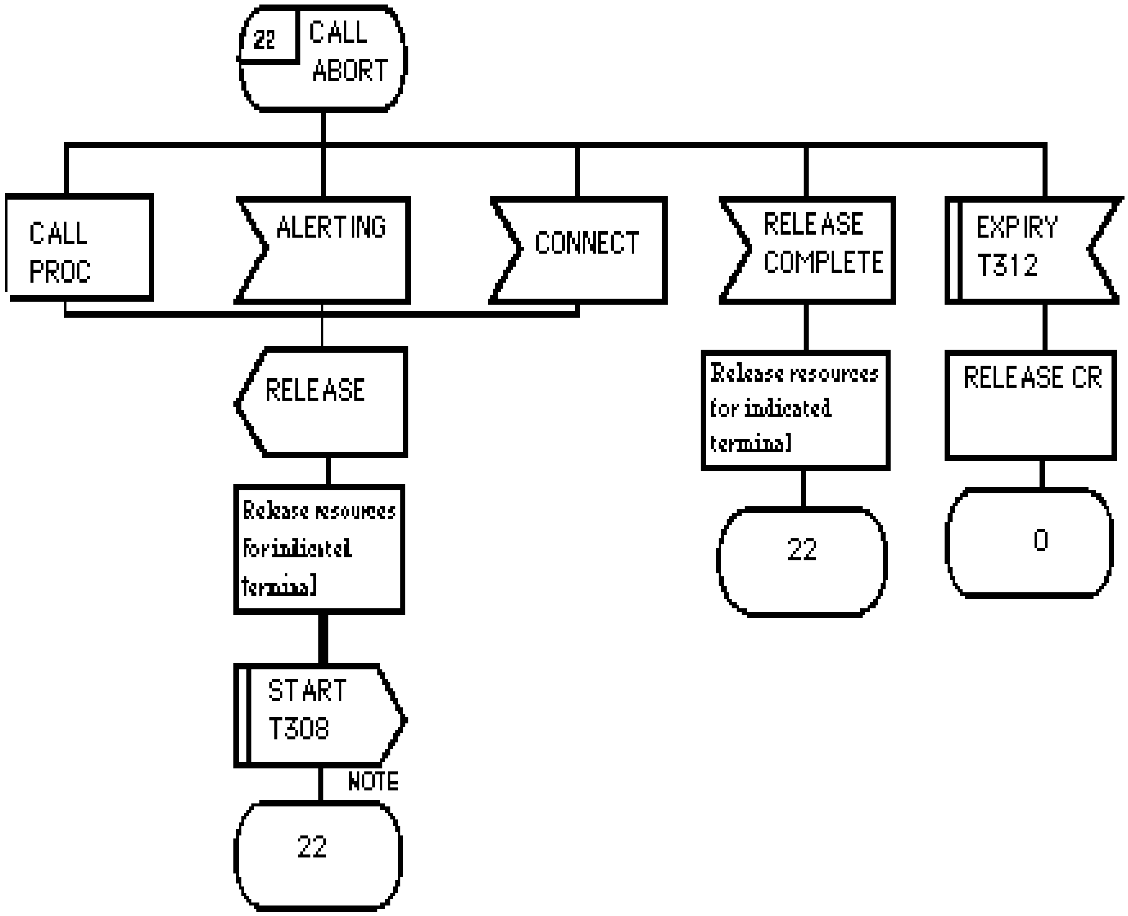


Figure 261 Call Control Diagrams - NETWORK SIDE (13 of 19)



NOTE: The CR shoud not be reused right away for a new call otherwise, the release complete from the network will be mistaken as a reject to the new call.

Figure 262 Call Control Diagrams - NETWORK SIDE (14 of 19)



NOTE: A separate state machine (i.e. STATE = N19) and t308 is kept for each terminal which has responded.

Figure 263 Call Control Diagrams - NETWORK SIDE (15 of 19)

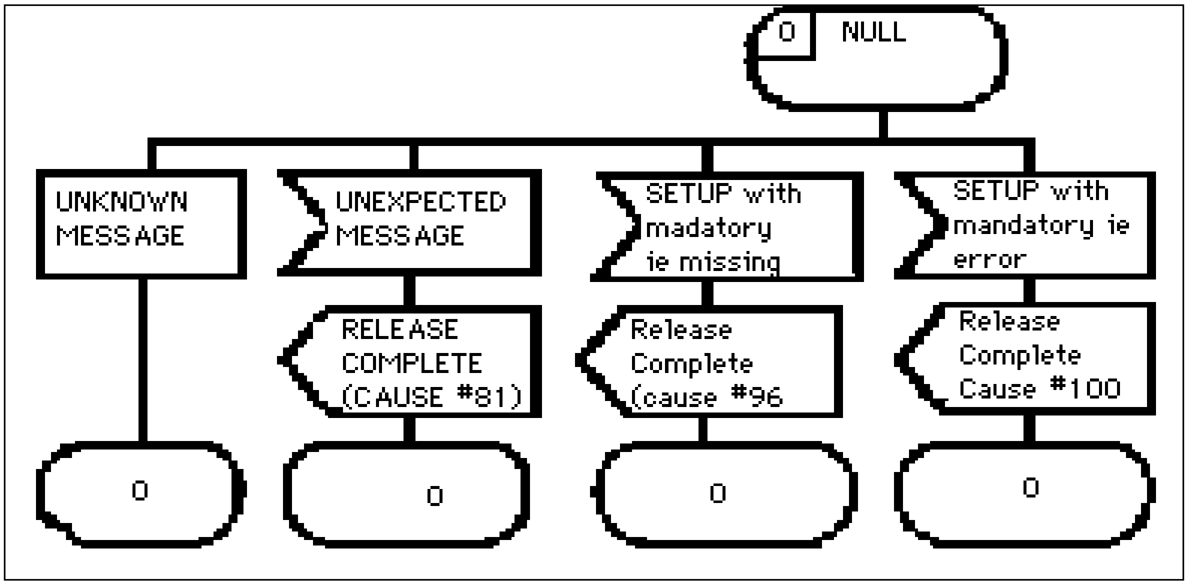


Figure 264 Call Control Diagrams - NETWORK SIDE (16 of 19)

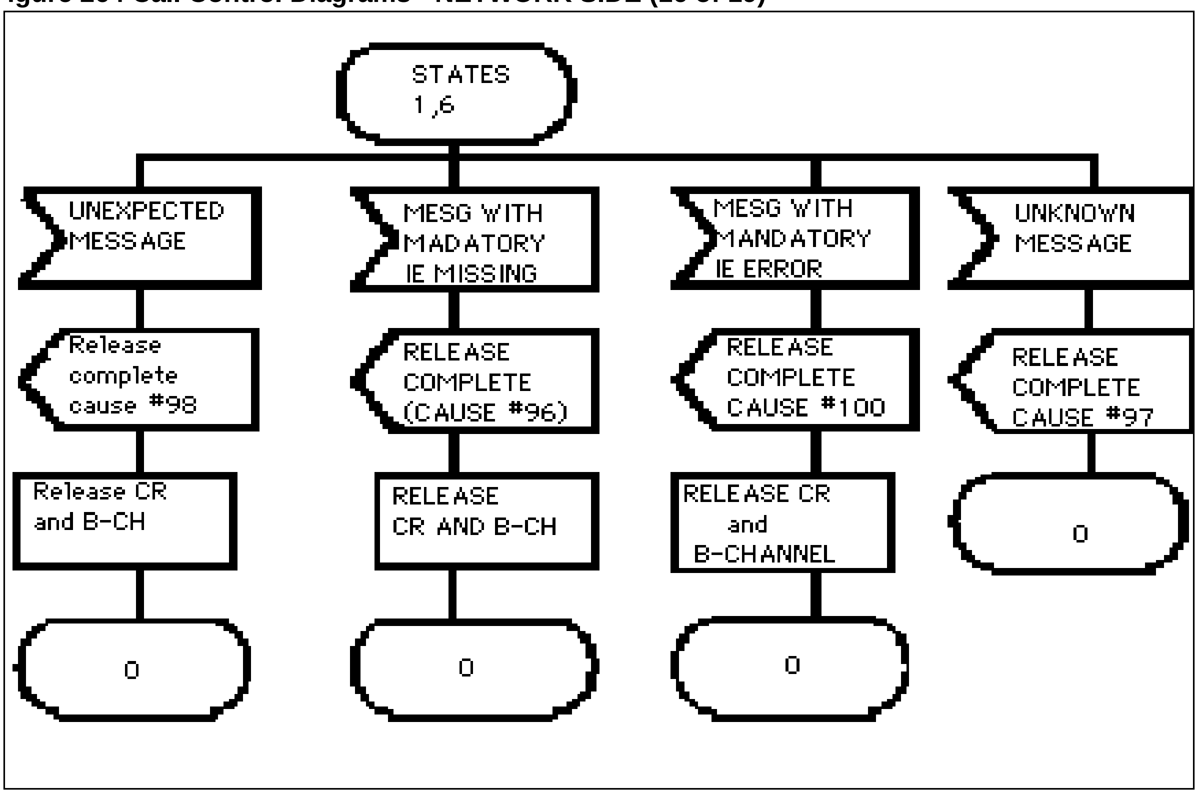
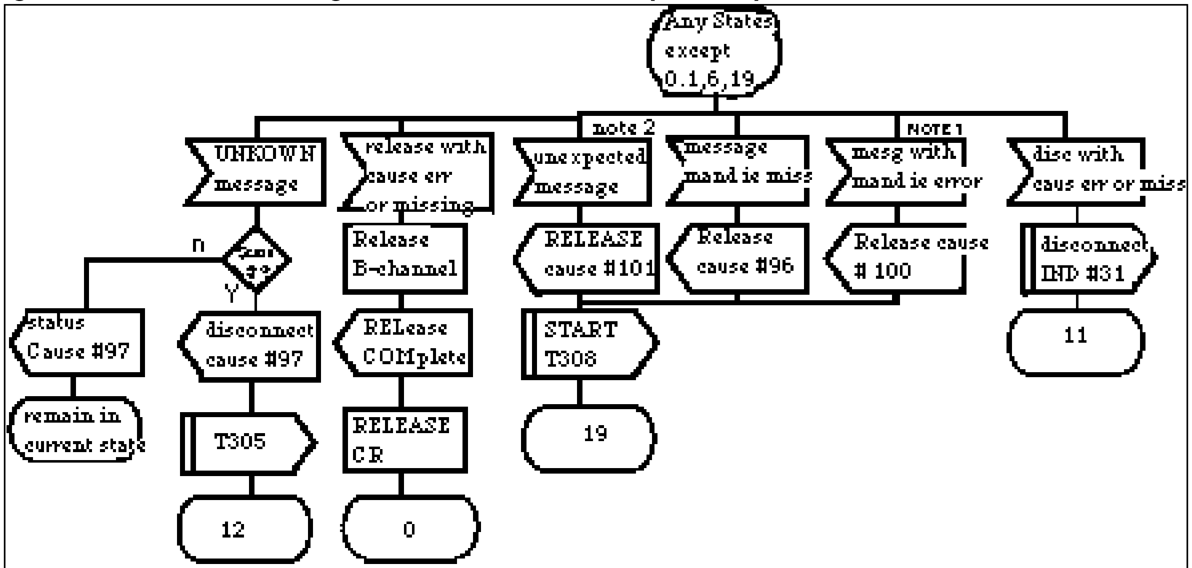


Figure 265 Call Control Diagrams - NETWORK SIDE (17 of 19)



Notes :1. EXCEPT DISCONNECT AND RELEASE

2. EXCEPT RELEASE COMPLETE

Figure 266 Call Control Diagrams - NETWORK SIDE (18 of 19)

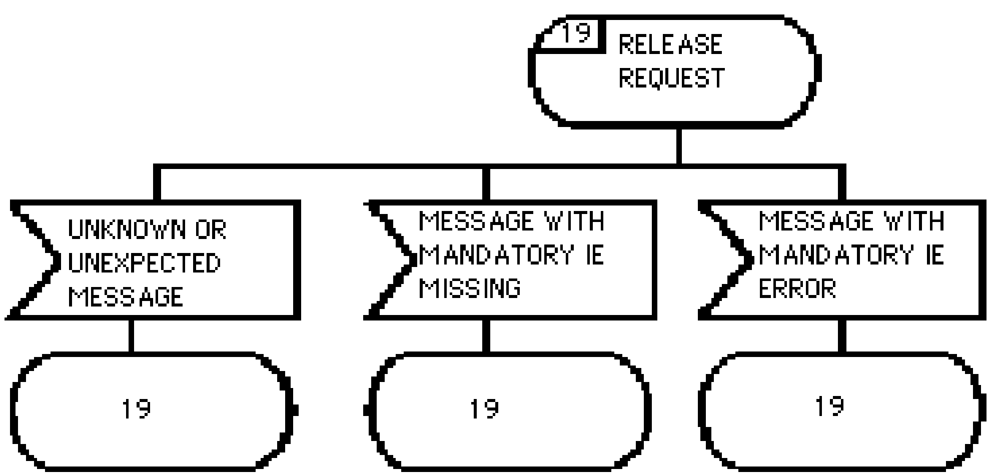


Figure 267 Call Control Diagrams - NETWORK SIDE (19 of 19)

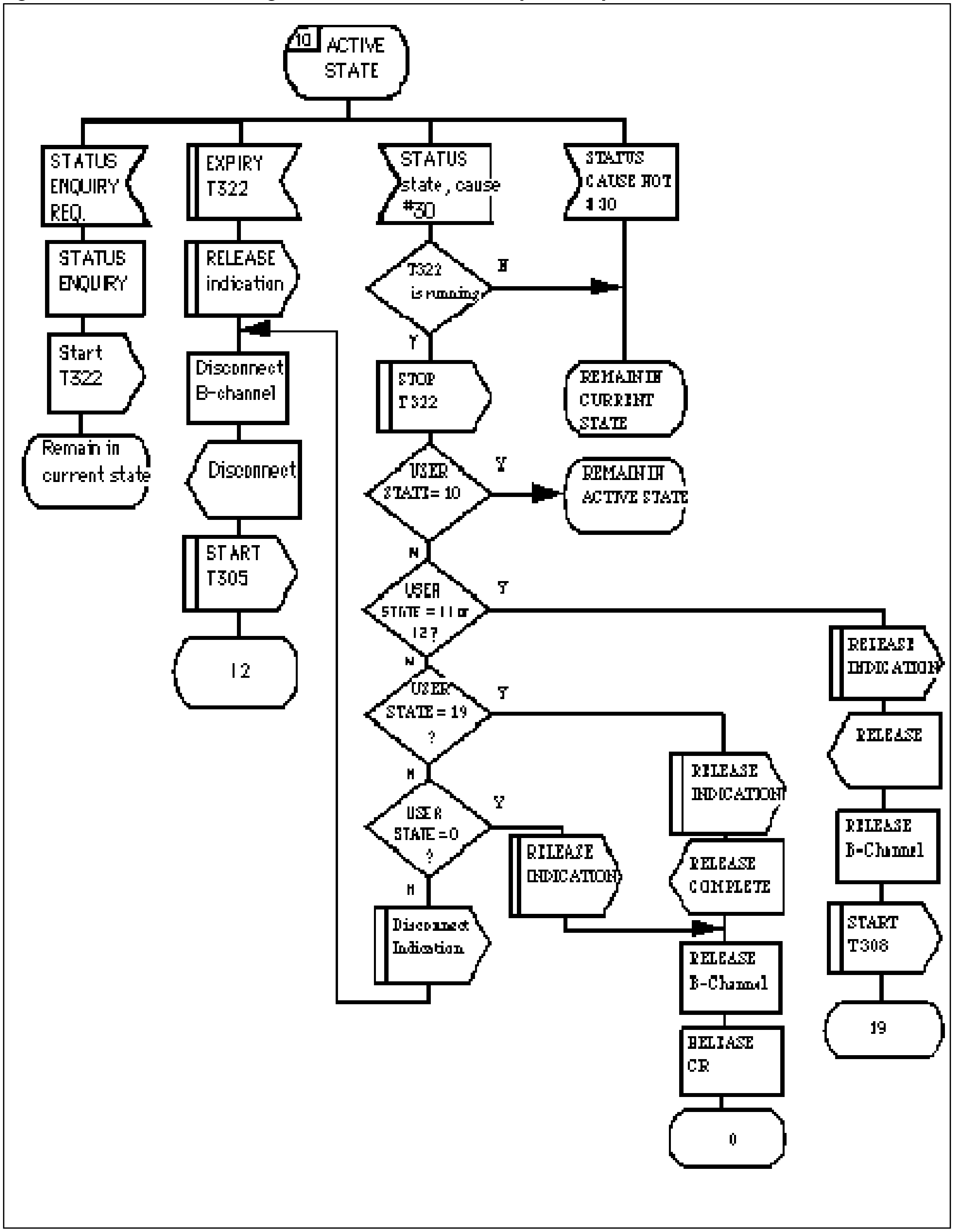


Figure 268 Call Independent Connection Diagrams Network Side (1 of 2)

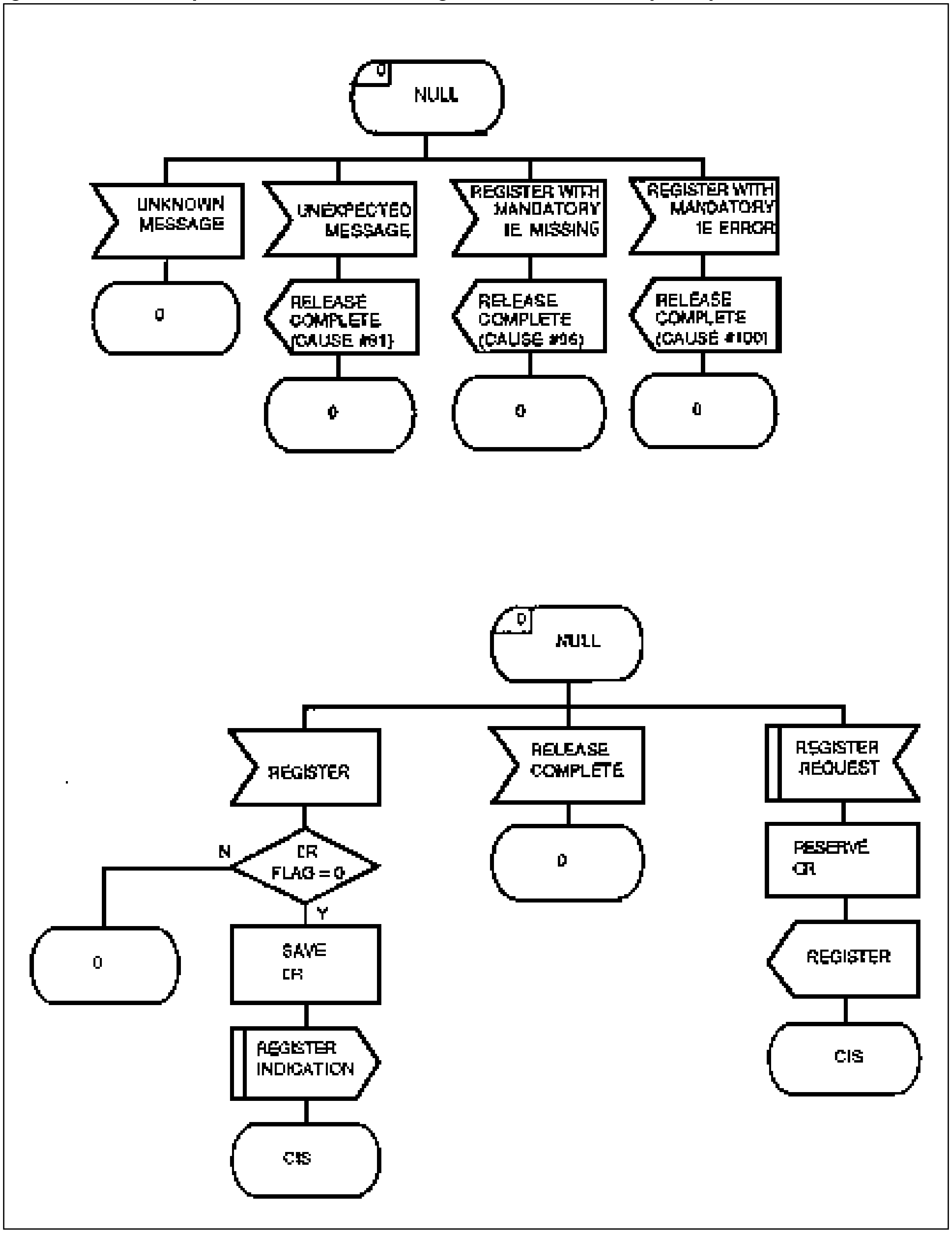


Figure 269 Call Independent Connection Diagrams Network Side (2 of 2)

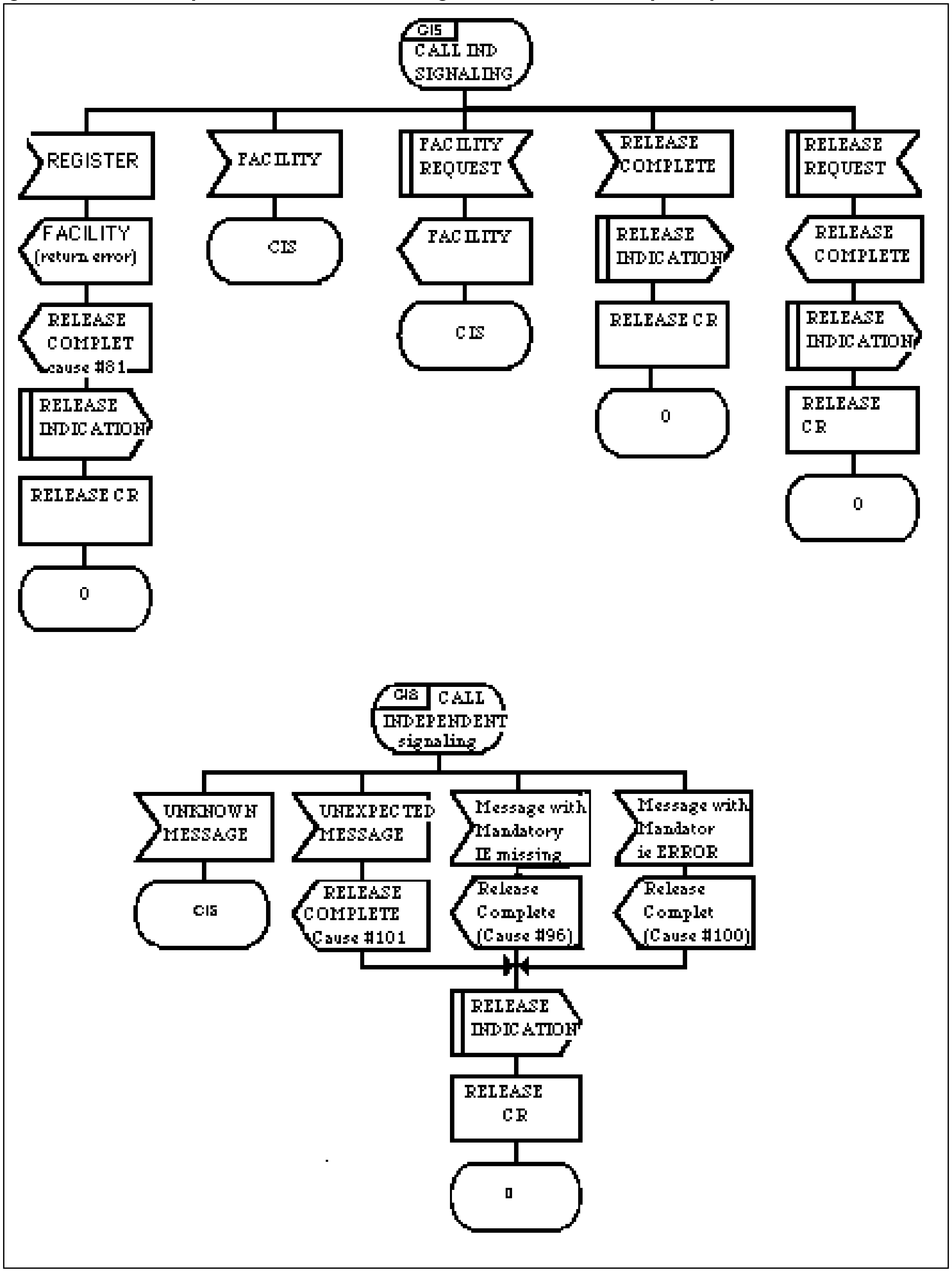


Figure 270 CALL-Independent Connection SDL Diagrams- USER SIDE(1 of 3)

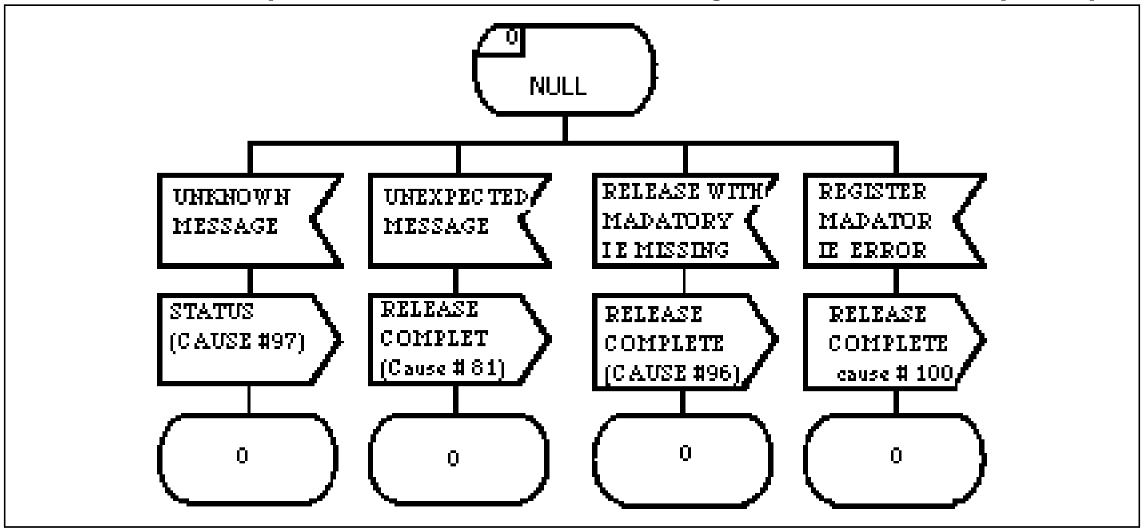


Figure 271 Call Independent Connection Diagrams USER Side (2 of 3)

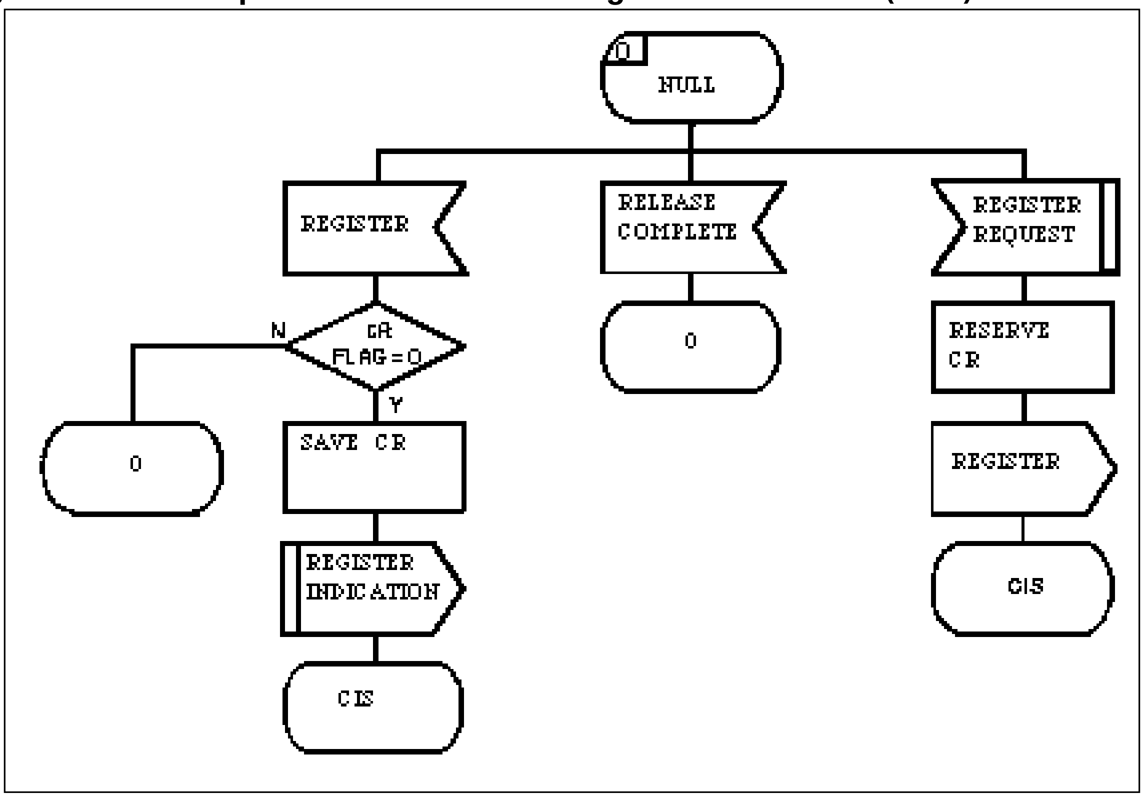
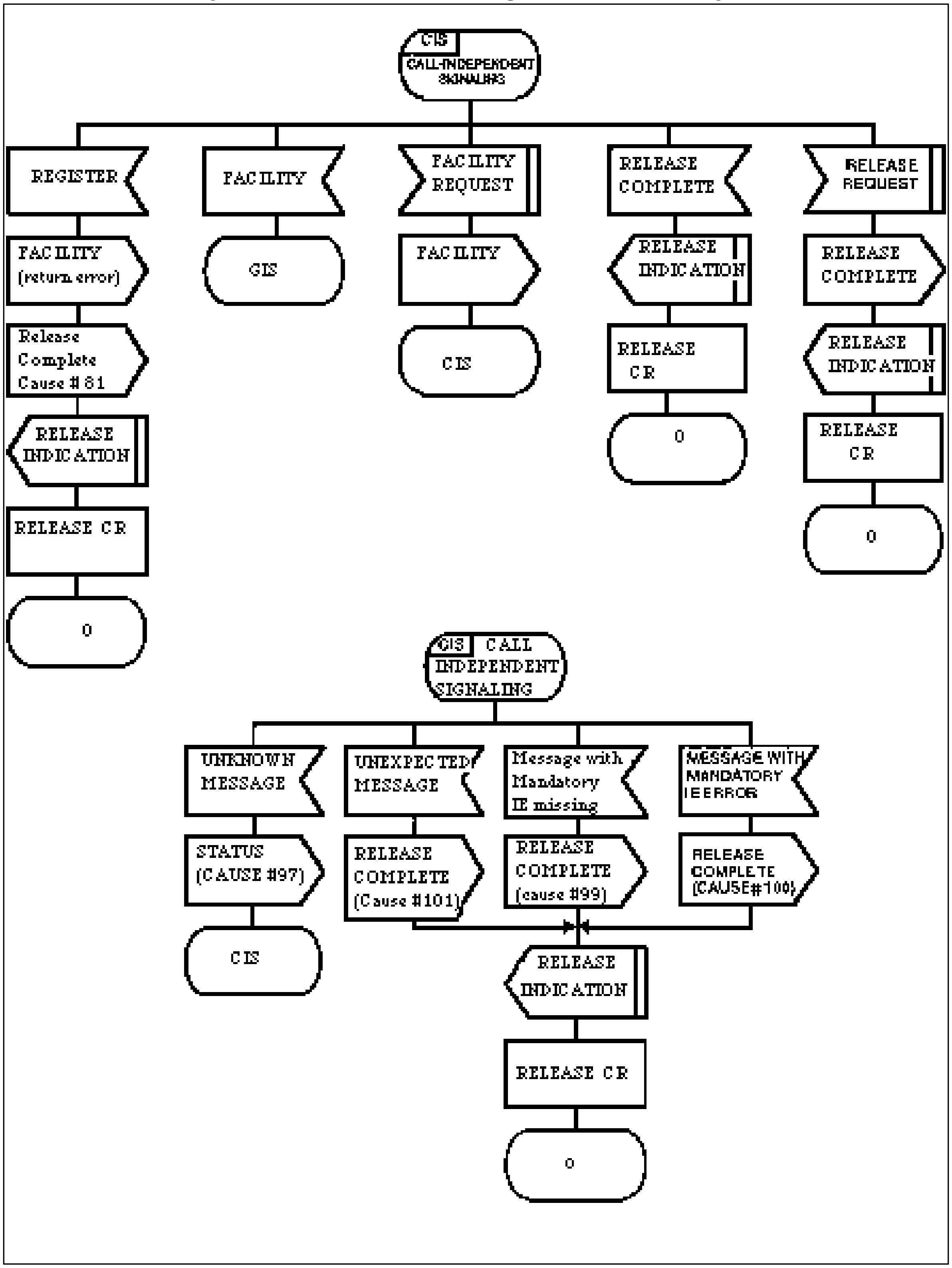


Figure 272 Call Independent Connection Diagrams User Side (3 of 3)



D.1 User Side Call States

The following states are specified in CCITT Q.931 for the user side of the user-network interface. This may serve as a guideline for terminal vendors when doing their implementation.

The following states are specified for the user side of the user-network interface. This may serve as a guideline for terminal vendors when doing their implementation.

- Null (State U0)

  No call exists.

- Call Init (U1)

  This call state exists for an outgoing (from the user) call, when the user requests call establishment from the network.

- Overlap Sending (U2)

  This state exists for an outgoing call when the user has received acknowledgement of the call establishment request which permits the user to send additional information in the overlap mode.

- Outgoing Call Proceeding (U3)

  This state exists for an outgoing call when the user has received acknowledgement that the network has received all call information necessary to effect call establishment.

- Call Delivered (U4)

  This state exists for an outgoing call, when the calling user has received indication that remote user alerting has been initiated.

- Call Present (U6)

  This state exists for an incoming (to the user) call when the user has received a call establishment request but has not (yet) responded.

- Call Received (U7)

  This state exists for an incoming call when the user has indicated alerting but has not (yet) answered.

- Connect Request (U8)

  This state exists for an incoming call when the user has answered the call and is waiting to be awarded the call.

- Incoming Call Proceeding (U9)

  This state exists for an incoming call when the user has sent acknowledgement that the user has received all call information necessary to effect call establishment.

- Active (U10)

  This state exists for an incoming call when the user has received an acknowledgement from the network that the user has been awarded the call. This state exists, for an outgoing call when the user has received an indication that a remote user has answered the call.

- Disconnect Request (U11)

  This state exists when the user has requested the network to clear the end-to-end connection (if any) and is waiting for a response.

- Disconnect Indication (U12)

  This state exists when the user has received an invitation to disconnect because the network has disconnected the end-to-end connection (if any) within the network.

- Release Request (U19)

  This state exists when the user has requested the network to release and is waiting for a response.

The following user state is associated with the global call reference.

- Restart (Rest 2)

  This state exists when a request for restart has been received from the network and responses have not been yet been received from all locally active call references.

The following user states are associated with a call-independent connection.

- Null (State U0)

  No connection exists.

- Call Independent Service (State U31)

  This state exists for a call-independent connection after the user accepts a network-initiated connection requested or after the user reserves a call reference for a user-initiated connection request.

Appendix E: Management Services

The feature Service Profile Management is proprietary and only applicable to NI-1 or earlier terminals.

E.1 Introduction

1 This section describes services provided over the Basic Rate Interfaces for the purposes of management. Management Services are any services offered to a user on the Basic Rate (BRI) Interface which aid in the management of either the user's hardware, software, services, or accesses.

2 These services are offered to ISDN CPE to aid in the Operations, Administration and Maintenance (OA&M) of ISDN CPE. All of these services are optional, and are only used by CPE who wish to take advantage of these services.

3 This first issue of this section covers only one service called_ Service Profile Management (SPM). This service provides the user's terminal with the service parameters contained in its network profile.

4 Other management services will be added in future releases of this document, as they become available.

E.1.1 Remote Operations

The protocol for the management services is carried in the Facility information element of messages used in a call independent signaling connection. Call independent signaling procedures are described in Chapter 5: "Functional Call Control Signaling" of this specification. In OSI terms, the management services procedures in this section are at layer 7 (application layer) of the OSI reference model.

The ISDN management services make use of the Remote Operations (RO) protocol and X.209 (ASN.1) encoding of that protocol. Background information may be found in Section 5.12, “Remote Operations Service Element (ROSE)”, and in the following CCITT recommendations.

- X.208 - Abstract Syntax Notation 1 (ASN.1) Notation
- X.209 - Encoding rules for ASN.1
- X.219 - RO Model, Notation and Service Definition
- X.229 - RO : Protocol Specification

E.1.2 Protocol Components

The SPM service uses the Remote Operations (RO) protocol. The RO protocol has the following four basic components:

- Invoke - Used by an object to invoke a remote operation on another object.
- Return result - Used by an object to return information as a result of an Invoke or to confirm an Invoke.
- Reject - Used to inform an object that the previous component sent was incorrect (syntactic problem)

- Return error - Used to inform an object that there is an application error.

Every Invoke component must contain an invoke identifier, and every component sent in return to that Invoke must contain the same invoke identifier.

For some operations, an object may wish to invoke an operation in response to an Invoke. In these cases the second Invoke is linked to the first Invoke and is called a linked Invoke. The linked Invoke is assigned a unique invoke identifier, and a linked identifier which is the invoke identifier of the Invoke component it is linked to.

Details of the message structure may be found in Chapter 5: "Functional Call Control Signaling".

E.1.3 Component Encoding

The following is the encoding for the component fields used in the services in this section. All of the services in this section will have the service discriminator in the Facility information element coded as “Management Services”.

E.1.4 Tags and Values

The operation value specifies the operation which will be performed, and is contained within the Invoke component. All values are encoded as integers.

Figure 273 Operation values

OPERATION VALUES

BITS 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 1	SPM Begin
0 0 0 0 0 0 1 0	SPM Info

An error value is used to report an application error associated with an operation, and is contained within the Return error component. The error values are operation specific.

Figure 274 Error Values

25i

ERROR VALUES

BITS 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 1	Incompatible Parameters
0 0 0 0 0 0 1 0	Application Not Available

Only two error values are defined for the initial implementation. One informs the network that the information sent is incompatible with the terminal equipment, and the other informs the terminal equipment that the application is not available.

A problem is used to report a protocol error in a received component, and is contained in a Reject component. Problems are described in Section 5.5.5.13.1, “Component” of this specification.

The following are the encodings for the operation specific tags. The coding rules for these tags are as follows:

Figure 275 Operation specific tags.

BITS	8	7	6	5	4	3	2	1
	CLASS		P/C	NUMBER OF TAG				

CLASS 0 0 Universal
0 1 Application
1 0 Context specific
1 1 Private

P/C 0 Primitive construction (no dependent tags)
1 Constructor (dependant tags to follow)

With constructor tags, the length specified is the length for all of the data elements which the constructor contains.

The following are the encodings for all tags used by the applications described in this section. These tags are used in the parameter sequences described later in this section.

Figure 276 Encoding for Tags

TAGS

BITS 8 7 6 5 4 3 2 1	
1 0 0 0 0 0 1 0	DN Tag
1 0 1 0 0 0 1 1	BCinfo Sequence Tag
1 0 0 0 0 1 0 0	BC Tag
1 0 0 0 0 1 0 1	Number of Calls Tag
1 0 0 0 0 1 1 0	CAP Value Tag
1 0 1 0 0 1 1 1	Feature Sequence Tag
1 0 0 0 1 0 0 0	FA Value Tag
1 0 0 0 1 0 0 1	Service Id Tag
1 0 1 0 1 0 1 0	Cap Sequence Tag

Note 1: The contents of the DN Tag are coded using IA5 characters.

Note 2: The contents of the Number of Calls tag are coded as an unsigned binary integer.

Note 3: The contents of the BC Tag are coded as per the contents of the Bearer capability information element (starting with octet 3), which can be found in Section 5.5.5.2, “Bearer Capability information element”, of this specification.

Note 4: The contents of the FA Value and CAP Value are coded as unsigned binary integers.

Figure 277 Values associated with the Service Id.

SERVICE ID VALUES

BITS 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 1	Last Number Redial (LNR)
0 0 0 0 0 0 1 0	Loudspeaker Paging Access (LPA)
0 0 0 0 0 0 1 1	Make Set Busy (MSB)
0 0 0 0 0 1 0 0	Release (RLS)
0 0 0 0 0 1 0 1	Ring Again (RAG)
0 0 0 0 0 1 1 0	Call Forward (CFX)
0 0 0 0 0 1 1 1	Call Forward Validation (CFV)
0 0 0 0 1 0 0 0	Intercom (ICM)
0 0 0 0 1 0 0 1	Group Intercom (GIC)
0 0 0 0 1 0 1 0	Automatic Line (AUL)
0 0 0 0 1 0 1 1	Speed Call Short (SPS)
0 0 0 0 1 1 0 0	Speed Call Long (SPL)
0 0 0 0 1 1 0 1	Speed Call User (SPU)
0 0 0 0 1 1 1 0	Auto Dial (AUD)
0 0 0 0 1 1 1 1	Executive Busy Override (EBO)
0 0 0 1 0 0 0 0	Call Pick Up (CPU)
0 0 0 1 0 0 0 1	Call Park (CPK)
0 0 0 1 0 0 1 0	Additional Functional Call (AFC)
0 0 0 1 0 0 1 1	Flexible Call Conference (FCC)
0 0 0 1 0 1 0 0	Flexible Call Transfer (FCT)
0 0 0 1 0 1 0 1	Flexible Call Drop (FCD)
0 0 0 1 0 1 1 0	Message Waiting (MWT)
0 0 0 1 0 1 1 1	Call Request (CAR) (Leave Message)
0 0 0 1 1 0 0 0	Privacy Release (PRL)
0 0 0 1 1 0 0 1	Privacy (PRV)

E.1.5 Service Profile Management(SPM) Procedures

E.1.5.1 Functional Description

Following are the procedures which both the terminal equipment (user) and network must support in order to provide the full functionality of SPM.

- The role of the user is:
  - — to invoke SPM and receive the necessary initializations,
  - — to provide the end-user with a “step-through” of the profile independent of the network, and
  - — to initiate SPM using an appropriate user interface, since SPM is not initiated through call establishment.
- The role of the network is:

— to send assigned DN(s), BC(s), and FA(s) in response to the SPM invocation from the user.

The network will send the following information to the user:

1 DN

2 Bearer Capability (BC) - octets 3, 4, and 5 of the Bearer capability information element (see Section 5.5.5.2, “Bearer Capability information element”).

3 Number of calls per DN - for this DN/BC group pair.

4 Feature Activator (FA) values and features assigned to the profile. The feature names will be encoded into values for transmission.

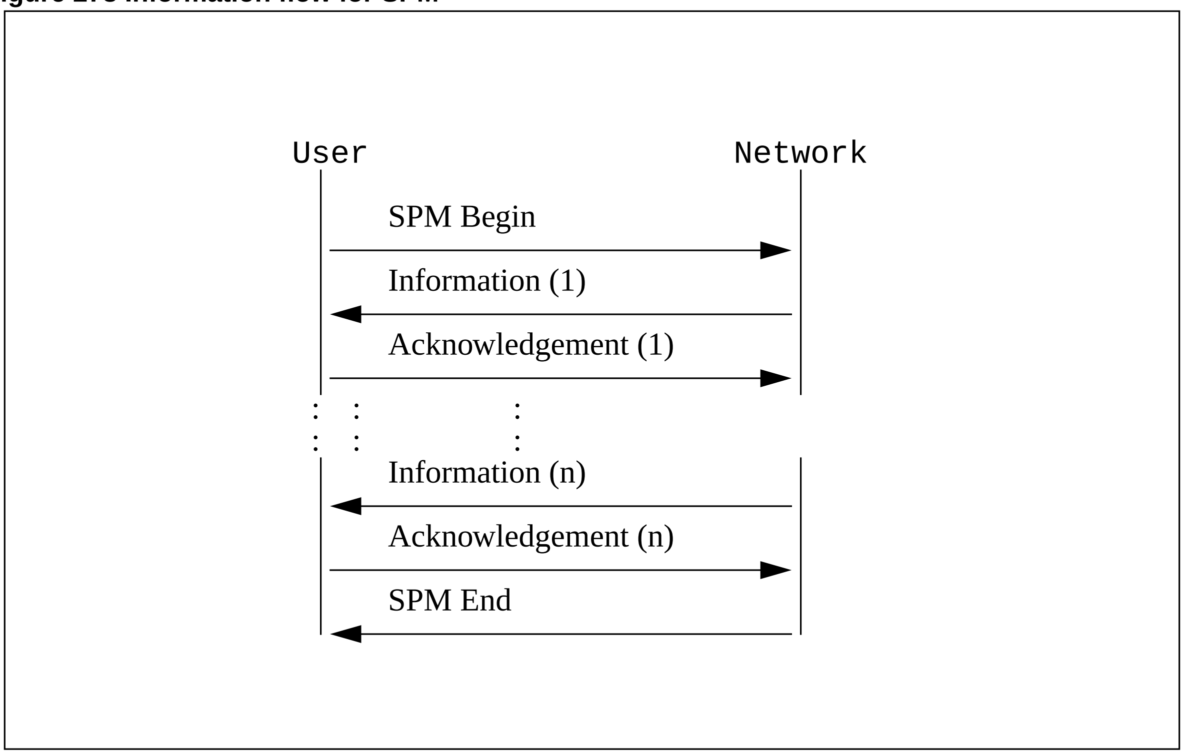
Note: Note: FA0 and FA1 will never be assigned to any feature, as they are reserved values.

The terminal should invoke SPM when it needs to have the information contained in its profile. SPM can only be invoked after the terminal has initialized layer 2, including TEI initialization, and layer 3 terminal identification (see Chapter 6: "Supplementary Services").

SPM uses a call independent signaling connection, initiated with a REGister message, to assign a call reference and create a layer 3 association. SPM assumes that the association between the TEI and the profile has been made, either through fixed TEI assignment or dynamic TEI and terminal identification.

Figure 278, “Information flow for SPM”shows the information flow for the SPM protocol.

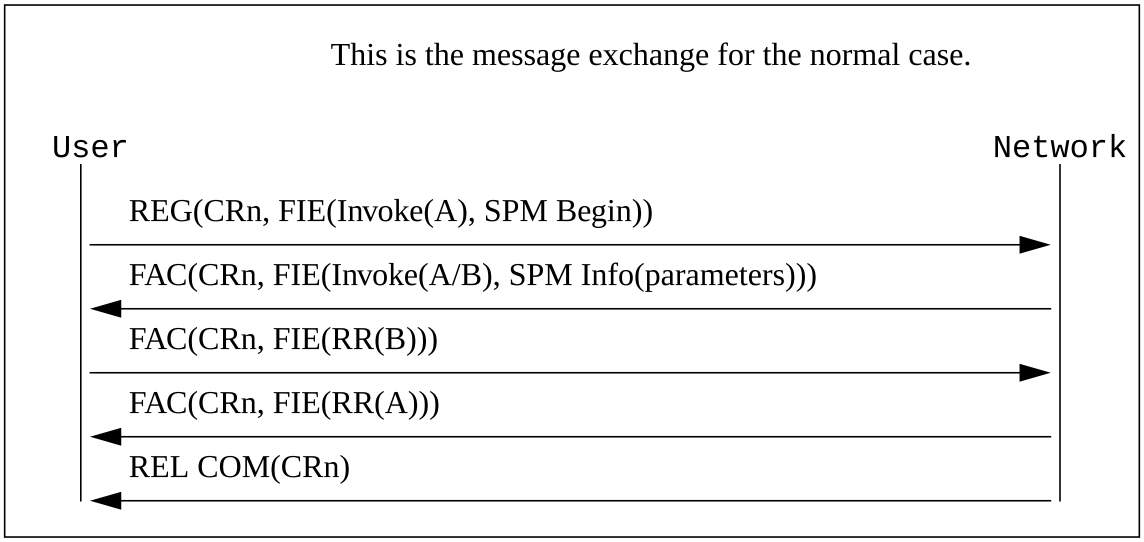
Figure 278 Information flow for SPM



E.2 Normal Procedures

Figure 279, "SPM Protocol", shows the message exchange between the network and the user in order to perform the SPM service.

Figure 279 SPM Protocol



The initial Invoke component is contained in a REGister message which establishes a call independent signaling connection. The last component of the SPM service may be contained in a FACility message or in the RELease COMplete message which clears the connection.

The user must be in the idle state in order to invoke SPM. The idle state is defined to be the state where the user has no call references active, is not placing a call, is not receiving a call, and is not in the process of activating a feature. If the user is not idle, the network will use the error procedures described in Section E.2.1, "Error Procedures".

The A and B represent the invoke identifiers. Every Invoke component has a unique invoke identifier, and this identifier must be used in all other components associated with the Invoke component. Invokes can be linked to other Invokes. A linked Invoke contains a unique invoke identifier and the identifier of the Invoke component to which it is linked. For more information please refer to the message structure shown in Section E.2.5, "Linked Invoke".

For the service described in this section there is too much information to be sent by the network in one message, therefore information being sent is partitioned into phases. The phases are named DN/BC, Feature, and CAP, and they are described later in this section.

E.2.1 Error Procedures

The user must be in the idle state in order to invoke SPM. If the user is not idle, the network shall return a Return error component with the error value

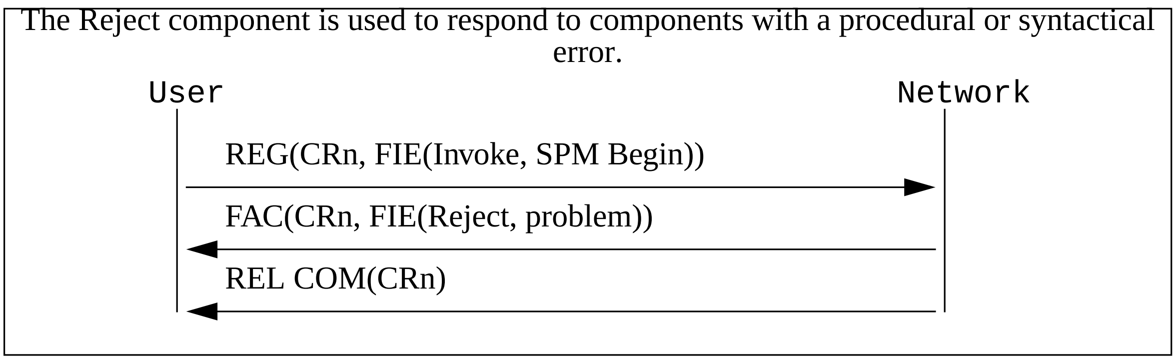
“Application Not Available”. The network then clears the connection by sending the user a RELease COMplete message.

If there is a procedural or syntactical problem with the operation of SPM, the network will send a Reject component to the user, and then clear the connection. Possible problems which the network will report to the user in a Reject component include the following:

- Using an invoke identifier which is already in use.
- Using a tag which is not recognized.
- Using a parameter which does not meet its predefined restrictions.
- Attempting operations in the wrong order.
- Not following the protocol rules for RO.
- Sending a Return result which is not in response to an Invoke.

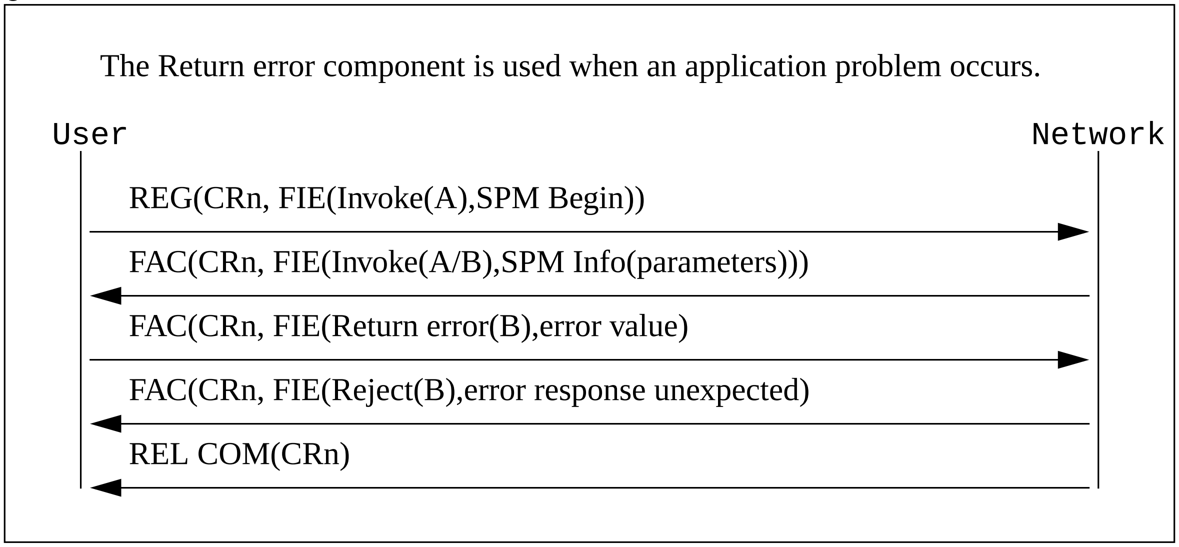
It is recommended that the user also support the above error procedures. In any case, the user should ignore FA values, Service Id values, and SPM phases which are not supported or which are not recognized. This is to ensure terminal compatibility with future network protocol versions.

Figure 280 Reject Transaction



If the user receives parameters which are incompatible with the type of terminal (the terminal has a provisioning error), it may send a Return error component to the network.

Figure 281 Error Transaction



If for some reason the network can not run the application, the network may do one of two things:

1 In response to the Invoke component, the network may send a Return error component with the error value “Application not Available”.

2 The network may send a RELease COMplete message, with only the appropriate call reference.

E.2.2 Abort Procedures

At any time during the service operation, either side may abort SPM. The side wishing to abort the procedure should send a RELease COMplete message to the other side and release the call reference.

E.2.3 Timers

There are two application timers which are used by SPM. They are as follows:

USPM1

Timer on the user side (TE) which is started after a REGister or FACility message is sent, and is stopped upon receipt of either a FACility or RELease COMplete message. If the timer expires, the user sends a RELease COMplete message. DURATION: 4 seconds.

NSPM1

Timer on the network side (ET) which is started after a FACility message is sent to the user. The timer will be stopped on receipt of a FACility or a RELease COMplete message from the user, with the same call reference. If the timer expires, the network sends the user a RELease COMplete message, with the appropriate call reference. DURATION: 4 seconds.

E.2.4 SPM Component Structure

The following are the structures for the various components introduced above for this application.

E.2.5 Linked Invoke

For this application, linked Invokes are used to pass the service profile information to the terminal. The information is passed in the parameter portion of the component. Figure 282, “SPM example”, shows the contents of the parameter portion of the linked Invoke component.

This method is compatible with the view that Feature Activator assignments can be provisioned on a DN/BC pair.

Figure 282 SPM example

Parameter Sequence Tag
Length

Header at the beginning of each phase

DN Tag
Length
IA5 String of Digits
BcInfo Sequence Tag
Length
BCie Tag
Length
BCie Contents
Number of Calls Tag
Length
Number of Calls Value
CAP Value Tag
Length
CAP Value

repeat for each BC in this BC group

DN/BC phase

repeat for each DN

Feature Sequence Tag
Length
FA Value Tag
Length
FA Value
Service Id Tag
Length
Service Id Value

repeat for each feature in the profile

Feature phase

CAP Sequence Tag
Length
CAP Value Tag
Length
CAP Value
Service Id Tag
Length
Service Id Value

repeat for each group intercom and intercom appearance on the terminal

CAP phase

Note: If the Number of calls is missing, the default is 1.

The CAP specifies a place holder for the DN.

Each new phase may be contained within one or more linked Invoke components.

E.2.6 SPM Remote Operations Formal Description

The following are the operation and error macros for Service Profile Management. Operation parameters are described using ASN.1 notation. Please refer to Sections 5.12, 5.13, and 5.14 for further information on Remote Operations, macros, and ASN.1 notation.

Figure 283 Service Profile Management Operation

```
SPMBegin     OPERATION

                     RESULT
                     ERRORS    {ApplicationNotAvailable}
                     LINKED    {SPMInfo}
                     ::=  1

SPMInfo      OPERATION
                     ARGUMENT   Phases
                     RESULT
                     ERRORS    {IncompatibleParameters}
                     ::=  2

IncompatibleParameters   ERROR
                                 ::=  1

ApplicationNotAvailable  ERROR
                                 ::=  2

Phases       ::=  SEQUENCE {
                              CHOICE {
                                 IMPLICIT SEQUENCE OF DnBcInfo,
                                 SEQUENCE OF [7] Feature,
                                 SEQUENCE OF [10] Cap
                                 }}


    DnBcInfo      ::=  IMPLICIT SEQUENCE {
                              dn [2] IMPLICIT IA5String,
                              BcInfo}

    BcInfo       ::=  [3] IMPLICIT SEQUENCE {
                              IMPLICIT SET OF BCie,
                              NumberOfCalls,
                              CapValue}

    Feature      ::=  IMPLICIT SEQUENCE {
                              FaValue,
                              ServiceId}

    Cap          ::=  IMPLICIT SEQUENCE {
                              CapValue,
                              ServiceId}
```

Figure 284 Service Profile Management Operation

```
BCie          ::=  [4] IMPLICIT OCTET STRING

NumberOfCalls  ::=  [5] IMPLICIT INTEGER

CapValue       ::=  [6] IMPLICIT INTEGER

FaValue        ::=  [8] IMPLICIT INTEGER

ServiceId      ::=  [9] IMPLICIT ServiceIdValue

ServiceIdValue ::=  ENUMERATED {
                    lnr (1),        -- Last Number Redial
                    lpa (2),        -- Loudspeaker Paging Access
                    msb (3),        -- Make Set Busy
                    rls (4),        -- Release
                    rag (5),        -- Ring Again
                    cfx (6),        -- Call Forward
                    cfv (7),        -- Call Forward Validation
                    icm (8),        -- Intercom
                    gic (9),        -- Group Intercom
                    aul (10),       -- Automatic Line
                    sps (11),       -- Speed Call Short
                    spl (12),       -- Speed Call Long
                    spu (13),       -- Speed Call User
                    aud (14),       -- Automatic Dial
                    ebo (15),       -- Executive Busy Override
                    cpu (16),       -- Call Pick   -Up
                    cpk (17),       -- Call Park
                    afc (18),       -- Additional Functional Call
                    fcc (19),       -- Flexible Call Conference
                    fct (20),       -- Flexible Call Transfer
                    fcd (21),       -- Flexible Call Drop
                    mwt (22),       -- Message Waiting
                    car (23),       -- Call Request
                    prl (24),       -- Privacy Release
                    prv (25)        -- Privacy  }
```

References

GR-205, Issue 1

ISDN Electronic Key Telephone Service Requirements and revisions

GR-268

ISDN Call Control Switching and Signaling Requirements, and various revisions and supplements

TR-847

ISDN Features - Common Switching and Signaling Generic Requirements

TR-857

Additional Call Offering for Managing Multiple Independent Calls

GR-2815, Issue 1

Default Service on ISDN Basic Rate Interfaces Generic Requirements

TR-TSY-000861, Issue 1

ISDN Layer 3 Protocol Details for the Support of Supplementary Services

GR-301

Public Packet Switched Network Generic Requirements (PPSNGR), Bellcore

TR-TSY-000846

Bellcore Supplementary Services

TR-TSY-0001329, Issue 1

Generic Requirements for ISDN Basic Rate Interface Verification (BRIV)

SR-NWT-002120, Issue 1 and Revision 1

National ISDN-2

SR-NWT-002457, Issue 1

National ISDN-3

SR-3476, Issue 1

National ISDN 1995 and 1996

SR-3875, Issue 1

National ISDN 1995, 1996 and 1997

SR-3339, Issue 1

1996 Version of National ISDN Basic Rate Interface Terminal Equipment Generic Guidelines

SR-4288

National ISDN Basic Rate Interface Terminal Equipment Generic Guidelines

CCITT Recommendation Q.920 (I.440)

ISDN user-network interface data link layer - general aspects

CCITT Recommendation Q.921 (I.441)

ISDN user-network interface - Data link layer specification

CCITT Recommendation Q.930(I.450)

ISDN user-network interface layer 3-general aspects

CCITT Recommendation Q.931(I.451)

ISDN user-network interface layer 3 specification

CCITT Recommendation I.430

Basic user-network interface layer 1 specification

CCITT Recommendation I.431

Primary rate user-network interface layer 1 specification

CCITT Recommendation X.25

Interface between data terminal equipment (DTE) and data circuit terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuits.

CCITT Rec.X.121CCITT V.110
CCITT Rec.E.164 (1988)
CCITT Rec.X.121 (1988)
CCITT Rec.X.122 (1988)

CCITT Recommendation X.31 (1988)

ANSI T1.602 (1988)

ISDN Signaling Specification - (LAPD) Layer 2

Draft Recommendation X.208

Specification of Abstract Syntax Notation One (ASN.1), CCITT, 1988

50006.08/06-88

Meridian Digital Centrex Features, Issue 1

Draft Recommendation X.209

Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1), CCITT, 1988

IBM GA 27-3093-3

IBM Synchronous Data Link Control - General Information, I

NTP 241-1001-184

Northern Telecom Practice, LAPB/X.25 Specification

NTP 241-1001-193

Northern Telecom Practice, SDLC Specification

NTP 241-1001-196

Northern Telecom Practice, SNA Multihost TPAD specification

NTP 241-1001-194

Northern Telecom Practice, LAPD/X.25 Specification

NTP 241-2001-340

Northern Telecom Practice, Service Data Specification

NTP 241-1001-303

Northern Telecom Practice, AM/RM operator Commands

List of Terms

ABCE	Automatic Bridged Call Exclusion
AC	Attendant Console
ACB	Automatic Call Back
ACBAR	Automatic Callback/Automatic Return
ACD	Automatic Call Distribution
ACO	Additional Call Offering
ACOU	Additional Call Offering-Unrestricted
ACREJ	Anonymous Call Rejection
ACRJ	Anonymous Call Rejection
AE	Application Entity
AFC	Additional Function Calls
Ai	Action indicator
AMA	Automatic Message Accounting
AMWI	Audible Message Waiting Indicator
AND	Abbreviated Number Delivery
ANI	Automatic Number Identification
AR	Automatic Recall
ASN.1	Abstract Syntax Notation One
ASP	Assignment Source Point
AT	Abstract Terminal
AUD	Automatic Dial
AUL	Automatic Line
BBG	Basic Business Group
BC	Bearer Capability
BCE	Bridged Call Exclusion
BRI	Basic Rate Interface
BRIV-OE	ISDN Basic Rate Interface Verification, Office Equipment
BS	Bearer Service
CA	Call Appearance
CACH	Call Appearance Call Handling
CAP	Call Appearance
CAPI	Call Appearance Information Element
CAR	Call Appearance Reservation

CAR	Call Request
CBQ	Call Back Queuing
CBU	Call Forward, Busy, Unrestricted
CCITT	International Telegraph and Telephone Consultative Committee
CCR	Customized Code Restriction
CDN	Called Party Number
CDS	Called Party Subaddress
CDU	Call Forward, Don’t Answer, Unrestricted
CES	Connection Endpoint Suffix
CF	Call Forward
CFAC	Call Forward All Calls
CFB	Call Forward Busy
CFC	Call Forward Cancel
CFD	Call Forward Don't Answer
CDS	Called Party Subaddress
CFF	Call Forward Fixed
CFI	Call Forward Intergroup
CFI	Call Forward Intragroup
CFP	Call Forward Programming
CFRA	Call Forward Remote Access
CFU	Call Forward Universal
CFV	Call Forwarding Variable
CFW	Call Forward
CFWVAL	Call Forward Validation
CFX	Call Forward List
CFXDNCT	Call Forward for Directory Number Call Type
CGN	Calling Party Number
CGS	Calling Party Subaddress
CHG	Charge Number
CID	Channel identification
CIDCW	Caller Identity Delivery On Call Waiting
CIDS	Calling Identify Delivery and Suppression
CIDSDLV	Calling Identity Delivery
CIDSSUP	Calling Identity Suppression
CLID	Caller ID
CLASS	Custom Local Area Signalling Services
CLLI	Common Language Location Identifier
CM	Computing Module
CMD	Circuit-Mode Data

CN	Connected Number
CNAMD	Calling Name Delivery
CND	Calling Number Delivery
CNDA	Calling Number Delivery Activation
CNDB	Calling Number Delivery Blocking
CNDD	Calling Number Delivery Deactivation
CN	Calling Number Identification
CNIS	Calling Number Identification Services
CNP	Calling Number Privacy
COT	Customer Originated Trace
CPE	Customer Premises Equipment
CPS	Calling Party Subaddress
CPU	Call Pick Up
CR	Call Request
CR	Call Reference
CRA	Call Request Activation
CRB	Call Reference Busy
CRBL	Call Reference Busy Limit
CRd	Null Call Reference
CRn	Null Call Reference
CT	Call Type
CUG	Closed User Group
CWD	Call Waiting Dial
CWI	Call Waiting Incoming
CWO	Call Waiting Originating
CWT	Call Waiting
DC	Direct Call
DCA	Dialed Access Codes
DCBI	Directed Call Pickup with Barge-In
DCC	Flexible Calling Deactivate Conference Facility
DCMPMC	D-Channel Message Performance Monitoring and Control
DCPK	Directed Call Park
DDD	Direct Distance Dialing
DDO	Direct Dialing Overseas
DIN	Denied Incoming
DISA	Direct Inward System Access

DISC	Disconnect
DLH	Distributed Line Hunt
DM	Disconnected Mode
DN	Directory Number
DND	Directory Number Dependent
DND	Do Not Disturb
DNH	Directory Number Hunt
DOR	Denied Origination
DPN	Data Packet Network
DRCW	Distinctive Ringing Call Waiting
DSL	Digital Subscriber Line
DSL	Digital Subscriber Loop
DT	Display Text
DTE	Data Terminal Equipment
DTMF	Dual Tone Multi-Frequency
EBO	Executive Busy Override
EBX	Executive Busy Override - Exempt
EID	Endpoint Identifier
EKTS	Electronic Key Telephone Service
ERWT	Expensive Route Warning Tone
ESB	Emergency Service Bureau
EXB	Extension Bridging
FA	Feature Activation
FA	Feature Activator
FC	Feature Code
FC	Flexible Calling
FCA	Feature Code Access
FCM	Functional Call Management
FCS	Frame Check Sequence
FFM	Functional Feature Management
FI	Feature Indication
FI	Feature Indicator
FIT	Fully Initializing ISDN Terminal
FKA	Feature Key Access
FKM	Feature Key Management
FNAL	Feature Not Allowed

FPE	Feature Processing Environment
FRMR	Frame Reject
FTM	Functional Terminal Management
GIC	Group Intercom
HLC	High Layer Compatibility
HMI	Human-Machine Interface
I-CF	ISDN Call Forwarding
I-CND	ISDN Called Number Delivery
IBN	Integrated Business Network
ICM	Intercom
IE	Information Element
IRQ	Information Request
ISDN	Integrated Services Digital Network
KP	KeyPad
KSH	Keyset Short Hunt
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D-channel
LDN	Listed Directory Number
LEC	Local Exchange Carrier
LLC	Low-Layer Compatibility
LNR	Last Number Redial
LNRA	Last Number Redial Associated
LOD	Line Overflow to a DN
LOR	Line Overflow to a Route
LPIC	Preferred intraLATA Carrier
LS	Locking Shift
LSB	Least Significant Bit
LTID	Logical Terminal Identifier
LVM	Leave Message
MADN	Multiple Appearance Directory Number
MBCE	Manual Bridged Call Exclusion
MBS	Meridian Business Set
MCA	Multiple Call Arrangement
MCH	Malicious Call Hold
MDC	Meridian Digital Centrex
MDF	Main Distibution Frame

MEI	MDL Error Indicator
MLH	Multi-Line Hunt
MRFM	MADN Ring Forward Manual
MSB	Make Set Busy
MSB	Most Significant Bit
MWT	Message Waiting
NBL	Notification Busy Limit
NCOS	Network Class of Service
NCP	Network Control Program
NDC	No Double Connect
NDM	Normal Disconnect Mode
NI	Notification Indicator
NIT	Non-Initializing Terminal
NITS	Non-Initializing Terminals
NOAMA	No Automatic Message Accounting
NP	Network Provided
NPI	Number Plan Identification
NPSI	Network Control Packet Switching Interface
NRM	Normal Response Mode
NRS	Network Resource Selector
NT	Network Termination
NT1	Network Termination Equipment
NTMFT	Nortel Meridian Feature Transparency
NTTRF	Nortel Bellcore TR-compliant Functional
OE	Office Equipment
OM	Operation Measurement
OML	Overload Message Limit
OSA	Operator System Access
PBX	Private Branch Exchange
PCA	Privacy Change Allowed
PCM	Pulse Code Modulation
PD	Parameter Downloading
PDN	Primary DN
PH	Packet Handler
PI	Progress Indicator
PIC	Preferred interLATA Carrier

PMD	Packet Mode Data
PPSN	Public Packet Switched Network
PRK	Call Park
PS	Packet Switched
PSDS	Public Switched Digital Service
PVC	Protocol Version Control
PVC	Permanent Virtual Circuit
QLLC	Qualified Logical Link Control
OSA	Operator System Access
RAG	Ring Again
REJ	Reject
RES	Residential Enhanced Service
RF	Ring Forward
RGN	Redirecting Number
Ri	Reference number
RLS	Release
RN	Redirecting Number
RND	Redirecting Number Delivery
RNN	Redirection Number
RNR	Receive Not Ready
RO	Remote Operations
ROSE	Remote Operations Service Element
RR	Receive Ready
RU	Remote Unit
S	Supervisory
SABME	Set Asynchronous Balanced Mode Extended
SAP	Service Access Point
SAPI	Service Access Point Identifier
SC	Speed Call
SCA	Selective Call Acceptance
SCA	Single Call Arrangement
SCF	Selective Call Forwarding
SCL	Speed Call - Long list
SCP	Signalling Control Protocol
SCR	Selective Call Rejection
SCRJ	Selective Call Rejection

SCS	Speed Call - Short list
SCU	Speed Call User
SDLC	Synchronous Data Link Control
SDN	Secondary DN
SERVORD	Service Orders
SI	Screening Indicator
SIG	Signal
SLE	Screen List Editing
SLU	Subscriber Line Usage
SMDR	Station Message Detail Recording
SNA	System Network Architecture
SPID	Service Profile Identifier
SPM	Service Profile Management
SSRT	Station Ringing Transfer
SUSP	Subscriber Usage-Sensitive Pricing
SVC	Switched Virtual Circuit
TAFAS	Trunk Answer From Any Station
TCAP	Transaction Capabilities Application Part
TEI	Terminal Endpoint Identifier
TID	Terminal Identifier
3WC	Three-Way Calling
TN/NPI	Type of Number/Numbering Plan Indicator
TNS	Transit Network Selection
TON	Type Of Network
TRC	Terminating Restriction Code
TSP	Terminal Service Profile
UA	Universal Access
UA	Unnumbered Acknowledgment
UCD	Uniform Call Distribution
UI	Unnumbered Information
UP	User Provided
UPPS	User Provided Passed Screening
USID	User Service Identifier
VI	Voiceband Information
WML	Warm Line
VMWI	Visual Message Waiting Indicator

XID	Exchange Identification
XPM	Extended Peripheral Module
3WC	Three-Way Calling

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ISDN Basic Rate User Network Interface Specification

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