ISDN
BASIC RATE
USER-NETWORK INTERFACE SPECIFICATION

NIS S208-6, Issue 1.1
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ISDN BASIC RATE INTERFACE SPECIFICATION
NIS S208-6

ISSUE 1.1 OVERVIEW

The publication of NIS S208-6, Issue 1.1 represents Northern Telecom's implementation of National ISDN-1. To achieve full NI-1 compliance, terminal vendors are advised to build to Bellcore SR-NWT-001953. Terminals that are built to SR-NWT-001953 will be functional on DMS-100. Building to NIS S208-6, Issue 1.1 will provide terminals with Bellcore NI-1 compliance and additional functionality as offered by DMS-100.

Since the publication of the NIS S208-4 specification, the DMS-100 ISDN Basic Rate Interface has been based on CCITT, ANSI standards and Bellcore ISDN Technical References (TRs). A refinement of compliance to these standards and references has taken place in subsequent DMS-100 specifications.

Northern Telecom and other major central office switch manufactures have made public commitments to support the Bellcore National ISDN - 1 service offering. In keeping with the objective of National ISDN-1, this specification sets out a uniform protocol which terminal manufacturers can build to and be portable from one manufacturer's central office switch to another. This has been called "terminal portability". Terminal portability is a break through for ISDN which will remove significant hurdles and foster more wide spread ISDN deployment.

Many of the changes from NIS S208-5 to this specification represent additional requirements for the network, which are optional for the CPE equipment. Vendors which have previously built terminal equipment to the NIS S208-5 interface specification should find that minor refinements are required to support National ISDN - 1 services. It should be noted; however, that it is not a necessary requirement that terminals upgrade to NIS S208-6, as backward compatibility is provided to previous releases through Protocol Version Control (PVC).

Issue 1.1 of the ISDN Basic Rate Interface Specification NIS S208-6 represents the Bulk Change Supplement (BCS) 34 software level of the DMS-100 ISDN Basic Rate Interface product. This issue also covers all changes to DMS-100 and corrections to NIS S208-6, issue 1.0 since its release in April of 1991.

This overview describes in general the technical changes that have been made since the publication of NIS S208-6, Issue 1.0. Minor editorial changes are not discussed. Changes for Issue 1.1 are marked with change bars in the the left-hand margin. All pages in this issue of NIS S208-6 are numbered sequentially.

CHANGES INTRODUCED BY NIS S208-6, Issue 1.1

SECTION A - Introduction

- Backward compatability of 7 kHz bearer service is not assured due to new procedures that are currently under development.

SECTION B - Physical Layer Specification

- No Changes

SECTION C - Data Link Layer Specification

- No Changes

SECTION D - Functional Call Control Signaling

- Section 4.0 Message Functional Definitions

  References for the information elements were corrected in ALL of the message content diagrams.

- In section 4.0, a number of new information elements are now supported. The newly supported information elements are the following:

  The Redirection Number information element is now supported in the CALL PROCeeding message and the DISConnect message.

  The Redirecting Number information element is now supported in the INFOrmtion message and the NOTIFY message.

  The Cause information element is now supported in the NOTIFY message and the RELese COMplete message.

  The Display Text information element is supported and can be in ANY message. The display text information element is currently implemented in the CONNect ACKnolwdge, HOLD ACKnowldge, KEY HOLD and the PROGress messages.

  The Protocol Version Control information element in the INFOrmation message was updated to reflect a codeset change.

  The length of the Keypad information element was corrected to read 3-34 for the INFOrmation message and the SETUP message.

The length of the Called Party Information element was corrected to read 6-29 for the INFOrmation message and the SETUP message.

- Section 5.0, Message Structure

Section 5.5.1.3 The procedures taken by the network when a non-locking shift information element is discarded have been up-dated to reflect current implementation practices.

Section 5.5.1.10 The coding standard for the Cause information element was updated to include Network Specific cause values 1-4, and National Specific cause values.

Network Specific cause value numbers: 1,2,3,4,14 are NOT supported. National Specific cause values: 4, 8, 9, 10, 11 are now supported.

Section 5.5.1.12 A note now indicates that Connected Number will not be supported in the future.

Section 5.5.1.22 The following notifaction indicators may not be supported in the future: connected via conference facility (controller); connected via conference facility (conferee); two party call; conference facility released; connected to Emergency Service Bureau; connected to Attendant Console; remote party disconnected; call o longer bridged; retrieve held call; no longer connected to Attendant Console; conference bridge full; conference bridge port available.

Call diverted is not supported.

Section 5.5.1.27 Octet 3b, Reason for Redirection, is now optional for Redirecting Number and Redirection Number.

Section 5.5.1.32 The Transit Network Selection information element now supports the user specified network identification, and the user specified identification code for the network identification plan.

Section 5.5.2.2 The following display text and control tags are implemented at this time: Blank tag, Called Address, Called Address, Accumulated Digits, Calling Address, Reason, Calling Party Name, Redirecting Name, Connected Name, Redirection Name, Redirection Number, Redirecting Number, and Connected Number.

Original Called Name and Original Called Party are not supported at this time.

Section 6.1.2.3.1 The Channel Identification information element may be included in the CONNect message.

Section 6.1.3.5 During clear collision, sending a RELease COMplete is not required.

Section 6.1.4.8 Data Link Reset procedures which effect calls in the null state and in the clearing phase have been up-dated to reflect current implementaion practices.

Section 6.1.4.11 Upon receipt of STATUs message from the local user, the CPE requires either the support of all call states or a minimum of two call states.

Section 7.2 Timer T309 was added as a User-Side Timer.

If initiated the second time, Timer T303 (2nd) is required.

Timer T310 is not supported on the User-Side.

SECTION E - Supplementary Services

- Section 2.0, Abstract Terminal

  For PVC 2 terminals, the display text information element is used.

- Section 5.0, Generic Procedures for Supplementary Service Access

  A section has been added on Screen List Editing to reflect design intent for BCS 35.

SECTION F - Data Service

No Changes

SECTION G - Subscription Parameters

No Changes

SECTION H - Management Services

No Changes

Addendum A - DPN Packet Mode Data Services

No Changes

Addendum B - ISDN Meridian Feature Transparency

The following comments summarize the changes made in Addendum B.

- A Call Timer field has been added to the list of network managed local display fields. This field would be used by the terminal to display a call timer to the user. The network will indicate the initial timer value to the terminal.

- Terminals working with the current issue of MFT (Version=MFT, Issue=1) should not respond to the handsfree on and handsfree off instructions from the network. That is, terminals should not respond with off-hook or on-hook indications to the network when receiving one of these instructions.

- Further detail on the operation of local fields has been provided.

NOTICE

This specification is provided as a guide for network planners and suppliers of systems and equipment designed to meet the requirements of Northern Telecom's Basic Rate Interface Specifications. Northern Telecom 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.

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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. Northern Telecom 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 Northern Telecom to make submissions to standards bodies and adopt domestic and international standards. The contributions currently being discussed at ECSA T1 committees, CCITT study groups, and in respect of Bellcore Technical Requirements will be monitored and incorporated into future programs whenever appropriate.

SECTION A: ISDN BASIC RATE INTERFACE - INTRODUCTION

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1.0 INTRODUCTION

1.1 GENERAL

This document contains the specification for the Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) user-network interfaces between the Northern Telecom ISDN DMS-100 switch and terminals designed for the Basic RAte Interface Digital Subscriber Line (DSL). The interfaces described in this document are based on the CCITT ISDN I and Q Series Recommendations, ISDN Standards established by ANSI/ECSA-T1, and the ISDN Basic Interface Call Control Switching and Signaling Requirements (TR-TSY-000268 Issue 2) and supplementary service Technical References published by Bellcore.

This release provides a comprehensive level of compliance to CCITT recommendations Q.931 and Q.932, and describes Northern Telecom's offering of the National ISDN-1. Other services are provided in addition.

This interface specification is applicable to the Northern Telecom DMS-100 ISDN User Network Basic Rate Interface at the BCS34 software level. A summary of the more significant changes from NIS S208-5 Issue 1.1 follows:

- Section A - minor changes
- Section B - minor changes
- Section C - additional functionality
- Section D - revised
- Section E - revised
- Section F - revised
- Section G - no changes
- Section H - no changes

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

1.2 SCOPE AND OBJECTIVE

The purpose of this document is to define the characteristics of the ISDN basic rate interfaces 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.

It is expected that this specification will be revised in the future to incorporate DMS-100 service and feature enhancements, and to reflect domestic and international standards as they evolve.

1.3 STRUCTURE OF DOCUMENT

This specification is organized into the following sections:

Section A: ISDN Basic Rate Interface - Introduction

Section B: ISDN Basic Rate Interface - Physical Layer Specification

Section C: ISDN Basic Rate Interface - Data Link Layer Specification

Section D: ISDN Basic Rate Interface - Functional Call Control Signaling Specification

Section E: ISDN Basic Rate Interface - Supplementary Services Associated with Functional Call Control

Section F: ISDN Basic Rate Interface - Data Services

Section G: ISDN Basic Rate Interface - Subscription Parameters

Section H: ISDN Basic Rate Interface - Management Services

Addendum A: ISDN Basic Rate Interface - DPN Packet Mode Data Services

Addendum B: ISDN Basic Rate Interface - Meridian Feature Transparency

The remainder of section A gives a brief description of the ISDN basic rate interface on DMS-100, ISDN terminal support philosophy and how Northern Telecom will support this philosophy in the DMS-100 switch. For Meridian Feature Transparency, only the discussions regarding layers 1 and 2 in the remainder of Section A apply. Addendum 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:

- Section B, 'T' interface or 'U' interface physical layer requirements, as appropriate.
- Section C, static TEI or dynamic TEI, as appropriate.
- Section D, for terminals using functional signaling for basic call control.
- Section E, for features that the terminal supports.
- Section F, for terminals supporting network based data services but only the features that the terminal supports.
- Section G, subscription parameters are provided for information only.
- Section H, for Service Profile Management (SPM).

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

- Section B, 'T' interface or 'U' interface physical layer requirements, as appropriate.
- Section C, static TEI or dynamic TEI, as appropriate.
- Addendum B, for terminals supporting Meridian Feature Transparency.

2.0 ISDN BASIC RATE INTERFACE

2.1 OVERVIEW

ISDN basic rate interface 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 CCITT 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; and
- the network layer defines the procedures for establishing, maintaining and clearing calls, and accessing supplementary services.

2.2 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 (NT1) 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 NT1 equipment over standard metallic loops in the outside plant.

2. A four-wire interface defined at the user side of the network termination (NT1) 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 means for connecting ISDN terminal equipment (TEs, NT2s, and TAs) to network termination equipment (NT1s), or to a DMS-100 switch or DMS-100 Remote Units. This interface is intended for application over inside plant loops (customer's 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 Remote Units are shown in Figure 1.

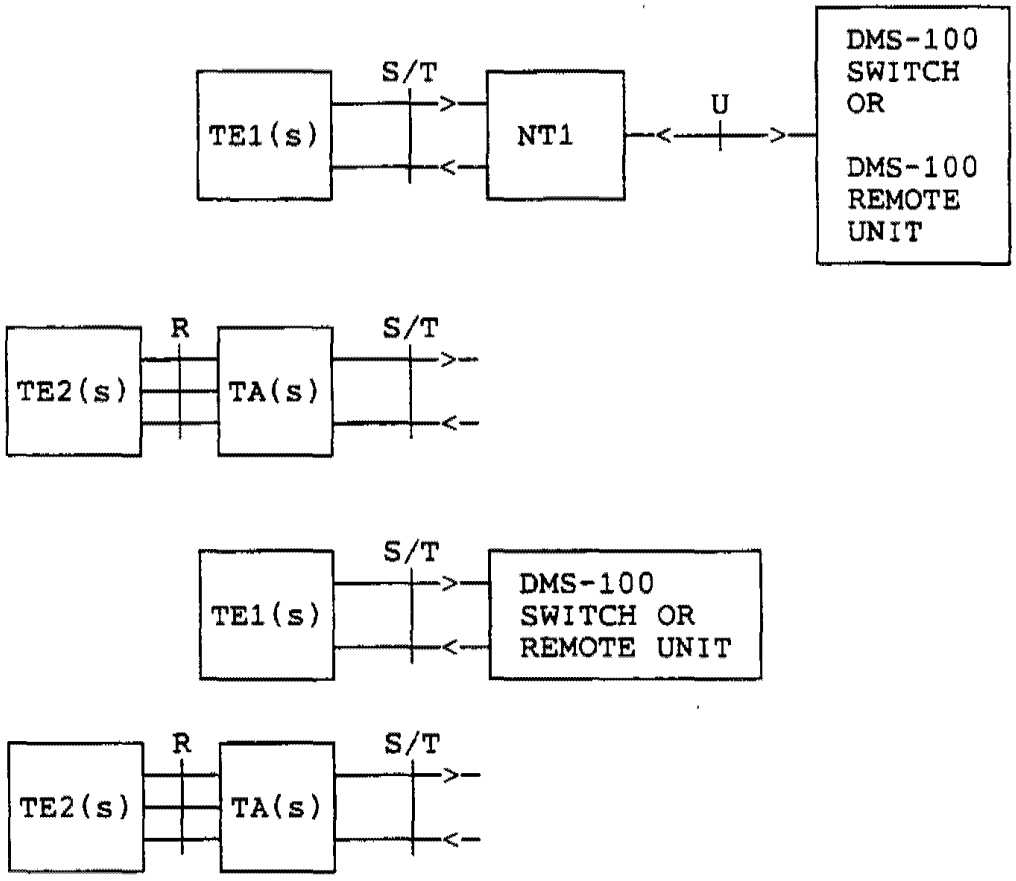


Figure 1 - ISDN Interface Reference Configurations, showing Location of S/T and U interfaces

The physical layer characteristics are defined in section B.

2.3 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 section C.

2.4 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 (section D) together with signaling procedures for access to network-based supplementary services (section E). Access to data services and associated features are defined in section F.

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

- functional signaling (Functional Feature Management - FFM), for control of services which affect the processing of calls in progress (e.g. holding a functional call, offering additional functional calls) or are considered as optional parts of basic call processing (e.g. calling line identification display); and

- feature activators and indicators (Feature Key Management - FKM), generally for access to supplementary services which do not affect basic call processing (e.g. Make set busy).

These procedures are defined in detail in section E.

An alternative Network Layer known as Meridian Feature Transparency provides access to the full set of Meridian Digital Centrex features accessible to Electronic Business sets. These procedures are defined in section Addendum B.

3.0 ABSTRACT TERMINAL

To allow for the support of different physical implementions of terminals, the concept of an "Abstract Terminal" is introduced.

An Abstract Terminal is a collection of logical terminal components (e.g. directory numbers, call references, bearer capabilities, feature activators, feature indicators, keypad, display, etc.) which a physical terminal may implement.

Physical terminals can have a wide variety of man machine interfaces (MMI), however the network has only one virtual MMI, namely the Abstract Terminal.

Conceptually the Abstract Terminal 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 MMI. For more information on the Abstract Terminal, refer to section E of this document.

4.0 ISDN TERMINAL NUMBERING AND ADDRESSING

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

4.1 DMS-100 ISDN TERMINALS AND BEARER SERVICES

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

A bearer service 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 services:

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

Note: Access to the packet mode bearer service in the B-channel is a provisioned service option selected at subscription time. Access to packet mode bearer service via a switched B-channel is currently being planned.

* New procedures for this bearer service are expected to be developed in the future. Backward compatibility of this bearer service using existing procedures will not be assured.

4.2 ISDN TERMINAL ADDRESSING

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

- addressing terminals which access B-channel circuit mode Bearer Services,
- addressing terminals which access packet mode Bearer Services on either B or D-channels.

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

4.2.1 Terminals using Circuit Mode Bearer Services

Each terminal is represented by one or more Abstract Terminals. Each Abstract Terminal uses its own logical link as identified by a Terminal Endpoint Identifier (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 :

1. A specific terminal.

2. A number of terminals arranged as a Hunt Group.

3. A group of terminals arranged in an Electronic Key Telephone Service (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.

An Abstract Terminal is currently capable only of accessing one B-channel at a time. If simultaneous access to both B-channels is required, as for example in an integrated voice and data terminal, then the terminal must contain two Abstract Terminal representations.[1]

4.2.2 Terminals using Packet Bearer Services

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

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[1] Removal of this restriction is planned.

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

However, for North American ISDN trial purposes the psuedo-DNIC <9001> can be used to distinguish those users on the ISDN from those on the public packet switching network for intra-LATA calls.

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

4.3 ISDN CALLS

The DN and the Bearer Capability 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 Bearer Services between terminals of a compatible Bearer Capability. The following call types are possible:

CS Voice to B-channel CS Voice.

CS Data to B-channel CS Data.

PS Data to D-channel PS Data.

PS Data to B-channel PS Data.

Possible call origins are :

CS Voice - Intra-ISDN (B-channel Voice Terminal)
- Extra-ISDN (POTS)

CS Data - Intra-ISDN (B-channel Data Terminal)
- Extra-ISDN (PSDS[2])

PS Data - Intra-ISDN (B or D-channel PS terminal)
- Extra-ISDN (PPSN[3])

---

[2] Public Switched Digital-data Service

[3] Public Packet Switched Network

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

4.3.1 Intra-ISDN Calls

A common DN can identify both Voice and Data B-channel circuit mode terminals. Calls will be offered as described below.

Separate DN's are required for all PS Data terminals.

4.3.1.1 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 which have a compatible bearer capability. When the appropriate service (subscription) options are set, the DN, the bearer capability, or both, will be checked by the network for compatibility with the associated terminal call appearance as datafilled in the network.

4.3.1.2 Intra-ISDN Packet Mode Calls

Since connections to the ISDN Packet Handler are dedicated at subscription time, intra ISDN PS calls are performed using standard in-band X.25 call set-up procedures. The calling user specifies the called address. This address format will require 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 signifance number. This option will eliminate the need for dialing prefixes. The actual method chosen will be at the option of the telephone operating company deploying this service.

4.3.2 Extra-ISDN Calls (POTS and PSDS)

Calls to the common DN from the POTS network are presumed to have a Bearer Capability of Voice and are processed accordingly.

Calls to the common DN from the PSDS are presumed to have a Bearer Capability of circuit mode data and are processed accordingly.

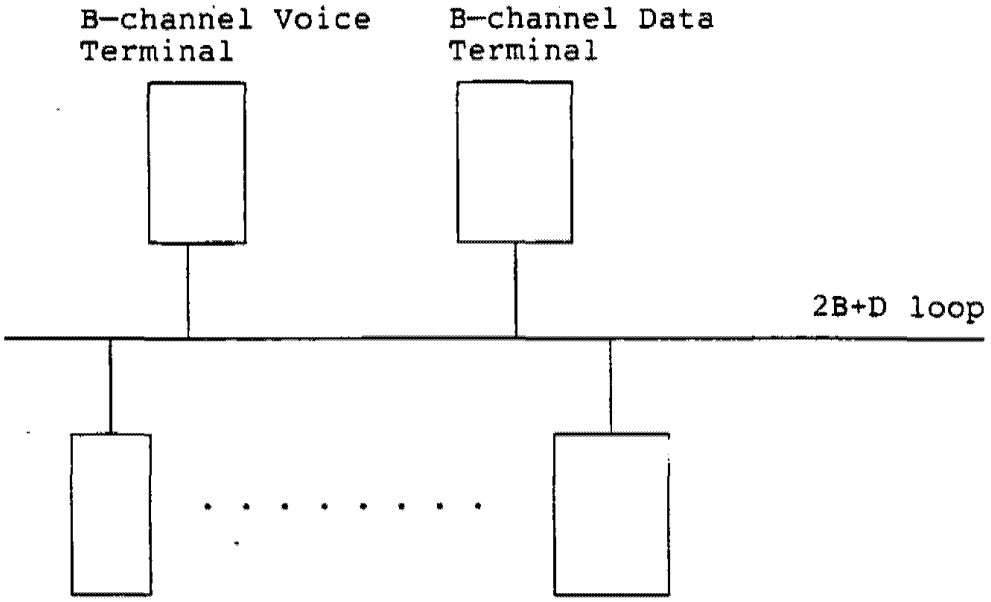
4.3.2.1 Extra ISDN Packet Mode Calls (PPSN)

The use of escape codes has been standardized by CCITT as the mechanism for interworking between X.121 (PPSN) and E.164 (ISDN) numbering plans. The use of escape codes is fully supported on NT DMS-100 switch to allow full interworking of TEs on PPSNs and TEs on ISDN. Refer to section F for details of all call types.

5.0 CONFIGURATIONS OF TERMINALS

A maximum of 8 terminals will be supported per BRI interface. Currently, only two terminals are allowed to have access to a B-channel per interface*. A B-channel terminals can support either voice or data or both voice and data. The B-channel may also be provisioned for special service applications, or packet mode bearer services. On the D-channel, the number of data terminals that can be supported is limited by the maximum of 8 terminals per loop.

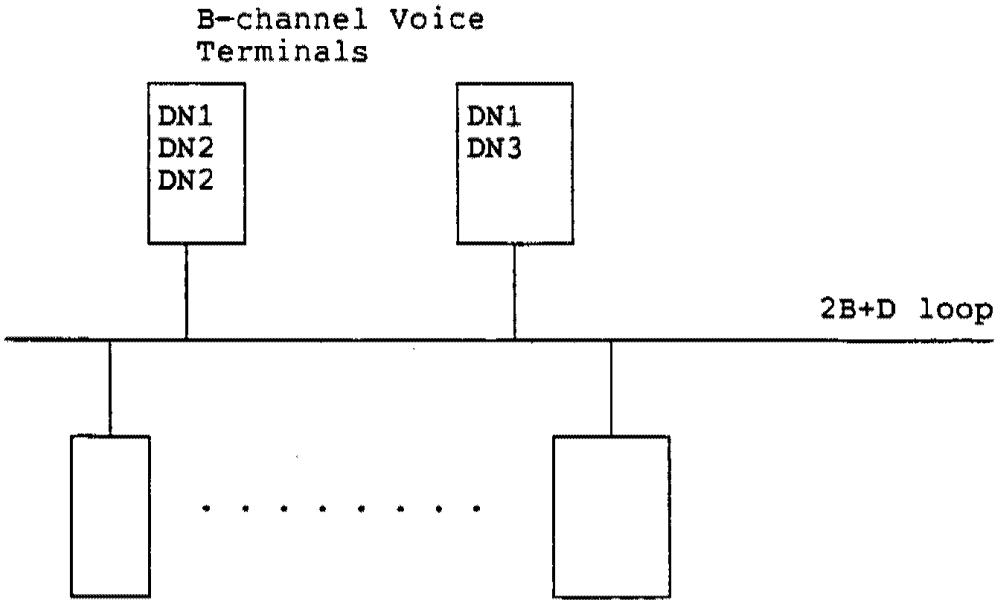
The diagrams below show examples of the different arrangements :



(a) Two terminals requiring B-channels. Total maximum of terminals allowed is 8.

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* Removal of this restriction is planned.



(b) Multiple appearances of the same DN on the same and different terminals

1. Each B-channel terminal on the loop may have the same DN as another B-channel terminal on the same loop using the EKTS feature.

2. Each B-channel terminal on the loop may have multiple appearances of the same DN.

6.0 ISDN TERMINAL LOUDNESS OBJECTIVES

Encoding and decoding between analog speech (or other) signals and B-channel 64 kbit/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 (CCITT 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).

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SECTION B: ISDN BASIC RATE INTERFACE - PHYSICAL LAYER SPECIFICATION

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1.0 PHYSICAL LAYER SPECIFICATIONS

1.1 GENERAL

This specification defines the Layer 1 characteristics of the ISDN basic rate interface user-network interfaces supported on the DMS-100 Switch and/or DMS-100 Remote Units. Two Layer 1 specifications are defined:

1. A two-wire loop interface defined at the network side of the Network Termination (NT1) 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 NT1 equipment over standard metallic loops in the outside plant.

2. A four-wire interface defined at the user side of the network termination (NT1) 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 means for connecting ISDN terminal equipment (TEs, NT2s, and TAs) to network termination equipment (NT1s) provided by Northern Telecom and to DMS-100 switches and DMS-100 Remote Units. 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 Remote Units are shown in Figure 1.

Section 4 defines the Alternate Mark Inversion (AMI) loop interface specification utilized in the initial ISDN implementation, prior to the availability of 2B1Q.

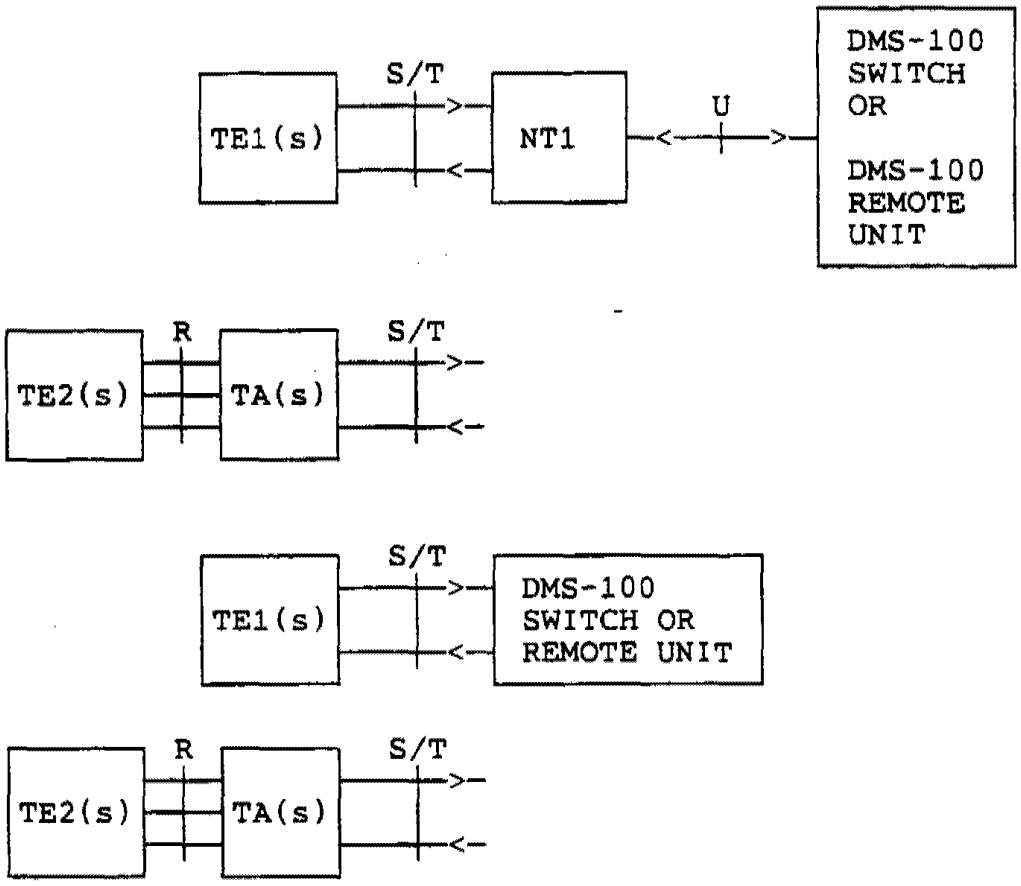


Figure 1 - Reference Configurations for the ISDN basic rate User-Network Interfaces on the DMS-100 Switch and DMS-100 Remote Units

2.0 U INTERFACE LAYER 1 SPECIFICATION

The U Interface is located at the "U Reference Point" as defined in Figure 1.

Section 4 defines the AMI loop interface specification utilized in the initial ISDN implementation, prior to the availability of 2B1Q.

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). Northern Telecom 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.

3.0 S/T INTERFACE LAYER 1 SPECIFICATION

The S/T interface is located at the "S/T Reference Point" as shown in Figure 1.

The Layer 1 specification for this interface supported by the DMS-100 Switch, and Network Termination Equipment (NT1s) provided by Northern Telecom, at the S/T reference point is compliant with the ANSI T1.605-1991 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 options that are supported include the following:

- the optional PS1 mode of powering across the S/T interface, and
- the optional S/Q channel messaging.

4.0 AMI SPECIFICATION

4.1 INTRODUCTION

This section defines the AMI Loop Interface Specification utilized in initial ISDN implementation, prior to the availability of systems which comply with the ISDN 2B1Q Specification documented in section 2. This section provides a set of requirements for transmission between the DMS-100 and NT1.

The transmission system is designed to operate on 2-wire non-loaded, twisted copper pairs with mixed gauges.

The scope of this interface specification is as follows:

- it describes the transmission technique used to support full-duplex transmission on a twisted copper pair;
- it describes the output signal which NT1 must provide on the network side;
- it defines the line code to be used;
- it describes the electrical and mechanical specifications of the network interface;
- it describes the organization of transmitted data;
- and it specifies the protocol on the operations and maintenance channel.

4.2 PHYSICAL CHARACTERISTICS

4.2.1 Wiring Polarity Integrity

The NT1 shall not be dependant on a specific polarity for the two wires of the access lines as the pair may be reversed.

4.2.2 Connector

The NT1 shall connect to the network through a miniature 8-position non-key jack. The specification for the 8-position jack can

be found in the ISO standard ISO 8877. The jacks are equipped with four contacts, the center two of which are used for the cable pair, commonly called tip (T) and ring (R). The pin assignments for the 8-position jack and the 8-position plug are given in the following table.

PIN NUMBER	FUNCTION	NOTE
1	No connection	
2	No connection	
3	No connection	
4	Signal	Tip or Ring of pair to and from the network interface
5	Signal	Tip or Ring of pair to and from the network interface
6	No connection	
7	No connection	
8	No connection	

4.3 TRANSMISSION METHOD

4.3.1 General

The transmission system uses the Echo Canceller with Hybrid (ECH) principle to provide full duplex operation over a two wire subscriber loop.

4.3.2 Line Code

Bipolar Alternate Mark Inversion (AMI) coding is used with 50 percent duty-cycle-pulse-width for both directions of transmission.

4.3.3 Line Bit Rate

Nominal rate is 160 kbaud +/- 5 PPM.

4.3.4 Pulse Shape

An isolated pulse, either positive or negative, prior to filtering shall have an amplitude of 2.5 volts peak +/- 5% and a pulse width of 3.125 milliseconds (nominal) +/- 150 nanoseconds with a maximum rise or fall time (from 10% to 90% points) of 100 nanoseconds.

4.3.5 Signal level

The peak signal level at the output of the transmitter should be 2.5 volts +/- 5% with a 120 Ohms termination.

4.3.6 Signal power

The total average power of the transmitted signal shall be 10.0 dBm into a 120 Ohms load, over the frequency band of 0 Hz to 160 kHz.

4.3.7 Performance

A minimum BER of 1 X 10-7 is required when NT1 is receiving random sequence of pulses over the loop.

4.3.8 Loop Coverage

The system should cover a loop length corresponding to 43 dB loss (with 49 disturbers in same cable and rendering a BER OF 10-7) at 80 kHz.

4.4 FUNCTIONAL CHARACTERISTICS

4.4.1 Frame Structure

In both direction of transmission, data shall be grouped into frames of 20 bits each. The frame structure shall be identical for both direction of transmission.

4.4.1.1 Binary Organization of the Frame

Each frame consists of the following groups of bits:

Bit Position	Group
1-8	B1 - channel 1
9	D - channel bit
10	framing signal
11-18	B2 - channel
19	D - channel bit
20	C - channel bit

4.4.1.2 Framing Bit Pattern

The framing bit pattern shall be alternate binary one's and zero's. This pattern shall be the same in both directions of transmission. The framing bit itself is not scrambled.

4.4.1.3 Frame Acquisition

Frame acquisition shall be less than 10 ms.

4.4.2 Scrambling

The binary data stream (2B + D + C) is scrambled prior to the insertion of the framing bit. The polynomial of the scrambler/descrambler are as follows:

X**-10 + X**-3 + 1 Descrambler
X**-11 + X**-1 + 1 Scrambler

4.4.3 Activation / Deactivation

The NT1 should stay active at all times.

4.5 ELECTRICAL CHARACTERISTICS

4.5.1 DC Resistance

The NT1 should present a nominal 2.2 kOhms DC terminating resistance for the two wire transmission line.

4.5.2 AC Impedence

The NT1 should present an impedence of 120 Ohms + 10% over a frequency range of 5 kHz to 160 kHz to the two wire copper pair.

4.5.3 Sealing Current

The NT1 should meet the requirement for a sealing current of 5.5 mA +/- 1 mA.

4.5.4 Return Loss

The return loss of the NT1 when terminated with 120 Ohms real impedence should be >= 15 dB from 16 kHz to 144 kHz.

4.5.5 Jitter

The maximum jitter on the NT1 clock shall be less than 200ns for frequencies between 10 Hz to 10 kHz.

4.5.6 Longitudinal Balance

The longitudinal balance of the termination to the two wire pair presented by the NT1 should be above 45 dB from 10 kHz to 300 kHz.

4.6 TEST AND MAINTENANCE FUNCTIONS

4.6.1 General

Test and maintenance functions are supported by the C-channel. A C-Channel protocol provides the network with effective fault isolation and error performance monitoring capabilities.

Messages are initiated by the DMS-100 and acknowledged by the NT1. The message format is the same in both directions. The operating principle is based on message acknowledgements by the NT1 and time-outs by the DMS-100. This technique precludes autonomous messaging by the NT1.

When the DMS-100 has no C-Channel message to transmit, it shall send binary "ones" on the channel. This also applies to the NT1 when it is not transmitting an acknowledgement message.

4.6.2 Message Format

A C-Channel message has twenty-four bits in length. The first bit, the start bit, is always zero to indicate the beginning of the message. The remaining twenty three bits are divided to four fields, namely Destination Code, Operation Code, the Data and Cyclic Redundancy Check Code (CRC).

Bit Position	Number of Bits	Name
1	1	start bit
2-5	4	Destination Code field
6-9	4	OpCode field
10-17	8	Data Code field
18-24	7	CRC field

Note: Start bit is preceded by "11111111"

4.6.2.1 Destination Code field

The destination code consists of four bits, bits 2-5 of the C-Channel message, resulting in sixteen possible unique destination codes assigned as follows:

0000 & 0001	indicates the destinations within the Line Termination
0010	indicates destination is in the NT1 relevant to the T-interface side
0011	indicates destination is in the NT1 relevant to the U-interface side
1111	unacknowledged

The remaining eleven destinations are reserved.

4.6.2.2 OpCode Field

The OpCode consists of four bits (bits 6-9 of the C-Channel message), resulting in sixteen possible OpCodes.

OpCode	Name	Description
0000	Extension	unused
0001	Loopback (2B + D)	controls 2B + D loopback
0010	Read test register	reads test data
0011	Write test register	stores test data
0100	Read error register	has bipolar violation count
0101	Clear error register	error count register cleared
0110	Read bits	reads a particular status
0111	Write bits	controls a particular cond'n
1000	Read loop channel	reads B1,B2 loopback status
1001	Write loop channel	controls B1,B2 loop backs
1010	Spare	
1011	Spare	
1100	Spare	
1101	Spare	
1110	Spare	
1111	Broadcast (network to NT1)	no response sent
1111	Unsupported (NT1 to network)	unsupported request

Note: When spare codes are returned (being responded), they are not supported. The response OpCode is "1111"

4.6.2.3 Data Field

The data field is eight bits in length, bits 10-17 of the C-Channel message. The specific data in this field is dependent on the associated OpCode.

DMS-100 to NT1 Messages

Message Description	Destination	OpCode	Data Field	CRC Field
Extension	0011	0000	XXXX XXXX	<CRC>
Loopback (2B+D)	0011	0001	XXXX XXXX	<CRC>
Read Test Register	0011	0010	XXXX XXXX	<CRC>
Write Test Register	0011	0011	DDDD DDDD	<CRC>
Read Error Register	0011	0100	XXXX XXXX	<CRC>
Clear Error Register	0011	0101	XXXX XXXX	<CRC>
Read Bits (No Op)	0011	0110	X000 0000	<CRC>
RB (deactivation indicator)	0011	0110	X000 0001	<CRC>
RB (internal spare flip flop)	0011	0110	X000 0010	<CRC>
RB (U frame sync)	0011	0110	X000 0011	<CRC>
RB (Destination 04H-7FH)	0011	0110	X000 0100	<CRC>
Write Bits (context restore)	0011	0111	1000 0000	<CRC>
WB (deactivation request)	0011	0111	D000 0001	<CRC>
WB (clear spare flip flop)	0011	0111	1000 0010	<CRC>
WB (No Op)	0011	0111	D000 0011	<CRC>
WB (destination 04H-7FH)	0011	0111	D000 0101	<CRC>
Read Loop Channel	0011	1000	XXXX XXXX	<CRC>
Write Loop Channel	0011	1001	XXXX XXXX	<CRC>
Broadcast (no response sent)	1111	XXXX	XXXX XXXX	<CRC>

X: Don't Care D: Data Bit

DMS-100 to NT1 Message (cont'd)

Message Description	Destination	OpCode	Data Field	CRC Field
Extension	0010	0000	XXXX XXXX	<CRC>
Loopback (2B+D)	0010	0001	XXXX XXXX	<CRC>
Read Test Register	0010	0010	XXXX XXXX	<CRC>
Write Test Register	0010	0011	DDDD DDDD	<CRC>
Read Error Register	0010	0100	XXXX XXXX	<CRC>
Write Error Register	0010	0101	XXXX XXXX	<CRC>
Read Bits (No Op)	0010	0110	X000 0000	<CRC>
RB (activation)	0010	0110	X000 0001	<CRC>
Read Bits	0010	0110	X000 0010	<CRC>
RB (T frame sync)	0010	0110	X000 0011	<CRC>
RB (2B+D loop back)	0010	0110	X000 0100	<CRC>
RB (timing)	0010	0110	X000 0101	<CRC>
RB (version identifier)	0010	0110	X000 0110	<CRC>
RB (unused)	0010	0110	X000 0111	<CRC>
RB (D=08H-7FH)	0010	0110	XDDD XDDD	<CRC>
Write Bits (context restore)	0010	0111	X000 0000	<CRC>
WB (activation request)	0010	0111	D000 0001	<CRC>
WB (start CO relay timer)	0010	0111	X000 0010	<CRC>
WB (No Op)	0010	0111	X000 0011	<CRC>
WB (analog loopback relay)	0010	0111	D000 0100	<CRC>
WB (timer control LSB)	0010	0111	D000 0101	<CRC>
WB (timer control MSB)	0010	0111	D000 0110	<CRC>
WB (controls 80 kHz test)	0010	0111	D000 0111	<CRC>
WB (version identifier)	0010	0111	D000 1000	<CRC>
WB (version identifier)	0010	0111	D000 1001	<CRC>
WB (unused)	0010	0111	D000 1010	<CRC>
WB (unused)	0010	0111	D000 1011	<CRC>
WB (S1, multiframe bit)	0010	0111	D000 1100	<CRC>
WB (S2, S-channel)	0010	0111	D000 1101	<CRC>
WB (FA, Q bit identifier)	0010	0111	D000 1110	<CRC>
WB (No Op)	0010	0111	X000 1111	<CRC>
WB (D=10H-7FH)	0010	0111	XDDD DDDD	<CRC>
Read Loop Chan.(B1 to network)	0010	1000	X000 0000	<CRC>
RLC (B2 to network)	0010	1000	X000 0001	<CRC>
RLC (B1 to S/T I/F)	0010	1000	X000 0010	<CRC>
RLC (B2 to S/T I/F)	0010	1000	X000 0011	<CRC>
RLC (D=04H-7FH)	0010	1000	XDDD DDDD	<CRC>
Write Loop Chan.(B1 to network)	0010	1001	D000 0000	<CRC>
WLC (B2 to network)	0010	1001	D000 0001	<CRC>
WLC (B1 to S/T I/F)	0010	1001	D000 0010	<CRC>
WLC (B2 to S/T I/F)	0010	1001	D000 0011	<CRC>
WLC (D=04H to 7FH)	0010	1001	XDDD DDDD	<CRC>

X: Don't Care D: Data Bit

NT1 to DMS-100 Response

Message Description	Destination	OpCode	Data Field	CRC Field
Extension	0011	1111	XXXX XXXX	<CRC>
Loopback (2B+D)	0011	0001	XXXX XXXX	<CRC>
Read Test Register	0011	0010	DDDD DDDD	<CRC>
Write Test Register	0011	0011	DDDD DDDD	<CRC>
Read Error Register	0011	0100	DDDD DDDD	<CRC>
Clear Error Register	0011	0101	0000 0000	<CRC>
Read Bits (No Op)	0011	0110	X000 0000	<CRC>
RB (deactivation Indicator)	0011	0110	D000 0001	<CRC>
RB (internal spare flip flop)	0011	0110	D000 0010	<CRC>
RB (U frame sync)	0011	0110	D000 0011	<CRC>
RB (destination 04H-7FH)	0011	1111	XXXX XXXX	<CRC>
Write Bits (context restore)	0011	0111	1000 0000	<CRC>
WB (deactivation request)	0011	0111	D000 0001	<CRC>
WB (clear spare flip flop)	0011	0111	1000 0010	<CRC>
WB (no op)	0011	0111	D000 0001	<CRC>
WB (Destination 04H-7FH)	0011	1111	XXXX XXXX	<CRC>
Read Loop Channel	0011	1111	XXXX XXXX	<CRC>
Read Loop Channel	0011	1111	XXXX XXXX	<CRC>

X: Don't Care D: Data Bit

NT1 to DMS-100 Response (cont'd)

Message Description	Destination	OpCode	Data Field	CRC Field
Extension	0010	1111	XXXX XXXX	<CRC>
Loopback (2B+D)	0010	1111	XXXX XXXX	<CRC>
Read Test Register	0010	0010	DDDD DDDD	<CRC>
Write Test Register	0010	0011	DDDD DDDD	<CRC>
Read Error Register	0010	1111	XXXX XXXX	<CRC>
Write Error Register	0010	1111	XXXX XXXX	<CRC>
Read Bits (No Op)	0010	0110	XXXX XXXX	<CRC>
RB (activation)	0010	0110	D000 0001	<CRC>
Read Bits	0010	0110	XXXX XXXX	<CRC>
RB (T frame sync)	0010	0110	D000 0011	<CRC>
RB (2B+D loop back)	0010	0110	D000 0100	<CRC>
RB (timing)	0010	0110	D000 0101	<CRC>
RB (version identifier)	0010	0110	D000 0110	<CRC>
RB (unused)	0010	0110	D000 0111	<CRC>
RB (D=08H-7FH)	0010	1111	XXXX XXXX	<CRC>
Write Bits (context restore)	0010	0111	X000 0000	<CRC>
WB (activation request)	0010	0111	D000 0001	<CRC>
WB (start CO relay timer)	0010	0111	X000 0010	<CRC>
WB (No Op)	0010	0111	XXXX XXXX	<CRC>
WB (analog loopback relay)	0010	0111	D000 0100	<CRC>
WB (timer control LSB)	0010	0111	D000 0101	<CRC>
WB (timer control MSB)	0010	0111	D000 0110	<CRC>
WB (controls 80 kHz test)	0010	0111	D000 0111	<CRC>
WB (version identifier)	0010	0111	D000 1000	<CRC>
WB (version identifier)	0010	0111	D000 1001	<CRC>
WB (unused)	0010	0111	D000 1010	<CRC>
WB (unused)	0010	0111	D000 1011	<CRC>
WB (S1, multiframe bit)	0010	0111	D000 1100	<CRC>
WB (S2, S-channel)	0010	0111	D000 1101	<CRC>
WB (FA, Q bit identifier)	0010	0111	D000 1110	<CRC>
WB (No Op)	0010	0111	XXXX XXXX	<CRC>
WB (D=10H-7FH)	0010	1111	XXXX XXXX	<CRC>
Read Loop Chan.(B1 to network)	0010	1000	D000 0000	<CRC>
RLC (B2 to network)	0010	1000	D000 0001	<CRC>
RLC (B1 to S/T I/F)	0010	1000	D000 0010	<CRC>
RLC (B2 to S/T I/F)	0010	1000	D000 0011	<CRC>
RLC (D=04H-7FH)	0010	1111	XXXX XXXX	<CRC>
Write Loop Chan.(B1 to net.)	0010	1001	D000 0000	<CRC>
WLC (B2 to network)	0010	1001	D000 0001	<CRC>
WLC (B1 to S/T I/F)	0010	1001	D000 0010	<CRC>
WLC (B2 to S/T I/F)	0010	1001	D000 0011	<CRC>
WLC (D=04H to 7FH)	0010	1111	XXXX XXXX	<CRC>

X: Don't Care D: Data Bit

4.6.3 Cyclic Redundancy Check (CRC) Field

Each message contains a CRC code that is seven bits in length, bits 18 to 24 of the C-Channel message. The CRC code generator polynomial, preset to "1s", is as follows:

$$G(X) = X^{**7} + X^{**6} + X^{**2} + 1$$

The CRC code enables the detection of the following specific types of errors:

a. All 1, 2, and 3 bit errors.

b. All odd numbers of errors

c. All burst errors of up to 7 bits.

SECTION C: ISDN BASIC RATE INTERFACE - DATA LINK LAYER SPECIFICATION

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1.0 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 the 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" is used to indicate 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.

2.0 FRAME STRUCTURE FOR PEER-TO-PEER COMMUNICATION

2.1 GENERAL

All data link layer peer-to-peer exchanges are in frames conforming to one of the formats shown in Figure 1 on page C-4. 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.

2.2 FLAG SEQUENCE

All frames shall start and end with the flag sequence consisting of one 0 bit followed by six 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 defined as the closing flag. The closing flag may also serve as the opening flag of the next frame in some applications. However, all receivers must be able to accommodate receipt of 1 or more consecutive flags. See ISDN User-Network Interfaces: Layer 1 recommendations (I.430 (|4|)) for applicability.

2.3 ADDRESS FIELD

The address field shall consist of two octets as illustrated in Figure 1 on page C-4. 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 Section 3.2.

2.4 CONTROL FIELD

The control field shall consist of one or two octets. Figure 1 on page C-4 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 3.4.

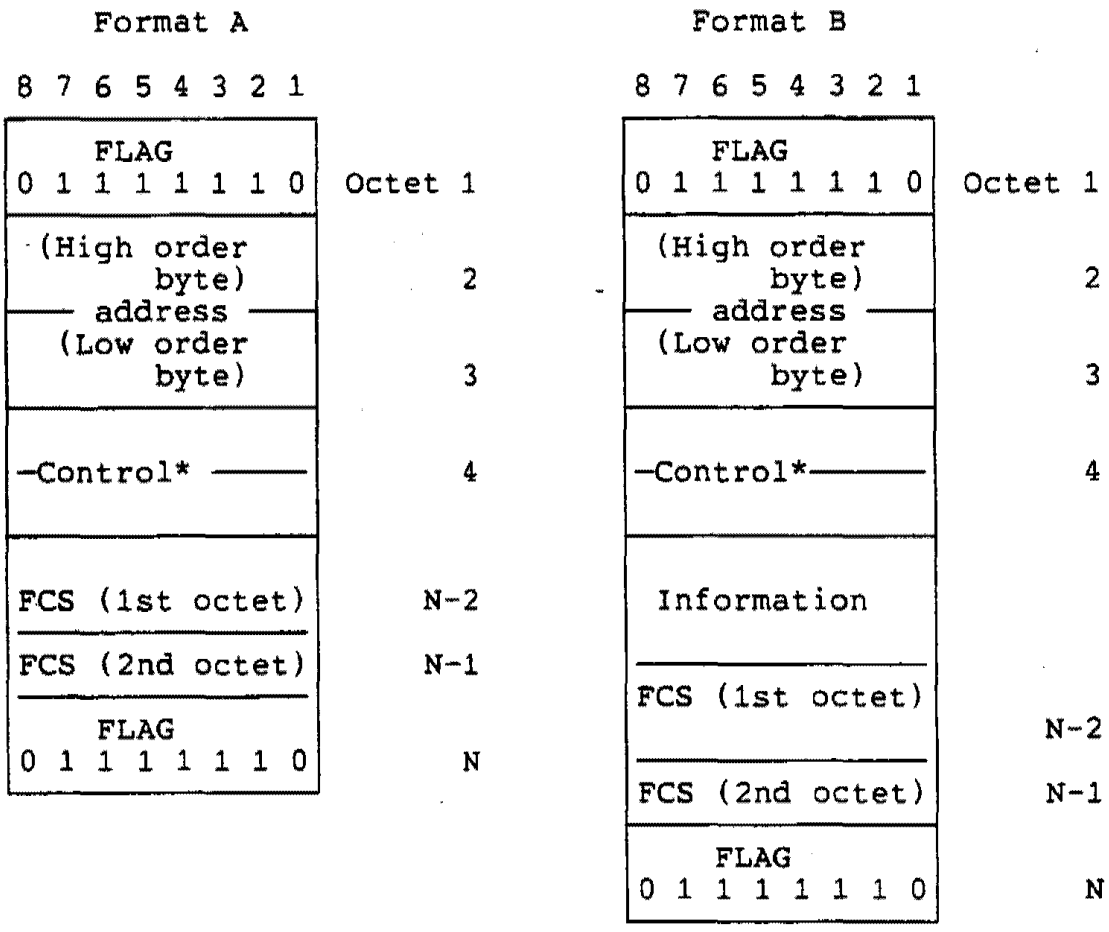
2.5 INFORMATION FIELD

The information field of a frame, when present, follows the control field (see Section 2.4) and precedes the frame check sequence (see Section 2.7). The contents of the information field shall consist of an integral number of octets which 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 5.8.3.

2.6 TRANSPARENCY

A transmitting data link layer entity shall examine the frame content between the opening and closing flag sequences, (address, control, information and FCS fields) and shall insert 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 shall examine the frame contents between the opening and closing flag sequences and shall discard any 0 bit which directly follows five contiguous 1 bits.



* Unacknowledged operation - 1 octet

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

Figure 1. Frame Formats

2.7 FRAME CHECKING SEQUENCE (FCS) FIELD

The FCS field shall be a sixteen-bit sequence. It shall be the ones complement of the sum (modulo 2) of:

a. 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

b. 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 sixteen-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, will be "0001 1101 0000 1111" (x^{15} through x^0, respectively) in the absence of transmission errors.

2.8 FORMAT CONVENTION

2.8.1 Numbering Convention

The basic convention used is illustrated in Figure 2 on page C-6. The bits are grouped into octets. The bits of an octet are shown horizontally and are numbered from 1 to 8. Multiple octets are shown vertically and are numbered from 1 to n.

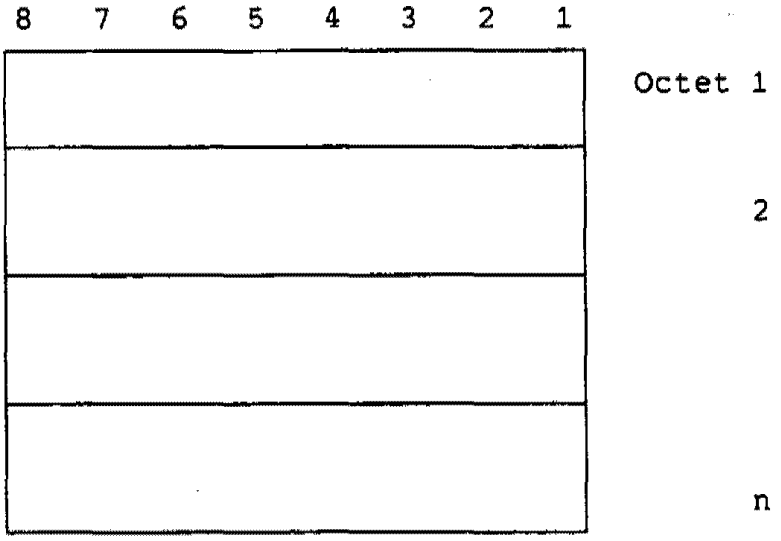


Figure 2. Format Convention

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.

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. Figure 3 on page C-7 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).

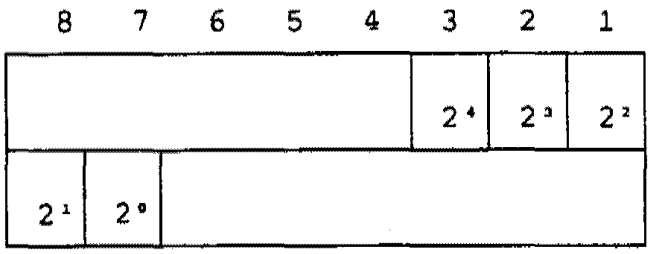


Figure 3. Field Mapping Convention

An exception to the preceding field mapping convention is the data link layer FCS field, which 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 (Figure 4).

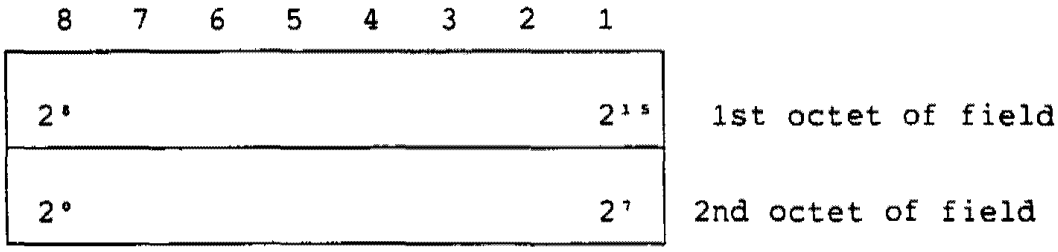


Figure 4. FCS Mapping Convention

2.9 INVALID FRAMES

An invalid frame is a frame which:

a. is not properly bounded by two flags, or

b. 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 contain sequence numbers, or

c. does not consist of an integral number of octets prior to zero bit insertion or following zero bit extractions, or

d. contains a frame check sequence error, or

e. contains a single octet address field, or

f. contains a service access point identifier (see Section 3.3.3) which is not supported by the receiver.

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

2.10 FRAME ABORT

Receipt of seven or more continuous 1 bits shall be interpreted as an abort and the data link layer entity shall ignore the frame currently being received.

3.0 ELEMENTS OF PROCEDURES AND FORMATS OF FIELDS

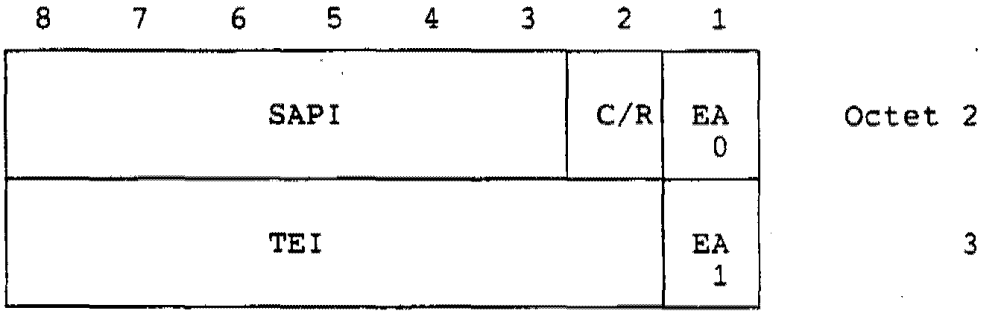
3.1 GENERAL

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

Procedures are derived from these elements of procedures and are described in Section 5.0.

3.2 ADDRESS FIELD FORMAT

The address field format shown in Figure 5 contains the address field extension bits, a command/response indication bit, a data link layer Service Access Point Identifier (SAPI) subfield, and a Terminal Endpoint Identifier (TEI) subfield.



EA = Address field extension bit

C/R = Command/response field bit

SAPI = Service access point identifier

TEI = Terminal endpoint identifier

Figure 5. Address Field Format

3.3 ADDRESS FIELD VARIABLES

3.3.1 Address Field Extension Bit (EA)

The address field range is extended 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 shall have bit 1 of the first octet set to a 0 and bit 1 of the second address octet set to 1.

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 shall send commands with the C/R bit set to 0, and responses with the C/R bit set to 1. The network side shall do 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 Figure 6.

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

Figure 6. C/R Field Bit Usage

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 also a layer 3 or management entity which 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 follows:

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

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 resends 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 (i.e. intra-loop signaling).

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 shall apply in the assignment of these values.

3.3.4.1 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).

3.3.4.2 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 shall be allocated in the following manner:

	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. In order for terminals to use network assigned dynamic TEIs, such terminals are required to support the automatic assignment procedure described in section 5.3.2.

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 which uses either user assigned dynamic TEIs or static TEIs shall not use the the automatic TEI assignment procedure.

For further information regarding point-to-point connections, see Annex C-A.

3.4 CONTROL FIELD FORMATS

The control field identifies the type of frame, which will be either a command or response. The control field will contain sequence numbers where applicable.

Three types of control field formats are specified; numbered information transfer (I format), supervisory function (S format), and unnumbered information transfers and control functions (U format). The control field formats are shown in Figure 7 on page C-15.

Control field bits (Modulo 128)	8	7	6	5	4	3	2	1	
I format	N(S)							0	Octet 4
	N(R)							P	5
S format	X	X	X	X	S	S	0	1	Octet 4
	N(R)							P/F	5
U format	M	M	M	P/F	M	M	1	1	Octet 4

N(S)=Transmitter send sequence number

N(R)=Transmitter receive sequence number

S = Supervisory function bit

M=Modifer function bit

P/F=Poll bit when issued as a command, final bit when issued as a response

X= Reserved and set to 0

Figure 7. Control Field Formats

3.4.1 Information Transfer (I) Format

The I format shall be used to perform an information transfer between layer 3 entities. The functions of N(S), N(R) and P (defined in Section 3.5) are independent; that is each I frame has an N(S) sequence number, and N(R) sequence number which may or may not acknowledge additional I frames received by the data link layer entity, and a P bit that may be set to 0 or 1. The use of N(S), N(R) and P is defined in Section 5.0.

3.4.2 Supervisory (S) Format

The S format shall be used to perform data link supervisory control functions such as; acknowledge I frames, request retransmission of I frames, and 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 which 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.

3.4.3 Unnumbered (U) Format

The U format shall be used to provide additional data link control functions and unnumbered information transfers for unacknowledged information transfer. This format 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.

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.

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. The P bit set to 1 is used by a data link layer entity to solicit (poll) a response frame from the peer data link layer entity. The F bit set to 1 is used by a data link layer entity 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 5.0.

3.5.2 Multiple Frame Operation - Variables and Sequence Numbers

3.5.2.1 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 through 127.

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

3.5.2.2 Send State Variable V(S)

Each point-to-point data link connection endpoint shall have 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) shall be 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 $1 \leq k \leq 127$.

3.5.2.3 Acknowledge State Variables V(A)

Each point-to-point data link connection endpoint shall have an associated V(A) when using I frame commands and supervisory frame commands/responses. The V(A) identifies the last frame that has been 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). The value of V(A) shall be updated by the valid N(R) values received from its peer (see Section 3.5.2.6). A valid N(R) value is one that is in the range $V(A) \leq N(R) \leq V(S)$.

3.5.2.4 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).

3.5.2.5 Receive State Variable V(R)

Each point-to-point data link connection endpoint shall have 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). The value of V(R) shall be incremented by one with the receipt of an error-free, in-sequence I frame whose N(S) equals the V(R).

3.5.2.6 Receive Sequence Number N(R)

All I frames and supervisory frames contain N(R), the expected send sequence number of the next received I frame. At the time that 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.

3.5.3 Unacknowledged Operation Variables and Parameters

No variables are defined. One parameter is defined, N201 (See Section 5.8.3).

3.6 FRAME TYPES

3.6.1 Commands and Responses

The following commands and responses are used by either the user or the network data link layer entities and are represented in Figure 8 on page C-19 and Figure 9 on page C-20. Each data link connection shall support the full set of commands and responses for each application implemented.

Frame types associated with an application which is not implemented shall be discarded and no action shall be taken as a result of that frame.

For purposes of the LAPD procedures in each application, those encodings not identified in Figure 8 on page C-19 or Figure 9 on page C-20 are identified as undefined command and response control fields. The actions to be taken are specified in Section 5.7.5.

The commands and responses in Figure 8 on page C-19 are defined in the following sections:

3.6.2 Information (I) Command

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

Format	Commands	Responses	Encoding 8 7 6 5 4 3 2 1	Octet
I	I (Information)		N(S) 0	4
			N(R) P	5
S	RR (receive ready)	RR	0 0 0 0 0 0 0 1	4
			N(R) P/F	5
	RNR (receive not ready)	RNR	0 0 0 0 0 1 0 1	4
			N(R) P/F	5
	REJ (reject)	REJ	0 0 0 0 1 0 0 1	4
			N(R) P/F	5
U	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

I = Information Transfer S = Supervisory U = Unnumbered

Figure 8. Commands and Responses - Unacknowledged and Multiple Frame Acknowledged Information Transfer Applications

Format	Commands	Responses	Encoding 8	7	6	5	4	3	2	1	Octet
U	XID (Exchange ID)	XID (Exchange ID)	1	0	1	P/F	1	1	1	1	4

U = Unnumbered

Note: The XID frame is not applicable for this specification.

Figure 9. Commands and Responses: Connection Management Application

3.6.3 Set Asynchronous Balanced Mode Extended (SABME) Command

The SABME unnumbered command is used to place 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, the data link layer entity's V(S), V(A), and V(R) shall be cleared (set to zero). The transmission of an SABME command indicates the clearance of all exception conditions.

Previously transmitted I frames that are 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.

3.6.4 Disconnect (DISC) Command

The DISC unnumbered command is used to terminate the multiple frame operation.

No information field is permitted with the DISC command. The data link layer entity receiving the DISC command confirms the acceptance of a DISC command 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 that are 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.

3.6.5 Unnumbered Information (UI) Command

When a layer 3 or management entity requests unacknowledged information transfer, the UI unnumbered command is used to send 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.

3.6.6 Receive Ready (RR) Command/Response

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

a. indicate it is ready to receive an I frame;

b. acknowledge previously received I frames numbered up to and including N(R) - 1 (as defined in Section 5.0); and

c. clear a busy condition that was 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, the RR 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.

3.6.7 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. New I frames pending initial transmission shall be transmitted following the retransmitted 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 retransmission of a REJ response frame is described in Appendix C-I; 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 that was 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.

3.6.8 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.

3.6.9 Unnumbered Acknowledgement (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. No information field is permitted with the UA response. The transmission of the UA response indicates the clearance of any busy condition that was reported by the earlier transmission of an RNR frame by that same data link layer entity.

3.6.10 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 cannot be performed. No information field is permitted with the DM response.

3.6.11 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 retransmission of the identical frame; that is, at least one of the following error conditions, resulting from the receipt of a valid frame:

a. The receipt of a command or response control field that is undefined or not implemented;

b. The receipt of a supervisory or unnumbered frame with incorrect length;

c. The receipt of an invalid N(R), or

d. The receipt of a frame with an information field which exceeds the maximum established length.

An undefined control field is any of the control field encodings not identified in Figure 8 on page C-19 or Figure 9 on page C-20.

A valid N(R) value is one that is in the range $V(A) \leq N(R) \leq V(S)$.

An information field which immediately follows the control field and consists of five octets is returned with this response and provides the reason for the FRMR response. This information field format is given in Figure 10 on page C-25.

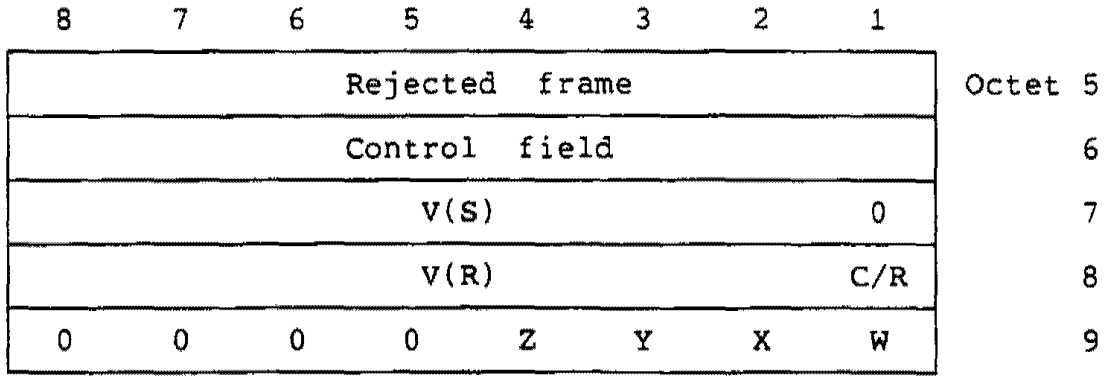


Figure 10. FRMR Information Field Format Extended (Modulo 128) Operation

- Rejected frame control field is the control field of the received frame which 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) is the current send state variable value on the user side or network side reporting the rejection condition.
- C/R is set to 1 if the frame rejected was a response and is set to 0 if the frame rejected was a command.
- V(R) is the current receive state variable value on the user side 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 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 the frame contained an information field which is not permitted with this frame or is a supervisory or 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 side 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).
- Octet 7 bit 1, and Octet 9 bits 5 through 8, shall be set to 0.

4.0 ELEMENTS FOR LAYER-TO-LAYER COMMUNICATION

4.1 GENERAL

Communications between layers and between the data link layer and the management entity, are accomplished by means of primitives.

Primitives 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 which the primitive flows. For this document XX is:

a. DL for communication between layer 3 and the data link layer;

b. PH for communication between the data link layer and the physical layer;

c. MDL for communication between the management entity and the data link layer; or

d. MPH for communication between the management entity and the physical layer.

4.1.1 Generic Names

The generic name specifies the activity that should be performed. Figure 11 on page C-31 illustrates the primitives defined in this document. Note that not all primitives have associated parameters.

The primitive generic names that are defined in this document are:

4.1.1.1 DL-ESTABLISH

The DL-ESTABLISH primitives are used to request, indicate and confirm the outcome of the procedures for establishing multiple frame operation.

4.1.1.2 DL-RELEASE

The DL-RELEASE primitives are used to request, indicate and confirm the outcome of the procedures for terminating a previously established multiple frame operation, or for reporting an unsuccessful establishment attempt.

4.1.1.3 DL-DATA

The DL-DATA primitives are used to request and indicate layer 3 messages which are to be transmitted, or have been received by the data link layer, using the acknowledged information transfer service.

4.1.1.4 DL-UNIT DATA

The DL-UNIT DATA primitives are used to request and indicate layer 3 messages which are to be transmitted, or have been received, by the data link layer using unacknowledged information transfer service.

4.1.1.5 MDL-ASSIGN

The MDL-ASSIGN primitives are 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 (|1|)), across all SAPIs. The MDL-ASSIGN primitive is used by the data link layer to indicate to the layer management entity the need for a TEI value to be associated with the CES specified in the primitive message unit.

4.1.1.6 MDL-REMOVE

The MDL-REMOVE primitives are 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.

4.1.1.7 MDL-ERROR

The MDL-ERROR primitives are used to indicate to the connection management entity that an error has occurred, associated with a previous management function request or detected as a result of communication with the data link layer peer entity, which cannot be corrected by the data link layer. The layer management entity may respond with an MDL-ERROR primitive if the layer management entity cannot obtain a TEI value.

4.1.1.8 MDL-UNIT DATA

The MDL-UNIT DATA primitives are used to request and indicate layer management messages which are to be transmitted, or have been received by the data link layer, using unacknowledged information transfer service.

4.1.1.9 PH-DATA

The PH-DATA primitives are used to request and indicate message units containing frames used for data link layer peer-to-peer communications passed to and from the physical layer.

4.1.1.10 PH-ACTIVATE

The PH-ACTIVATE primitives are used to request activation of the physical layer connection or to indicate that the physical layer connection has been activated.

4.1.1.11 PH-DEACTIVATE

The PH-DEACTIVATE primitive is used to indicate that the physical layer connection has been deactivated.

4.1.1.12 MPH-ACTIVATE

The MPH-ACTIVATE primitive is used to indicate that the physical layer connection has been activated.

4.1.1.13 MPH-DEACTIVATE

The MPH-DEACTIVATE primitives are used to request deactivation of the physical layer connection or to indicate that the physical layer connection has been deactivated. The REQUEST is for use by the network side system management.

4.1.1.14 MPH-INFORMATION

The MPH-INFORMATION primitive is for use by the user side management entity, and provides an indication as to whether the terminal is:

- connected; or
- disconnected or unable to provide sufficient power to support the TEI management procedures.

4.1.2 Primitive Types

The primitive types defined are:

4.1.2.1 REQUEST

The REQUEST primitive type is used when a higher layer or a management entity is requesting a service from the lower layer.

4.1.2.2 INDICATION

The INDICATION primitive type is used by a layer providing a service to inform the higher layer or layer management.

4.1.2.3 RESPONSE

The RESPONSE primitive type is used by layer management as a consequence of the INDICATION primitive type.

4.1.2.4 CONFIRM

The CONFIRM primitive type is used by the layer providing the requested service to confirm that the activity has been completed.

4.1.3 Parameter Definition

4.1.3.1 Priority Indicator

Since several SAPs may exist on the network side 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 is used to determine which message unit will have greater priority when contention exists. The priority indicator is only needed at the user side for distinguishing message units sent by the SAP with a SAPI value of 0, from all other message units.

4.1.3.2 Message Unit

The message unit contains additional layer-to-layer information concerning actions and results associated with requests. In the case of the DATA primitives, the message unit 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 shall be 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.

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
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

Figure 11. Primitives Associated With Layer 2

4.2 PRIMITIVE PROCEDURES

4.2.1 General

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

In the scope of this specification the interactions between layer 3 and the data link layer are specified.

4.2.2 Layer 3 - Data Link Layer Interactions

The states of a data link connection endpoint may be derived 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:

a. Broadcast data link connection endpoint:

- INFORMATION TRANSFER state

b. Point-to-point data link connection endpoint:

- LINK CONNECTION RELEASED state
- AWAITING ESTABLISH state
- AWAITING RELEASE state
- LINK CONNECTION ESTABLISHED state

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

The following defines the constraints on the sequences in which the primitives may occur. 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 diagram, Figure 12 on page C-34. The LINK CONNECTION RELEASED and LINK CONNECTION ESTABLISHED states are stable states whilst the AWAITING ESTABLISH and AWAITING RELEASE states are transition states.

The model illustrates the behavior of layer 2 as seen by layer 3. This model 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 thereby illustrating actions that seem to be in conflict with the actual layer 2 protocol description. In some implementations these 'collisions' could occur.

Notes on Figure 12 on page C-34:

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, this indicates the discard of all the data link service data units representing DL-DATA-REQUESTs.

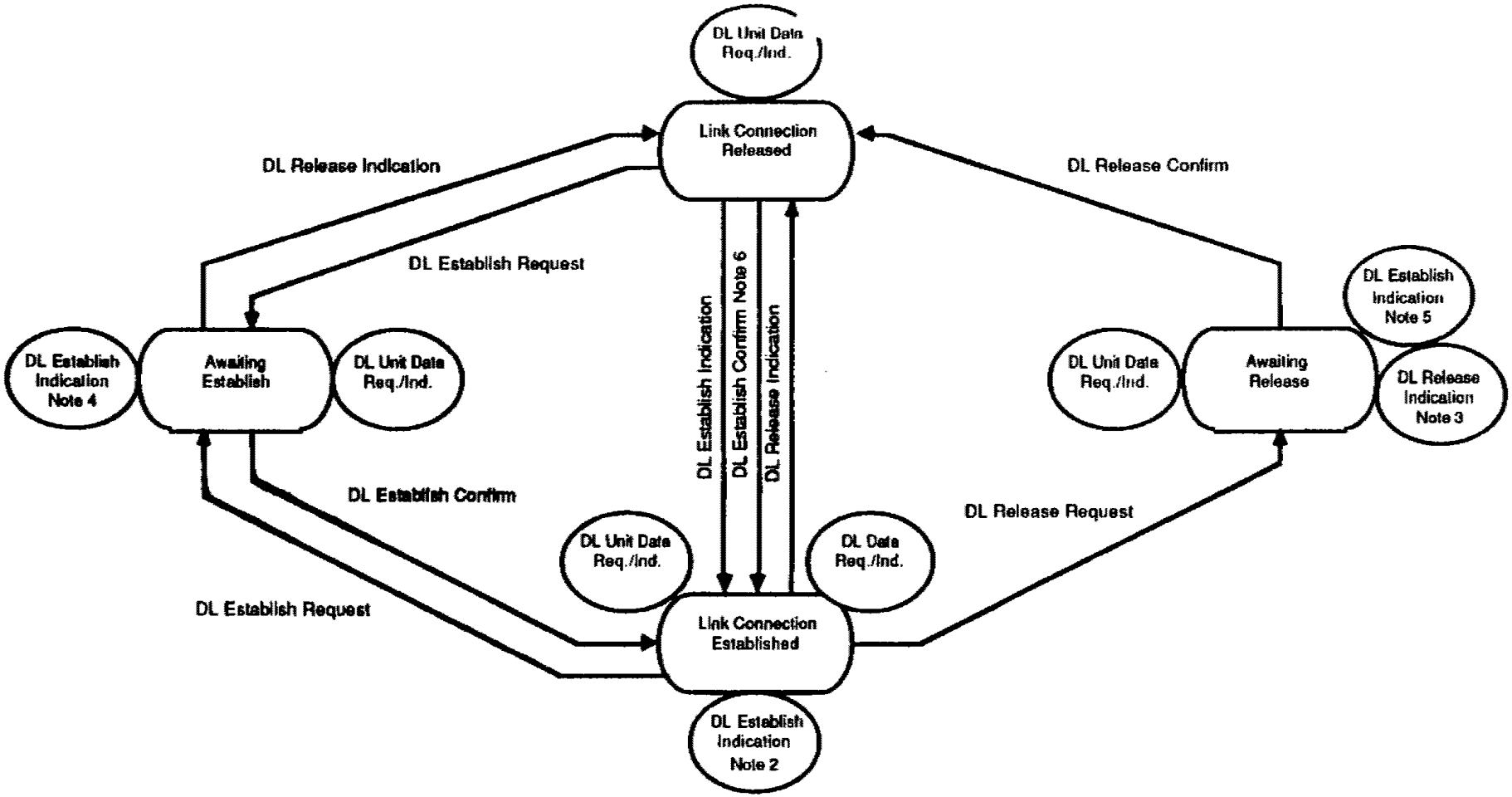
Note 2 - This primitive notifies layer 3 of link re-establishment.

Note 3 - This primitive will occur if a DL-RELEASE-REQUEST collides with a DL-RELEASE-INDICATION.

Note 4 - This primitive will occur if a DL-ESTABLISH-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note 5 - This primitive will occur if a DL-RELEASE-REQUEST collides with a DL-ESTABLISH-INDICATION.

Note 6 - This primitive will occur 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 will establish the link and issue a DL-ESTABLISH-CONFIRM.



State Transition Diagram for Sequences of Primitives at a Point-to-Point Data Link Connection endpoint as seen by Layer 3.

5.0 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) which apply are:

a. for unacknowledged information transfer (Section 5.2)

   UI-command,

b. for multiple frame acknowledged information transfer (Sections 5.4 to 5.7)

   SABME-command
   UA-response
   DM-response
   DISC-command
   RR-command/response
   RNR-command/response
   REJ-command/response
   I-command
   FRMR-response

5.1 PROCEDURE FOR THE USE OF THE P/F BIT

5.1.1 Unacknowledged Information Transfer

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

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, shall set the F bit to 1 in the next response frame it transmits as defined in Figure 13 on page C-36.

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

Figure 13. Immediate Response Operation of P/F Bit.

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.

5.2 PROCEDURES FOR UNACKNOWLEDGED INFORMATION TRANSFER

5.2.1 General

The procedures which apply to the transmission of information in unacknowledged operation are defined below.

No data link layer error recovery procedures are defined for unacknowledged operation.

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. The Layer 3 or management message unit shall be transmitted in a UI command frame.

For broadcast operation, the TEI value in the UI command address field shall be set to 127 (binary 111 1111, the group value).

For point-to-point operation, the appropriate TEI value shall be used.

The P bit shall be set to 0.

In the case of persistent Layer 1 deactivation, the data link layer will be informed by an appropriate indication. Upon receipt of this indication, all UI transmission queues shall be discarded.

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

5.2.3 Receipt of Unacknowledged Information

On receipt of a UI command frame with a SAPI and TEI which are supported by the receiver, the contents of the information field shall be passed to the layer 3 or management entity using 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 the UI command frame shall be discarded.

5.3 TERMINAL ENDPOINT IDENTIFIER (TEI) MANAGEMENT PROCEDURES

5.3.1 General

TEI management is based on the following procedural means:

- TEI Assignment Procedures (see Section 5.3.2)
- TEI Check Procedures (see Section 5.3.3)
- TEI Removal Procedures (see Section 5.3.4)
- optional user equipment initiated TEI Identity Verify Procedures (see Section 5.3.5).

NOTE - Irrespective of the assignment procedures used, the TEI check and TEI removal procedures must be supported by terminals.

A user equipment in the TEI-unassigned state shall use 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:

a. allow automatic TEI equipment to request the network to assign a TEI value that the data link entities within the re-

questing user equipment will use in their subsequent communications;

b. allow a network to remove a previously assigned TEI value from specific or all user equipments;

c. allow a network to check:

   - whether or not a TEI value is in use, or

   - whether multiple TEI assignment has occurred.

d. allow user equipment the option to request that the network invoke TEI check procedures.

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

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

Section 5.3.4.1 includes the actions taken by a data link layer entity receiving a MDL-REMOVE-REQUEST primitive.

Typically, one TEI value would be used by the user equipment (for example, a data link layer entity which has been assigned a TEI value could use that value for all SAPs which it supports). If required, a number of TEI values may be requested by multiple use of the procedures defined in Section 5.3.2. It shall be the responsibility of the user to 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 shall inform the layer management entity using the MDL-ASSIGN-INDICATION primitive. Alternatively, the user side layer management entity may initiate the TEI assignment procedures for its own reasons.

NOTE - In the case of initialization from a no power condition, the user equipment should postpone the start of the TEI assignment procedure until an outgoing call or feature is requested, or an incoming call is received.

For outgoing calls or feature requests, it is recommended that the first time that the user attempts to initiate an outgoing call or

feature request, while the terminal is in the TEI unassigned state, 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, (i.e. TEI values in the range 64-126), or user-assigned (i.e. TEI values in the range 0-63). Terminals that use dynamic TEIs must support the terminal identification procedures described in Section E. 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 (see Section E) 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 primitive, or the MDL-UNIT-DATA-INDICATION primitive, respectively. The data link layer entity shall transmit management entity messages in UI command frames. The SAPI value shall be 63. The TEI value shall be 127.

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, or "static" TEIs datafilled in the network at subscription time, the user side layer management entity shall deliver the TEI value to be used to the data link layer entities via the MDL-ASSIGN-REQUEST primitive. The user side layer management entity shall deliver 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 shall not assign non-automatic TEI values, i.e. TEI values in the range 0 to 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 which 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 shall transmit to its peer a message containing the following elements:

a. message type = Identity request;
b. reference number (Ri); and
c. action indicator (Ai).

The reference number Ri shall be used to differentiate between a number of user equipments which may simultaneously request assignment of a TEI value. The Ri shall be 2 octets in length and shall be randomly generated for each request message by the user equipments.

All values in the range 0 to 65,535 shall be 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 which initiate their TEI assignment procedures simultaneously.

The single octet Action indicator, Ai, shall be used 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.

A timer T202 shall be started.

The ASP, on receipt of the Identity Request message, shall either:

a. select a TEI value;
b. deny Identity requests with Ai values in the range 64-126, and ignore Identity requests with the Ai value in the range 0-63, or
c. 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 cannot guarantee that dual TEI assignments, due to Identity Request messages having the same Ri value, will not occur).

The ASP, after having selected the TEI value, shall inform network data link layer entities by means of the MDL-ASSIGN-REQUEST primitive and transmit to its peer a message containing the following elements:

a. message type = Identity assigned;
b. Reference number (Ri), and
c. the assigned TEI value in the Ai field.

If the available TEI information/resources are exhausted, a TEI check procedure should be initiated.

A user side layer management entity receiving this Identity assigned message shall compare 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 shall either:

- initiate TEI removal, or
- initiate the TEI Identity verify procedures

If there is no match, the user side layer management entity shall:

- compare 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, inform the user side data link layer entities by means of the MDL-ASSIGN-REQUEST primitive and stop timer T202;
- compare the Ri value with any outstanding Identity request message, and if there is no match, do nothing;
- If there is no outstanding identity request, do 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 primitive from the layer management entity, the data link layer entity shall:

- enter the TEI-assigned state, and
- proceed with data link establishment procedures if a DL-ESTABLISH-REQUEST primitive is outstanding, or the transmission of a UI command frame if a DL-UNIT-DATA-REQUEST primitive is outstanding.

To deny an identity request message, the ASP shall transmit to its peer a message containing the following elements:

a. message type = Identity denied;
b. Reference number (Ri); and
c. the value of TEI which is denied in the Ai field (a value of 127 indicates that no TEIs are available).

5.3.2.1 Expiry of Timer T202

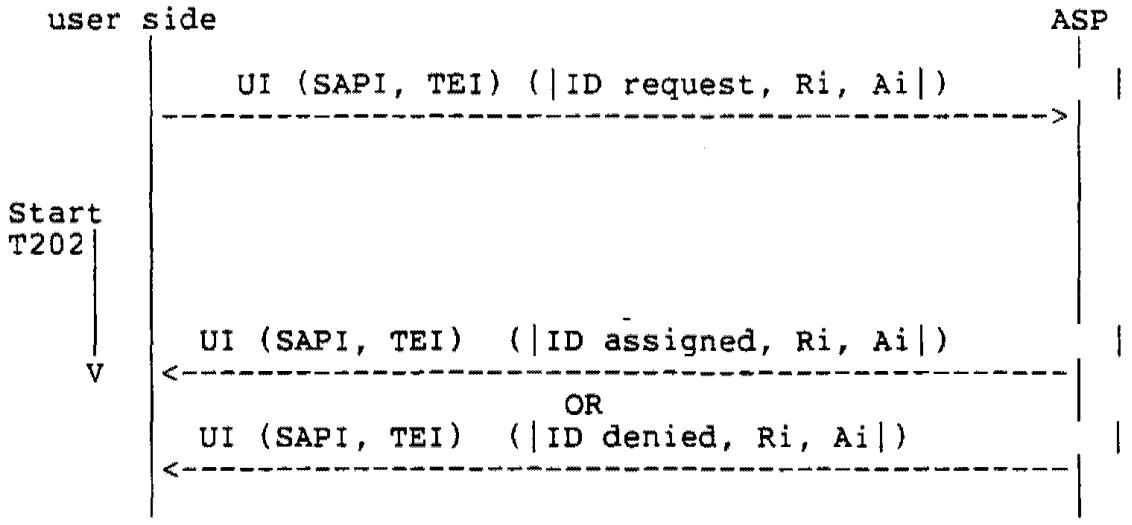
If the user receives either no response or an Identity denied message to its Identity request message, then on expiry of timer T202, the timer shall be restarted and the Identity request message shall be retransmitted with a new value of Ri.

After N202 unsuccessful attempts to acquire a TEI value, the layer management entity shall inform the data link layer entity using the MDL-ERROR-RESPONSE primitive. The data link layer entity receiving MDL-ERROR-RESPONSE primitive shall respond with the DL-RELEASE-INDICATION primitive if a request for establishment had previously occurred, and shall discard all un-serviced DL-UNIT DATA-REQUEST primitives.

After N202 unsuccessful attempts, the TEI assignment procedures should not be restarted until a condition occurs as defined by Section 5.3.1 (e.g. outgoing call request).

The value of T202 and N202 are specified in Section 5.8.

The TEI assignment procedure is illustrated in Figure 14 on page C-43.



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 Figure 17 on page C-51.
Ri : Reference number
() : contents of the data link layer command address field
(||) : contents of the data link layer command information field.

Figure 14. TEI Assignment Procedure

5.3.3 TEI Check Procedure

5.3.3.1 Use of the TEI Check Procedure

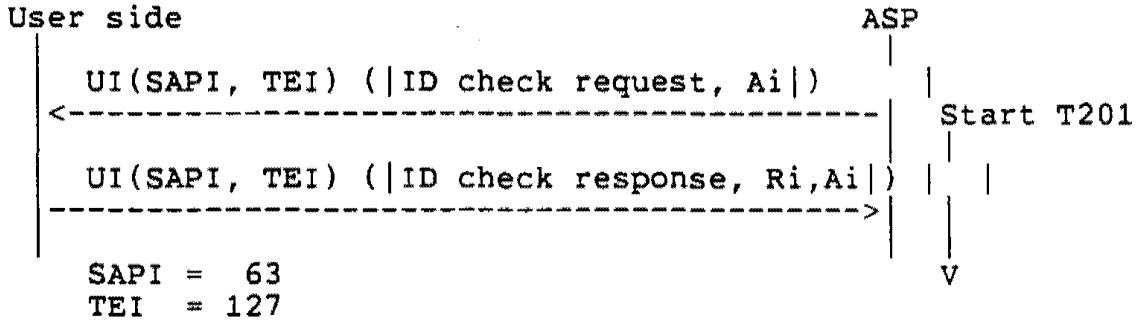
The TEI check procedure shall be used in the TEI audit and recovery procedures. The TEI check procedure allows the network side layer management entity either:-

- to establish that a TEI value is in use; or
- to 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.

5.3.3.2 Operation of the TEI Check Procedure

The check routine procedure is illustrated in Figure 15.



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

Figure 15. TEI Check Procedure

The ASP shall transmit a message containing the following elements:

a. message type = Identity check request, and

b. Ai field which contains the TEI value to be checked or the value 127 when all TEI values are to be checked.

Timer T201 shall be started.

If any user equipment has been assigned the TEI value specified in the Identity check request message, it shall respond by transmitting a message containing the following elements:

a. message type = Identity check response;

b. the TEI value in the Ai field; and

c. Reference number (Ri).

When the TEI check procedure is used to verify multiple-TEI assignment:

- If more than one identity check response is received within T201, then multiple-TEI assignment shall be considered present; otherwise, the request shall be repeated once and T201 restarted;

- If more than one Identity check response is received within the second T201 period, multiple-TEI assignment shall be considered present;

- If no Identity check response is received after both T201 periods, then the TEI value shall be assumed to be free and available for (re)assignment.

- If one Identity check response is received in one or both T201 periods, then the TEI value is assumed to be in use.

When the TEI check procedure is used to test whether a TEI value is in use, it is completed upon the receipt of the first TEI Identity check response message, and the TEI value is assumed to be in use. Otherwise:

- if no Identity check response is received within T201, the Identity check request shall be repeated once and timer T201 restarted;

- if no Identity check response is received after the second Identity check request, the TEI value shall be assumed to be free and available for assignment.

If the Ai value in the Identity check request is equal to 127, it is preferred that the receiving user side layer management entity respond with a single Identity check response message that contains all of the TEI values in use within that user equipment (see Section 5.3.6.5). 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, each Ai variable in the Ai field shall be processed as if received in separate Identity check responses for parallel Identity check requests.

5.3.4 TEI Removal Procedure

When the network side layer management entity determines that the removal of a TEI value (see Section 5.3.4.2) is necessary, the ASP shall transmit a message containing the following elements and issue an MDL-REMOVE-REQUEST primitive:

a. message type = Identity remove, and

b. TEI value which is to be removed, as indicated in the Ai field (the value 127 indicates that all user equipments should remove their TEI values; otherwise, the specific TEI should be removed).

The Identity remove message shall be sent twice in succession, to overcome possible message loss.

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 (see Section 5.3.4.2), it shall instruct the data link layer entity to enter the TEI-unassigned state, using MDL-REMOVE-REQUEST primitive. This action would also be taken for all TEIs when the Ai field contains the group address (127).

Further action to be taken shall be either initiation of automatic TEI assignment for a new TEI value, or 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 5.3.4.1 and after entering the TEI-unassigned state, indicate to its layer management entity (via the MDL-ASSIGN-INDICATION primitive) the need for a TEI value. The layer management entity may then assign (via the MDL-ASSIGN-REQUEST primitive) the same TEI value that was removed previously. The re-assignment of a non-automatic TEI value after TEI removal 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, equipment users will be notified of the error by persistent TEI removals and layer 2 releases. The procedure depends on equipment users to then take corrective action i.e. 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 which case, craftsperson intervention is required to restore the TEI value for use.

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 primitive shall:

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

b. if a DL-RELEASE-REQUEST primitive is outstanding, issue a DL-RELEASE-CONFIRM primitive.

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

5.3.4.2 Conditions for TEI Removal

At the user equipment, automatic TEI values shall be removed and in the case of non-automatic TEI values an appropriate indication shall be made to the user under the following conditions:

- on request from the network by an Identity remove message;
- on receipt of an MPH-INFORMATION-INDICATION (disconnected) primitive;
- 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; or
- optionally on receipt of an Identity assigned message containing a TEI value in the Ai field, which is already in use within the user equipment (see Section 5.3.2).

At the network side, TEIs should be removed:

- following a TEI audit procedure showing that a TEI value is no longer in use or that multiple TEI assignment has occurred; or

- on receipt of an MDL-ERROR-INDICATION primitive, indicating a possible multiple assignment, which may be confirmed by the invocation of the TEI check procedures.

5.3.5 TEI Identity Verify Procedure

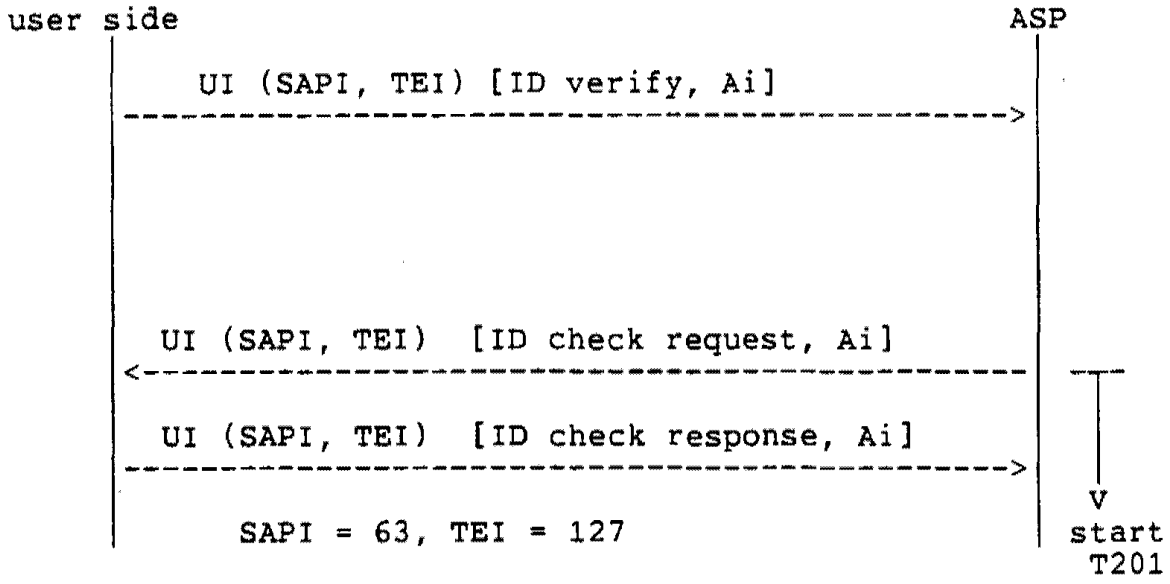
5.3.5.1 General

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

The Identity verify procedure is optional for the user equipment. The network will support this procedure for both automatic and non-automatic TEI values.

5.3.5.2 Operation of the TEI Identity verify procedure

The identity verify procedure is illustrated in Figure 16 on page C-49



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

Figure 16. TEI Identity Verify Procedure.

The user equipment shall transmit an Identity verify message containing the following elements:

a. message type = Identity verify request;

b. the TEI value to be checked in the Ai field; and

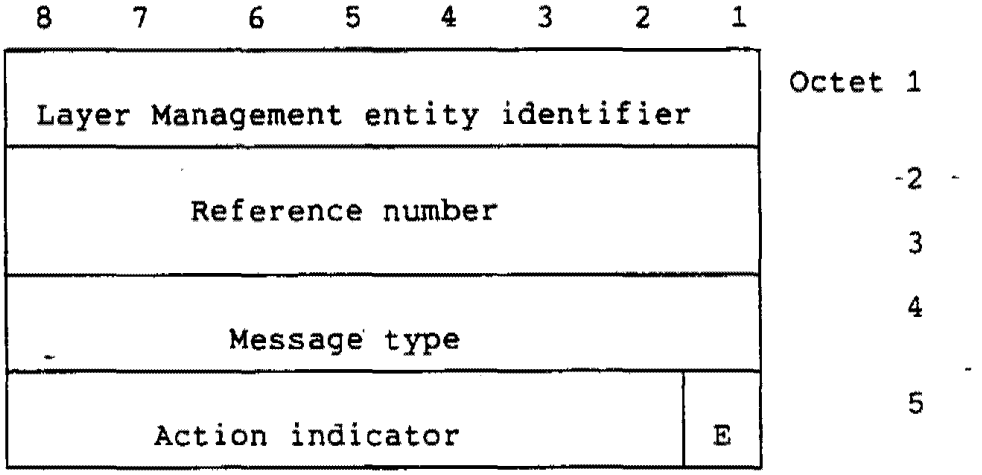
c. the Ri field is not processed by the network and is coded 0.

The ASP, on receipt of the Identity verify message shall, if implemented, invoke the TEI check procedure as defined in Section 5.3.3. This will result in the ASP sending an Identity check request message to the user equipment.

5.3.6 Formats and Codes

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) and TEI value set to 127 (binary 111 1111).



Fields that are not used in a specific message are coded all zeroes and are not to be processed by either side. The coding of each field for the various messages is specified in Figure 17 on page C-51.

E is the Action indication field extension bit (see Section 5.3.6.5).

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

Figure 17. Codes for Messages Concerning TEI Management Procedures

5.3.6.2 Layer Management Entity Identifier

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

5.3.6.3 Reference Number (Ri)

Octets 2 and 3 contain the Ri. When used, it can assume any value between 0 and 65535.

5.3.6.4 Message Type

Octet 4 contains the message type. The purpose of the message type is to identify the function of the message being sent.

5.3.6.5 Action Indicator

The Ai field is extended by reserving the first transmitted bit of the Ai field octets to indicate the final octet in the Ai field.

Ai variables in the Ai field are coded as follows:

a. bit 1 is the extension bit and is coded as follows:

- 0 to indicate an extention, and
- 1 to indicate the final octet;

b. bits 2 to 8 contain the action indicator.

The purpose of the action indicator is to identify the concerned TEI values.

5.4 PROCEDURES FOR ESTABLISHMENT AND RELEASE OF MULTIPLE FRAME OPERATION

5.4.1 Establishment of Multiple Frame Operation

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

5.4.1.1 General

These procedures shall be used to establish multiple frame operation between the network and designated user entity.

Layer 3 will request establishment of the multiple frame operation by the use of the DL-ESTABLISH-REQUEST primitive. Re-establishment may be initiated as a result of the data link layer procedures defined in Section 5.6. All frames other than unnumbered frame formats received during the establishment procedures shall be ignored.

5.4.1.2 Establishment Procedures

A data link layer entity shall initiate a request for the multiple frame operation to be set by transmitting the SABME command. All existing exception conditions shall be cleared, the retransmission counter shall be reset, and timer T200 shall then be started (timer T200 is defined in Section 5.8.1). All Mode setting commands shall be 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.

A data link layer entity receiving a SABME command, if it is able to enter the multiple frame established state, shall:

- respond with a UA response with the F bit set to the same binary value as the P bit in the received SABME command;
- 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 primitive;
- clear all existing exception conditions;
- clear any existing peer receiver busy condition; and
- start timer T203 (timer T203 is defined in Section 5.8.8) if implemented.

If the data link layer entity is unable to enter the multiple-frame-established state, it shall respond to the SABME command with DM response with 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 timer T200;
- start timer T203 if implemented;
- set V(S), V(R), and V(A) to 0; and
- enter the multiple-frame-established state and inform layer 3 using the DL-ESTABLISH-CONFIRM primitive.

Upon reception of a DM response with the F bit set to 1, the originator of the SABME shall indicate this to layer 3 by means of the DL-RELEASE-INDICATION primitive and reset timer T200. It shall then enter the TEI-assigned state. DM responses with F bit set to 0 shall be ignored in this case.

A DL-RELEASE-REQUEST primitive received during data link layer initiated re-establishment shall be serviced on completion of the establishment mode-setting operation.

5.4.1.3 Procedure on Expiry of Timer T200

If timer T200 expires before the UA or DM response with the F bit set to 1 is received, the data link layer entity shall:

- retransmit the SABME command as above;
- restart timer T200, and
- increment the retransmission counter.

After retransmission of the SABME command N200 times, the data link layer entity shall indicate this to layer 3 and the connection management entity by means of the DL-RELEASE-INDICATION and MDL-ERROR-INDICATION primitives, respectively, and enter the TEI-assigned state, after discarding all outstanding DL-DATA-REQUEST primitives and all I frames in the queue.

The value of N200 is defined in Section 5.8.2.

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, I frames and supervisory frames shall be transmitted and received according to the procedures described in Section 5.5.

If an SABME command is received while in the multiple-frame-established state the data link layer entity shall conform to the re-establishment procedure described in Section 5.6.

On receipt of a UI command the procedures defined in Section 5.2 shall be followed.

5.4.3 Termination of Multiple Frame Operation

5.4.3.1 General

These procedures shall be used to terminate the multiple frame operation between the network and a designated user entity.

Layer 3 entity will request for termination of the multiple frame operation by use of the DL-RELEASE-REQUEST primitive.

All frames other than the unnumbered frames received during the release procedures shall be ignored.

All outstanding DL-DATA-REQUEST primitives and all I frames in queue shall be discarded.

In the case of persistent Layer 1 deactivation the data link layer entity shall discard all I queues and deliver to Layer 3 a DL-RELEASE-CONFIRM primitive if a DL-RELEASE-REQUEST primitive is outstanding, or otherwise a DL-RELEASE-INDICATION primitive.

5.4.3.2 Release Procedure

A data link layer entity shall initiate a request for release of the multiple frame operation by transmitting the Disconnect (DISC) command with P bit set to 1. Timer T200 shall then be started and the retransmission counter reset.

A data link layer entity receiving a DISC command while in the multiple-frame-established or timer recovery state shall transmit a UA response with the F bit set to the same binary value as the P bit in the received DISC Command. A DL-RELEASE-INDICATION primitive shall be passed to layer 3 and TEI-assigned state shall be entered.

If the originator of the DISC command receives either;

- a UA response with the F bit set to 1, or

- 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 shall enter the TEI-assigned state and reset timer T200.

The data link layer entity which issued the DISC is now in the TEI-assigned state and will notify layer 3 by means of the DL-RELEASE-CONFIRM primitive. The conditions relating to this state are defined in Section 5.4.4.

5.4.3.3 Procedure of Expiry of Timer T200

If timer T200 expires before a UA or DM response with the F bit set to 1 is received, the originator of the DISC command shall:

- retransmit the DISC command as defined in Section 5.4.3.2
- restart timer T200, and
- increment the retransmission counter.

If the data link layer entity has not received the correct response as defined in Section 5.4.3.2 after N200 attempts to recover, the data link layer entity shall indicate this to the connection management entity by means of the MDL-ERROR-INDICATION primitive, enter the TEI-assigned state, and notify layer 3 by means of the DL-RELEASE-CONFIRM primitive.

5.4.4 TEI-Assigned State

While in the TEI-assigned state:

- the receipt of a DISC command shall result 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 command, the procedures defined in 5.4.1 shall be followed;
- on receipt of an unsolicited DM response with the F bit set to 0, the data link layer entity shall, if it is able to, initiate the establishment procedures by the transmission of an SABME (see Section 5.4.1.2); otherwise, the DM shall be ignored;
- on receipt of UI commands, the procedures defined in Section 5.2 shall be followed;

- on receipt of any unsolicited UA response issue an MDL-ERROR-INDICATION primitive indicating a possible multiple assignment of a TEI value; and

- all other frame types shall be discarded.

5.4.5 Collision of Unnumbered Commands and Responses

5.4.5.1 Identical Transmitted and Received Commands

If the transmitted and received unnumbered commands (SABME or DISC) are the same, the data link layer entities shall send the UA response at the earliest possible opportunity. The indicated state shall be entered after receiving the UA response. The data link layer entities shall notify layer 3, by means of the appropriate confirm primitive.

5.4.5.2 Different Transmitted and Received Commands

If the transmitted and received unnumbered commands (SABME or DISC) are different, the data link layer entities shall issue 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 shall enter the TEI-Assigned state and notify layer 3 by means of the appropriate primitive. The entity receiving the DISC command will issue a DL-RELEASE-INDICATION primitive while the other entity will issue a DL-RELEASE-CONFIRM primitive.

5.4.5.3 Unsolicited DM Response and SABME or DISC Command

When a DM response with the F bit set to 0 is received by a data link layer entity, a collision between a transmitted SABME or DISC command 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.

In order to avoid misinterpretation of the DM response received, a data link layer entity shall always send its SABME or DISC command with the P bit set to 1.

A DM response with the F bit set to 0 colliding with an SABME or DISC shall be ignored.

5.5 PROCEDURES FOR INFORMATION TRANSFER IN MULTIPLE FRAME OPERATION

The procedures which apply to the transmission of I frames are defined below.

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.

5.5.1 Transmitting I Frames

Information received by the data link layer entity from layer 3 by means of DL-DATA-REQUEST primitive shall be transmitted in an I frame. The control field parameters N(S) and N(R) shall be assigned the values of V(S) and V(R), respectively. V(S) shall be incremented by 1 at the end of the transmission of the I frame.

If timer T200 is not running at the time of transmission of an I frame, it shall be started. If timer T200 expires, the procedures defined in Section 5.5.7 shall be followed.

If V(S) is equal to V(A) plus k (where k is the maximum number of outstanding I frames - see Section 5.8.5), the data link layer entity shall not transmit any new I frames, but may retransmit an I frame as a result of the error recovery procedures as described in Sections 5.5.4 and 5.5.7.

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

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

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 receives a valid I frame whose N(S) is equal to the current V(R), the data link layer entity shall:

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

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 shall respond to its peer in one of the following ways:

- if the data link layer entity receiving the I frame is still not in an own receiver busy condition, it shall send an RR response with the F bit set to 1.

- if the data link layer entity receiving the I frame enters the own receiver busy condition upon receipt of the I frame, it shall send an RNR response with the F bit set to 1.

5.5.2.2 P Bit Set to 0,

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

a. If the data link layer entity is still not in an own receiver busy condition:

   - 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 shall transmit an RR response with the F bit set to 0, or

   - if an I frame is available for transmission and no peer receiver busy condition exists, the data link layer entity shall transmit the I frame with the value of N(R) set to the current value of V(R) as defined in Section 5.5.1, or

b. if on receipt of this I frame the data link layer entity is now in an own receiver busy condition, it shall transmit an RNR response with the F bit set to 0.

When the data link layer entity is in an own receiver busy condition, it shall process any received I frame according to Section 5.5.6.

5.5.3 Sending and Receiving Acknowledgements

5.5.3.1 Sending Acknowledgements

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

5.5.3.2 Receiving Acknowledgement

On receipt of a valid I frame or supervisory frame (RR, RNR or REJ), even in the own receiver busy or timer recovery condition, the data link layer entity shall treat the N(R) contained in this frame as an acknowledgement for all the I frames it has transmitted with an N(S) up to and including the received N(R) - 1. V(A) shall be set to N(R). The data link layer entity shall reset the timer T200 on receipt of a valid I frame or supervisory frame with the N(R) higher than V(A) (actually acknowledging some I frames), or an REJ with an N(R) equal to V(A).

NOTE 1: If a supervisory frame with the P bit set to 1 has been transmitted and not acknowledged, timer T200 shall not be reset.

NOTE 2: Upon receipt of a valid I frame, timer T200 shall not be reset if the data link layer entity is in the peer receiver busy condition.

If timer T200 has been 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 shall restart timer T200. If timer T200 then expires, the data link layer entity shall follow the recovery procedure as defined in Section 5.5.7 with respect to the unacknowledged I frames.

If timer T200 has been reset by the receipt of an REJ frame, the data link layer entity shall follow the retransmission procedures in Section 5.5.4.

5.5.4 Receiving REJ Frames

On receipt of a valid REJ frame, the data link layer entity shall act as follows:

a. if it is not in the timer recovery condition:

- clear an existing peer receiver busy condition;

- set its V(S) and its V(A) to the value of the N(R) contained in the REJ frame control field;
- stop timer T200;
- start timer T203, if implemented;
- if it was an REJ command frame with the p-bit set to 1, transmit an appropriate supervisory response frame (see note 2, Section 5.5.5) with the F-bit set to 1;
- transmit the corresponding I frame as soon as possible, as defined in Section 5.5.1, taking into account the items 1) to 3) below and the paragraph following items 1) to 3), and
- notify a protocol violation to the connection management entity by means of the MDL-ERROR-INDICATION primitive, if it was a REJ response frame with the F bit set to 1.

b. if 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 timer T200;
- start timer T203, if implemented;
- enter the multiple-frame-established state, and
- transmit the corresponding I frame as soon as possible, as defined in Section 5.5.1, taking into account the items 1) to 3) below and the paragraph following items 1) to 3).

c. if 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, and
- 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 5.5.5).

Transmission of I frames shall take account of the following:

1. if the data link layer entity is transmitting a supervisory frame when it receives the REJ frame, it shall complete that transmission before commencing transmission of the requested I frame;

2. if the data link layer entity is transmitting an SABME or DISC command, a UA response or a DM response when it receives the REJ frame, it shall ignore the request for retransmission; and

3. if the data link layer is not transmitting a frame when the REJ is received, it shall immediately commence transmission of the requested I frame.

All outstanding unacknowledged I frames, commencing with the I frame identified in the received REJ frame shall be transmitted. Other I frames not yet transmitted may be transmitted following the retransmitted I frames.

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 shall set a peer receiver busy condition and then:

- if it was an RNR command with the P bit set to 1 it shall respond with an RR response with the F bit set to 1 if the data link layer entity is not in an own receiver busy condition, and shall respond with an RNR response with the F bit set to 1 if the data link layer entity is in an own receiver busy condition, and

- if it was an RNR response with the F bit set to 1, an existing timer recovery condition shall be cleared and the N(R) contained in the RNR response shall be used to update V(S).

The data link layer entity shall take note of the peer receiver busy condition and not transmit any I frames to the peer which has indicated the busy condition.

Note 1. The N(R) in any RR or RNR command frame irrespective of the setting of the P bit will not be used to update the V(S).

The data link layer entity shall then:

- treat the N(R) contained in the received RNR frame as an acknowledgement for all the I frames that have been

(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 frame; and

- restart timer T200 unless a supervisory response frame with the F bit set to 1 is still expected.

If timer T200 expires, the data link layer entity shall:

- if it is not yet in a timer recovery condition enter the timer recovery condition, and reset the retransmission count variable, or

- if it is already in a timer recovery condition, add one to its retransmission count variable.

The data link layer entity shall then:

a. If the value of the retransmission count variable is less than N200:

   - transmit an appropriate supervisory command (see note 2) with a P bit set to 1;

   - restart timer T200; and

b. if the value of the retransmission count variable is equal to N200, initiate a re-establishment procedure as described in Section 5.6, and indicate this by means of the MDL-ERROR-INDICATION primitive to the connection management entity.

The data link layer entity receiving the supervisory frame with the P bit set to 1 shall respond, 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 shall reset timer T200, and:

- if the response is an RR or REJ response, the peer receiver busy condition is cleared and the data link entity may transmit new I frames or retransmit I frames as defined in Section 5.5.1 or 5.5.4 respectively; or

- if the response is an RNR response, the data link layer entity receiving the response shall proceed according to this Section 5.5.5, first paragraph.

If a supervisory command (RR, RNR, or REJ) with the P bit set to 0 or 1, or a supervisory response frame (RR, RNR, or REJ) with the F bit set to 0 is received during the enquiry process, the data link layer 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 below) with the F bit set to 1. However, the transmission or retransmission of I frames shall not be undertaken until the appropriate supervisory response frame with the F bit set to 1 is received or until the expiry of timer T200; or

- 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 RNR command with the P bit set to 1, transmit the appropriate supervisory response frame (see note 2) with the F bit set to 1.

Upon receipt of an SABME command the data link layer entity shall clear the peer receiver busy condition.

Note 2: If the data link layer entity is not in an own receiver busy condition and is in a Reject exception condition (i.e. N(S) sequence error has been received, and a REJ frame has been transmitted, but the requested I frame has not been 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, (i.e. 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.

5.5.6 Data Link Layer Own Receiver Busy Condition

When the data link layer entity enters an own receiver busy condition, it shall transmit an RNR frame at the earliest opportunity.

The RNR frame may either be sent as:

- an RNR response with the F bit set to 0; or

- an 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; or

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

All received I frames with the P bit set to 0 shall be discarded, after updating the V(A).

All received supervisory frames with the P/F bit set to 0 shall be processed, including updating the V(A).

All received I frames with the P bit set to 1 shall be discarded, after updating the V(A). However, an RNR response frame with the F bit set to 1 shall be transmitted.

All received supervisory frames with the P bit set to 1 shall be processed including updating the V(A). An RNR response with the F bit set to 1 shall be transmitted.

To indicate to the peer data link layer entity the clearance of the own receiver busy condition, the data link layer entity shall transmit an RR frame or, 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).

The 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.

5.5.7 Waiting Acknowledgement

The data link layer entity shall maintain an internal retransmission count variable.

If timer T200 expires the data link layer 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 retransmission count variable.

The data link layer entity shall then:

a. if the value of the retransmission count variable is less than N200:

- restart timer T200, and either
- transmit an appropriate supervisory command (see Note 2 in Section 5.5.5) with the P bit set to 1, or
- retransmit the last transmitted I frame (V(S)-1) with the P bit set to 1, or

b. If the value of the retransmission count variable is equal to N200, initiate a re-establishment procedure as defined in 5.6 and indicate this by means of the MDL-ERROR-INDICATION primitive 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, it shall set its V(S) to the value of the received N(R). Timer T200 shall be reset if the received supervisory frame response is an RR or REJ response and then, the data link layer entity shall resume with I frame transmission or retransmission, as appropriate. Timer T200 shall be reset and restarted if the received supervisory response is an RNR response, to proceed with the enquiry process according to Section 5.5.5.

5.6 RE-ESTABLISHMENT OF MULTIPLE FRAME OPERATION

5.6.1 Criteria for Re-Establishment

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

- the receipt, while in the multiple-frame mode of operation, of an SABME;
- the receipt of a DL-ESTABLISH-REQUEST primitive from layer 3 (see 5.4.1.1);
- the occurrence of N200 retransmission failures while in the timer recovery condition (see Section 5.7.3);
- the occurrence of a frame rejection condition as identified in Section 5.7.5;
- the receipt, while in the multiple-frame mode of operation, of an FRMR response frame (see Section 5.7.6);

- the receipt, while in the multiple-frame mode of operation, of an unsolicited DM response with the F bit set to 0, see Section 5.7.7;

- the receipt, while in the timer-recovery condition, of an unsolicited DM response with the F bit set to 1.

5.6.2 Procedures

In all re-establishment situations, the data link layer entity shall follow the procedures defined in Section 5.4.1. All locally generated conditions for re-establishment will cause the transmission of the SABME.

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

- issue an MDL-ERROR-INDICATION primitive to the connection management entity;

- if V(S) > V(A) prior to re-establishment issue a DL-ESTABLISH-INDICATION primitive to layer 3, and discard all I queues.

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

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 which are available to effect recovery following the detection of an exception condition at the data link layer are defined in this Section.

The actions to be taken by the connection management entity on receipt of an MDL-ERROR-INDICATION primitive are defined in Appendix C-II.

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 which contains an N(S) value which

is not equal to the V(R) at the receiver. The information field of an I frame whose N(S) does not equal the V(R) shall be discarded.

The receiver shall not acknowledge (nor increment its V(R)) the I frame causing the sequence error, nor any I frames which may follow, until an I-frame with the correct N(S) is received.

A data link layer entity which receives one or more I frames having sequence errors but otherwise error-free, or subsequent supervisory frames (RR, RNR and REJ), shall use 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 acknowledgement 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 retransmitted 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 (retransmission) following the detection of the first N(S) sequence error.

Only one REJ exception condition for a given direction of information transfer shall be established at a time.

A data link layer entity receiving REJ command or response shall initiate sequential transmission (retransmission) 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 is received or when an SABME or DISC command is received.

An optional procedure for the retransmission of a REJ response frame is described in Appendix C-I; however, this procedure will not be applicable for this specification.

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 which contains an invalid N(R) value.

A valid N(R) is one that is in the range $V(A) \leq N(R) \leq V(S)$.

The information field contained in an I frame which is correct in sequence and format may be delivered to layer 3 by means of the DL-DATA-INDICATION primitive.

The data link layer entity shall inform the connection management entity of this exception condition by means of the MDL-ERROR-INDICATION primitive, and initiate re-establishment according to 5.7.2.

5.7.3 Timer Recovery Condition

If a data link layer entity, due to a transmission error, does not receive a single I frame or 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.

The data link layer entity which transmitted the unacknowledged I frame(s) shall, on the expiry of timer T200, take appropriate recovery action as defined in Section 5.5.7 to determine at which I frame retransmission must begin.

5.7.4 Invalid Frame Condition

Any frame received which is invalid (as defined in Sections 2.9 and 3.6.1) shall be discarded, and no action shall be taken as a result of that frame.

5.7.5 Frame Rejection Condition

A frame rejection condition results from one of the conditions described in Sections 3.6.1(third paragraph) and 3.6.11 items b, c and d.

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

- issue an MDL-ERROR-INDICATION primitive; and
- initiate re-establishment (see Section 5.6).

NOTE: For satisfactory operation, it is essential that a receiver is able to discriminate between invalid frames, as defined in Section 2.9, and I frames with an information field which exceeds the maximum established length (see Section 3.6.11 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.

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 primitive; and
- initiate re-establishment (see 5.6).

5.7.7 Unsolicited Response Frames

The action to be taken on the receipt of an unsolicited response frame is defined in Figure 18 on page C-71.

The data link layer entity shall assume possible multiple-TEI assignment on the receipt of an unsolicited UA response and shall inform the layer management.

Unsol. Rsp	TEI Assigned	Awaiting Establishment	Awaiting Release	Multiple frame modes of operation	
				Estab-lished Mode	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

Figure 18. Action on receipt of unsolicited response frames

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

5.7.8 Multiple Assignment of a TEI Value

A data link layer entity shall assume multiple assignment of a TEI value and initiate recovery as specified below by:

a. the receipt of a UA response frame whilst in the multiple-frame-established state;

b. the receipt of a UA response frame whilst in the timer recovery state,

c. the receipt of a UA response frame whilst in the TEI-assigned state.

A data link layer entity, after assuming multiple assignment of a TEI value shall inform the management entity by means of the MDL-ERROR-INDICATION primitive.

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 that the value defined should be used 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.

5.8.1 Timer T200

The default value for timer T200 at the end of which retransmission of a frame may be initiated according to the procedures described in Section 5.5 shall be one second.

NOTE 1 - The proper operation of the procedure requires that timer T200 be greater than the maximum time between transmission of command frames and the reception of their corresponding response or acknowledgement frames.

NOTE 2 - When an implementation includes multiple terminals on the user side together with a satellite connection in the transmission path a value of T200 greater than 1 second may be necessary.

5.8.2 Maximum Number Retransmissions (N200)

The maximum number of retransmissions of a frame (N200) is a system parameter. The default value of N200 shall be 3.

5.8.3 Maximum Number of Octets in an Information Field (N201)

The maximum number of octets in an information field (N201) is a system parameter. (see also Section 2.5).

The default value shall be 260 octets.

5.8.4 Maximum Number of Transmissions of an Identity Request Message (N202)

The maximum number of transmissions of an Identity Request message (when the user requests a TEI) is a system parameter. The default value of N202 shall be 3.

5.8.5 Maximum Number of Outstanding Frames (k)

The maximum number (k) of sequentially numbered I frames that may be outstanding (that is, unacknowledged) at any given time is a system parameter which shall not exceed 127.

- For an SAP supporting basic access (16 kbps) signalling, the default value shall be 1.
- For an SAP supporting basic rate (16 kbps) packet information, the default value shall be 3.
- For all SAPs in the primary rate interface (64 kbps), the default value shall be 7.

5.8.6 Timer T201

The minimum time between retransmission of the TEI Identity check messages (T201) is a system parameter which shall be set to T200 seconds.

5.8.7 Timer T202

The minimum time between the transmission of TEI Identity request messages is a system parameter (T202) which shall be set to 2 seconds.

5.8.8 Timer T203

Timer T203 represents the maximum time allowed without frames being exchanged.

The default value of timer T203 shall be 10 seconds.

5.9 DATA LINK LAYER MONITOR FUNCTION

5.9.1 Introduction

The procedural elements defined in 5.0 allow for the supervision of the data link layer resource. This sub-section describes procedures which may be used to provide this supervision function.

5.9.2 Data Link Layer Supervision in the Multiple-Frame-Established State

The procedures herein propose a solution which is already identified in the HDLC classes of procedures. The connection verification is a service provided by data link layer to layer 3. This implies that layer 3 is informed in case of a failure only. 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 timer T203, and operates in the multiple-frame-established state as follows.

If there are no frames 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 a faulty data link connection condition, or a user equipment having been unplugged. Timer T203 represents the maximum time allowed without frames being exchanged.

If timer T203 expires, a supervisory command with a P bit set to 1 is transmitted. Such a procedure is protected against transmission errors by making use of the normal timer T200 procedure including retransmission count and N200 attempts.

5.9.3 Connection Verification Procedures

5.9.3.1 Start Timer T203

The timer T203 is started

- when the multiple-frame-established state is entered; and
- in the multiple-frame-established state whenever timer T200 is stopped.

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

5.9.3.2 Stop of Timer T203

The timer T203 is stopped

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

Note - These two conditions mean that timer T203 is only started whenever T200 is stopped and not restarted.

5.9.3.3 EXPIRY OF TIMER T203

If timer T203 expires, the data link layer entity will act as follows (it should be noted that timer T200 is neither running nor expired):

1. set the transmission count variable to 0
2. enter timer recovery state
3. transmit 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; or
   - if there is a receiver busy condition (own receiver busy), transmit an RNR command; and
4. start timer T200; and

5. send MDL-ERROR-INDICATION primitive to connection management after N200 retransmissions.

NOTE - Timer T203 may not be needed at the user side.

REFERENCES

1. CCITT Recommendation Q.920(I.440), "ISDN user-network interface data link layer - general aspects"

2. CCITT Recommendation Q.930(I.450), "ISDN user-network interface layer 3-general aspects"

3. CCITT Recommendation Q.931(I.451), "ISDN user-network interface layer 3 specification"

4. CCITT Recommendation I.430, "Basic user-network interface layer 1 specification"

5. CCITT Recommendation I.431, "Primary rate user-network interface layer 1 specification"

6. 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 circuit"

7. CCITT Recommendation Q.921 (I.441), "ISDN user-network interface - Data link layer specification".

8. ANSI T1.602 (1988), "ISDN Signaling Specification - (LAPD) Layer 2".

ABBREVIATIONS

Abbreviation	Meaning
Ai	Action indicator
ASP	Assignment Source Point
CEI	Connection Endpoint Identifier
CES	Connection Endpoint Suffix
C/R	Command/Response field bit
DISC	Disconnect
DL	Communication Between layer 3 and Data Link Layer
DLCI	Data Link Connection Identifier
DM	Disconnect Mode
EA	Extended Address field bit
ET	Exchange Termination
FCS	Frame Check Sequence
FRMR	FRaMe Reject
I	Information
ID	Identity
ISDN	Integrated Services Digital Network
L3	Layer 3
L2	Layer 2
L1	Layer 1
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D-channel
M	Modifier function bit
MDL	Communication Between Management entity and Data Link Layer
MPH	Communication Between System Management and Physical Layer
N(R)	Receive Sequence Number.
N(S)	Send Sequence Number
P/F	Poll/Final bit
PH	Communication Between Data Link layer and PHysical Layer
RC	Retransmission Counter
REJ	REJect
Ri	Reference number
RNR	Receive Not Ready
RR	Receive Ready
S	Supervisory
S	Supervisory function bit
SABME	Set Asynchronous Balanced Mode Extended
SAP	Service Access Point
SAPI	Service Access Point Identifier
TE	Terminal Equipment
TEI	Terminal Endpoint Identifier
U	Unnumbered
UA	Unnumbered Acknowledgement
UI	Unnumbered Information

V(A)	Acknowledged State Variable
V(M)	Recovery State Variable
V(R)	Receive State Variable
V(S)	Send State Variable

Appendix C-I: RETRANSMISSION OF REJ RESPONSE FRAMES

1. Introduction

This option is not applicable in this specification.

This Appendix describes an optional procedure which may be used to provide a reject retransmission procedure.

2. Procedure

This optional reject retransmission procedure can supplement the Q.921 LAPD protocol by defining a new variable for multiple frame operation (Section 3.5.2), and by modifying the N(S) sequence error exception condition reporting and recovery (Section 5.7.1).

2.1 Recovery State Variable V(M)

Each point-to-point data link entity may have an associated V(M) when using I frame commands and supervisory frame commands/responses. The V(M) denotes the sequence number of the last frame received which caused an N(S) sequence error condition. The V(M) can take on the value 0 to 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.

2.2 N(S) Sequence Error Supplementary Procedure

The first three paragraphs of Section 5.7.1, N(S) sequence error, apply. The remainder of the Section is as follows:

The REJ frame is used by a receiving data link layer entity to initiate an exception recovery (retransmission) following the detection of an N(S) sequence error. The receiving data link entity shall set V(M), to the N(S) sequence number which caused the N(S) sequence error condition.

Only one REJ exception condition for a given direction of information transfer shall be established at a time (i.e. 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 shall initiate sequential transmission (retransmission) 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.

If an N(S) sequence error exception occurs when the receiving data link entity is in the REJ exception condition, then check the N(S) of the received frame to see if the data link entity which received the REJ frame has retransmitted in response to the REJ frame (i.e., 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, then send another REJ response frame, issue an MDL-ERROR-INDICATION primitive to the connection management entity, and set V(M) equal to N(S). The transmitting side will not need to wait for timer T200 to expire before it can retransmit the lost frame.

If a N(S) sequence error occurs when the receiving data link layer entity is in the REJ exception condition, and it cannot be determined if the data link entity which received the REJ frame has retransmitted in response to that frame (i.e. if $N(S)>V(M)$), then set V(M) equal to the N(S) of the received frame.

Appendix C-II: OCCURENCE OF MDL-ERROR-INDICATION WITHIN THE BASIC STATES AND ACTIONS TO BE TAKEN BY THE MANAGEMENT ENTITY

1. Introduction

Figure 19 on page C-84 and Figure 20 on page C-85 give the error situations in which the MDL-ERROR-INDICATION primitive will be 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 that describes the unique error conditions. Figure 19 on page C-84 and Figure 20 on page C-85 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 Appendix does not incorporate the Retransmission of REJ Response frames described in Appendix C-I.

Layout of Figure 19 on page C-84 and Figure 20 on page C-85:

The "ERROR CODE" column gives the identification value of each error situation to be included as a parameter with the MDL-ERROR-INDICATION primitive.

The column entitled "ERROR CONDITION" together with the "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 primitive is generated.

For a given error condition, the column entitled "NETWORK MANAGEMENT ACTION" describes the preferred action to be taken by the Network Management entity.

The column entitled "USER MANAGEMENT ACTION" describes the preferred action to be taken by the User Side Management entity on a given error condition.

2. Preferred Management Actions

The various preferred Management Actions on an error situation may be described as one of the following:

a. ERROR LOG

This suggests that 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.

b. TEI CHECK

This means that the network side layer management entity invokes the TEI check procedure.

c. TEI VERIFY

This means that 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.

d. TEI REMOVE

This means that the user side layer management entity may directly remove its TEI value from service.

In most of the described error situations, there is either no action to be taken on the user side layer management or the action to be taken is implementation dependent, as Figure 19 on page C-84 and Figure 20 on page C-85 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, the layer management has to take into account that the data link layer will have initiated a recovery procedure.

ERROR CODE	ERROR CONDITION	AFFECTED* STATES	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	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

* For the description of the affected states, see Annex C-C.

Figure 19. Management Entity Actions for MDL-ERROR-INDICATIONs - PART I.

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

* For the description of the affected states, see Annex C-C.

** According to Section 5.7.5, this error code will never be generated.

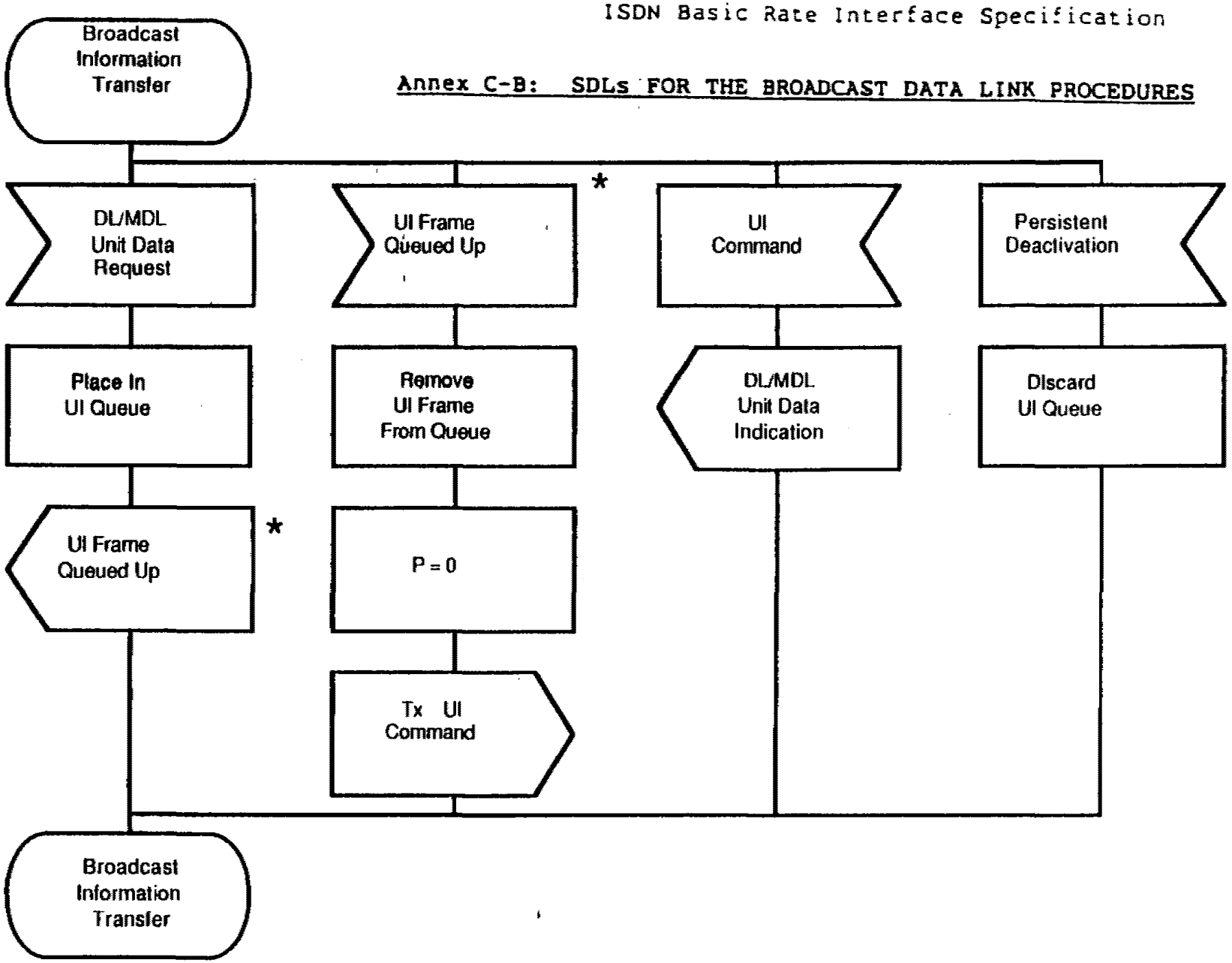
Figure 20. Management Entity Actions for MDL-ERROR-INDICATIONs - PART II.

Annex C-A: PROVISION OF POINT-TO-POINT SIGNALLING CONNECTIONS

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.

Annex C-B: SDLs FOR THE BROADCAST DATA LINK PROCEDURES



Annex C-C: SDLs FOR THE POINT-TO-POINT DATA LINK PROCEDURES

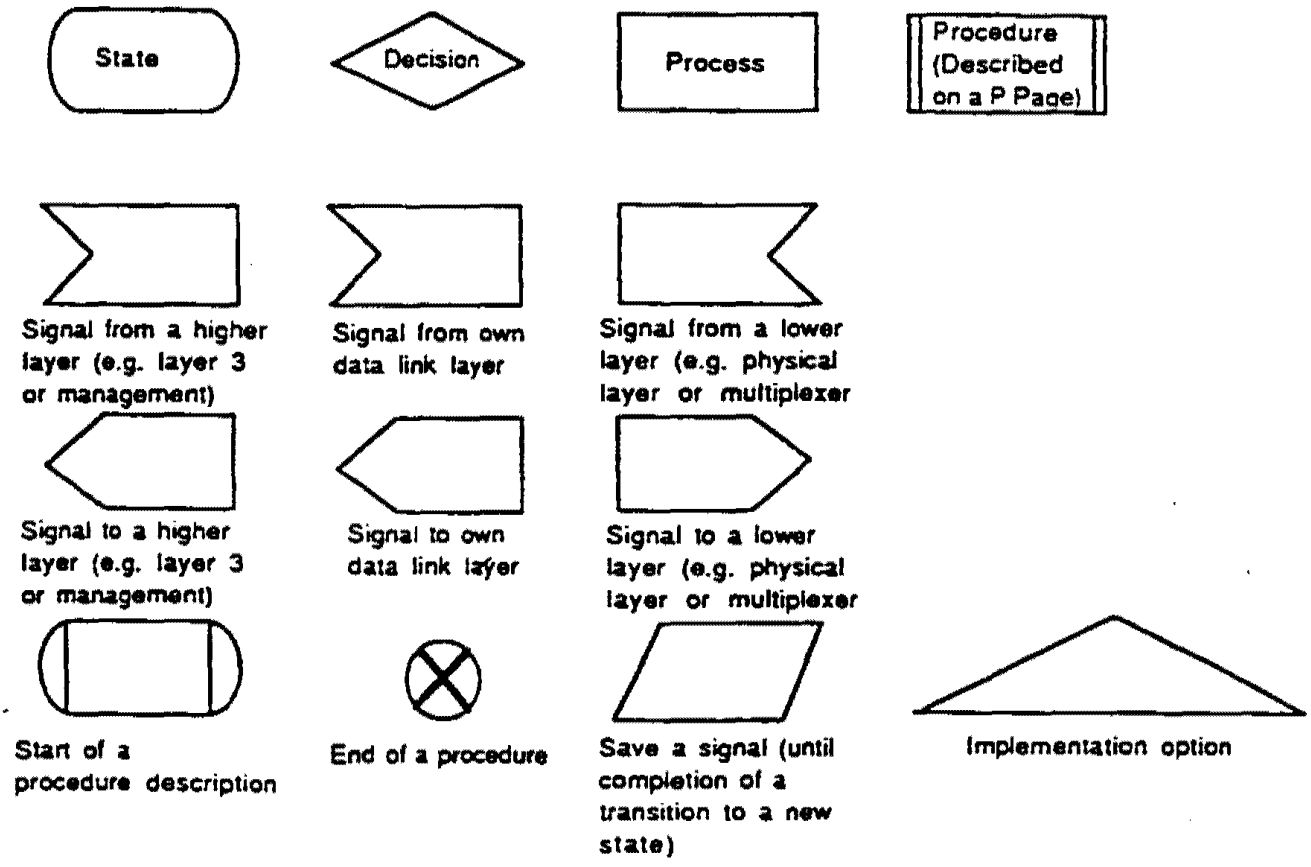
The purpose of this annex is to provide one example of an SDL representation of the point to point procedures of the data link layer, to assist in the understanding of the data link layer. This representation does not describe all of the possible actions of the data link layer entity. In particular, 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.

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 in order 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:

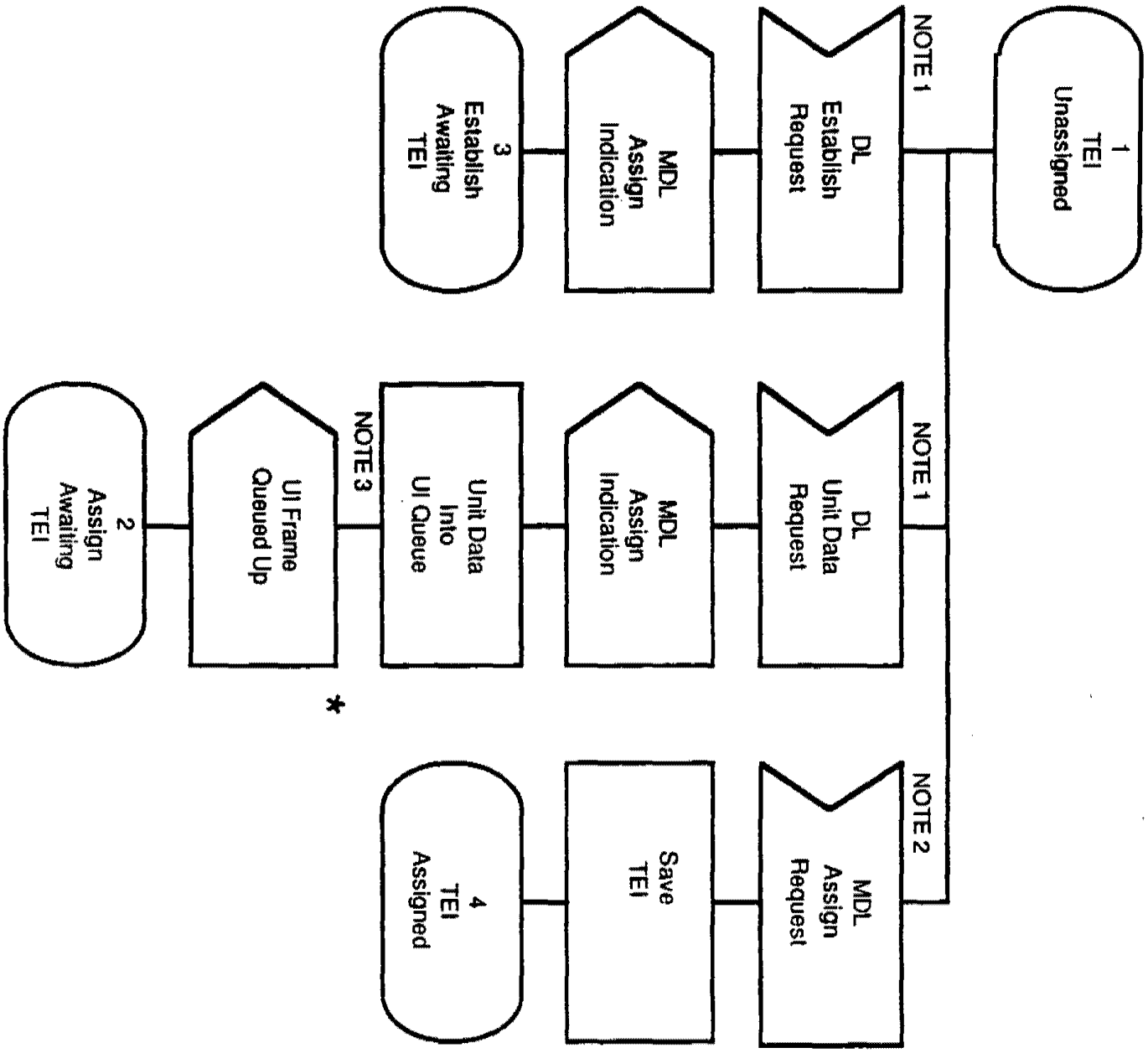


To mark an event or signal required as a result of the representation approach adopted, which is local to the data link layer entity.

RC Retransmission Counter

(A to O) The codes used in MDL-ERROR NOTIFICATION signals are defined in Appendix C-II. When multiple codes are shown only one applies.

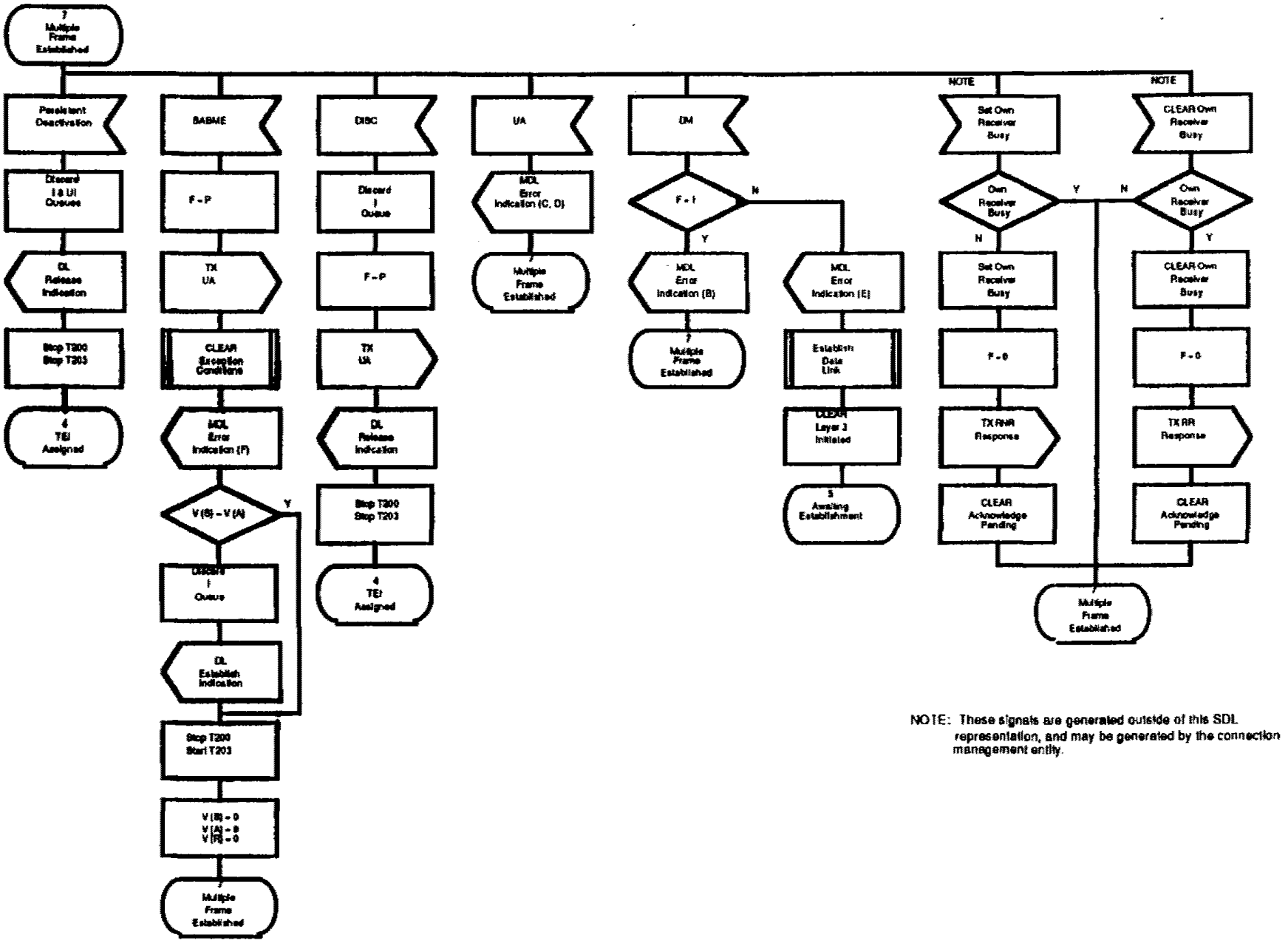
An SDL representation of the point-to-point data link procedures



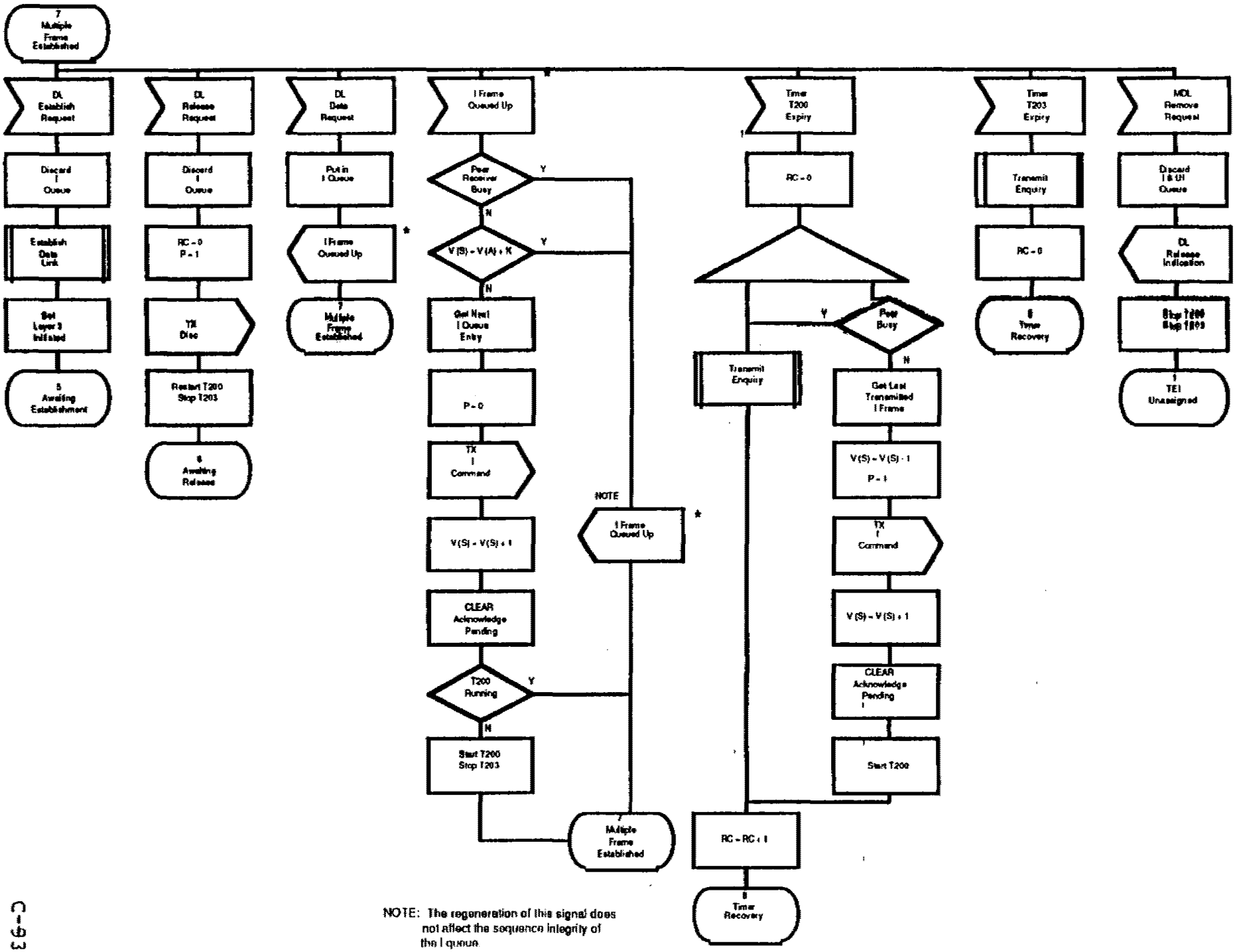
NOTE 1:
The use of these events on the network side is for further study.

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

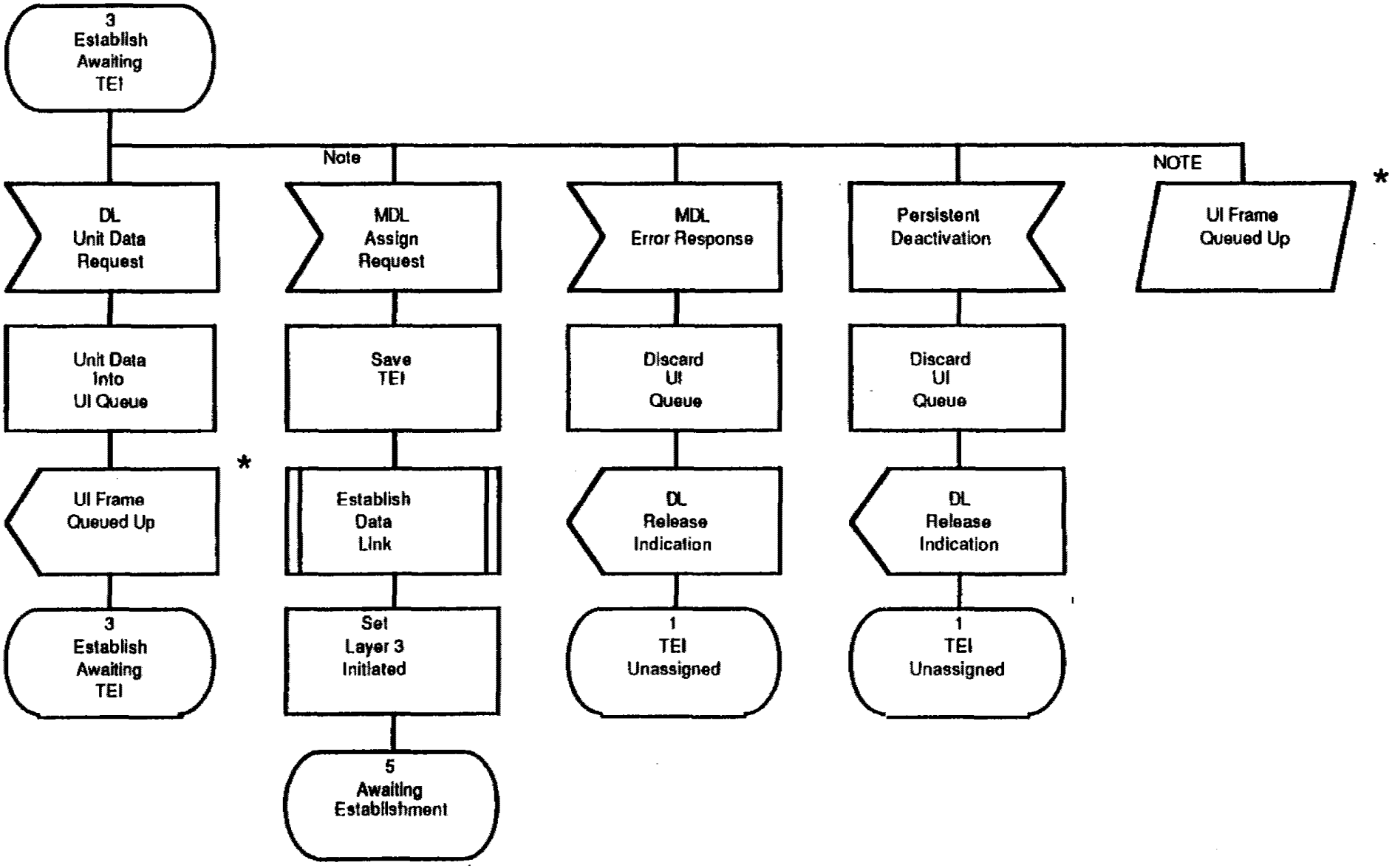
NOTE 3:
Processing of UI frame queued up is described in REFERENCE P.1.



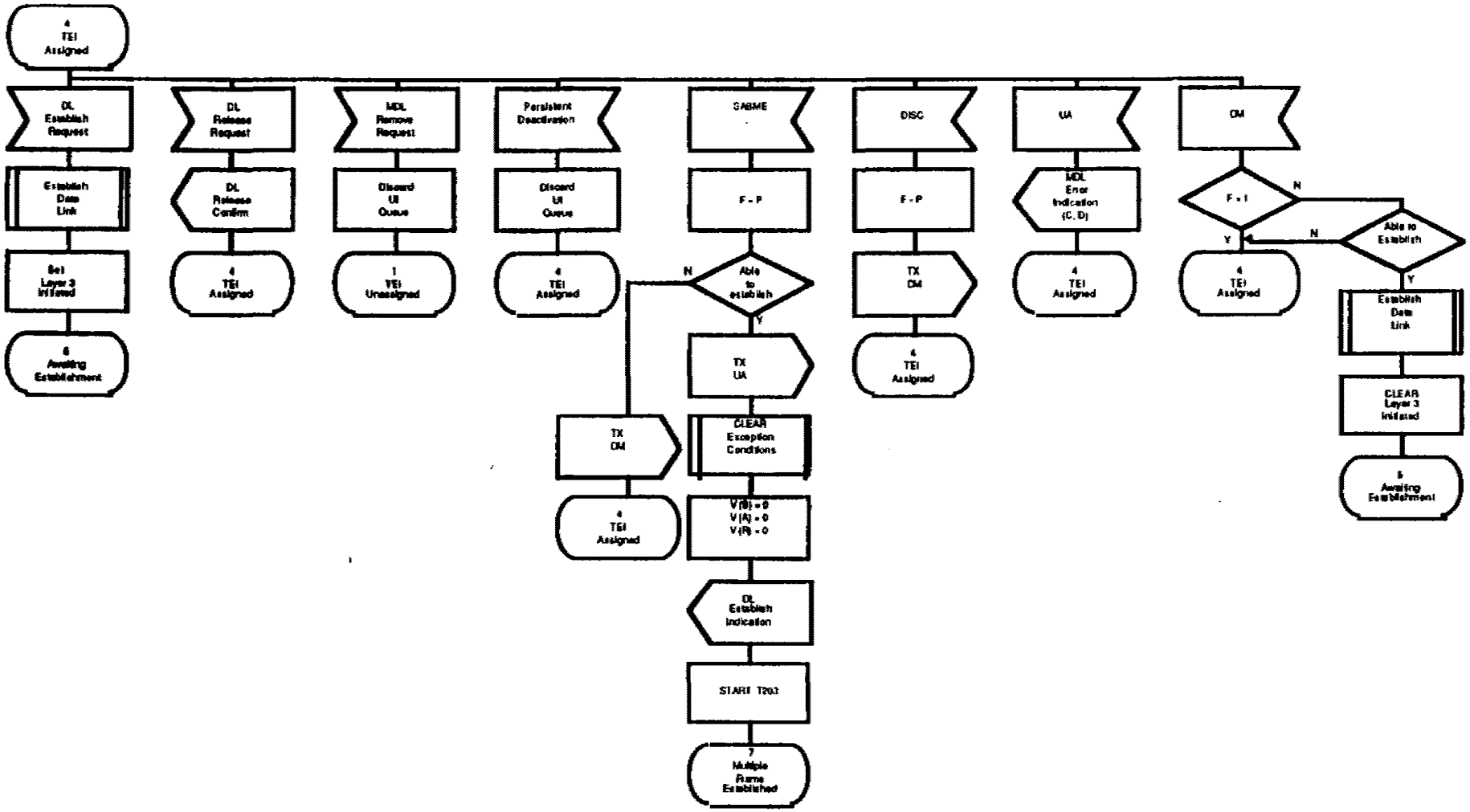
NOTE: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.

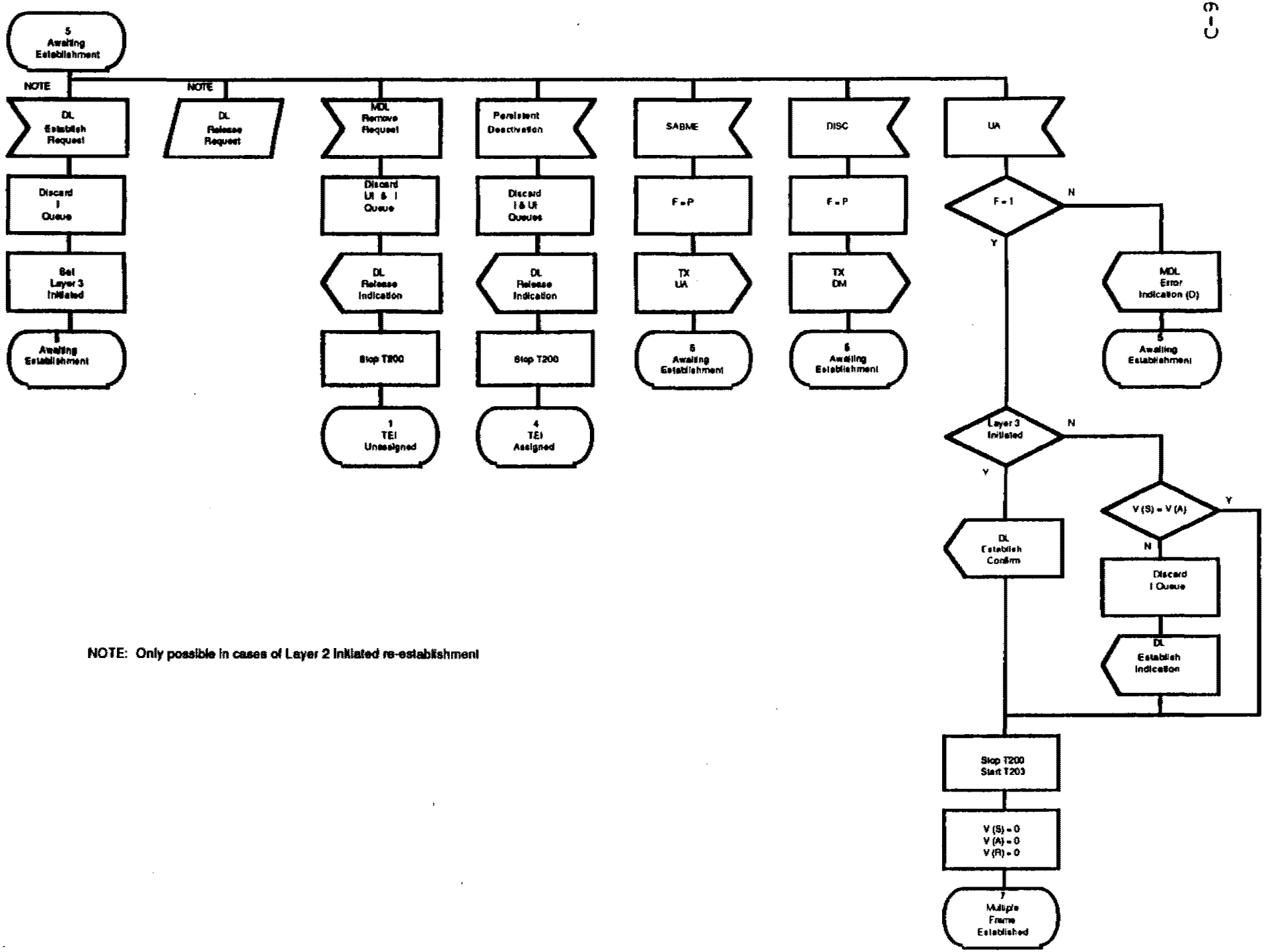


NOTE: The regeneration of this signal does not affect the sequence integrity of the I queue.

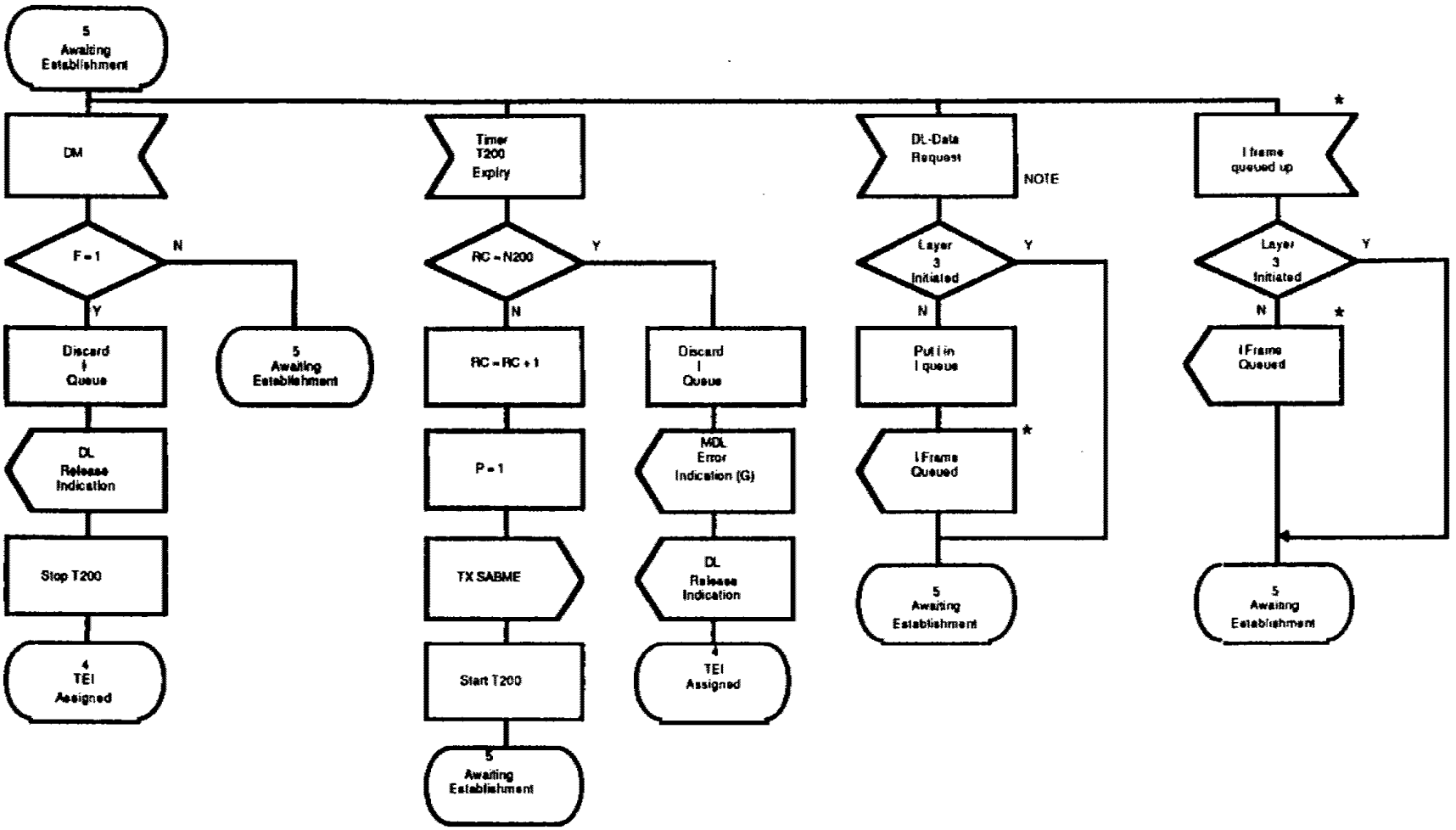


NOTE:
Processing of UI frame queued up is described on REFERENCE P.1.

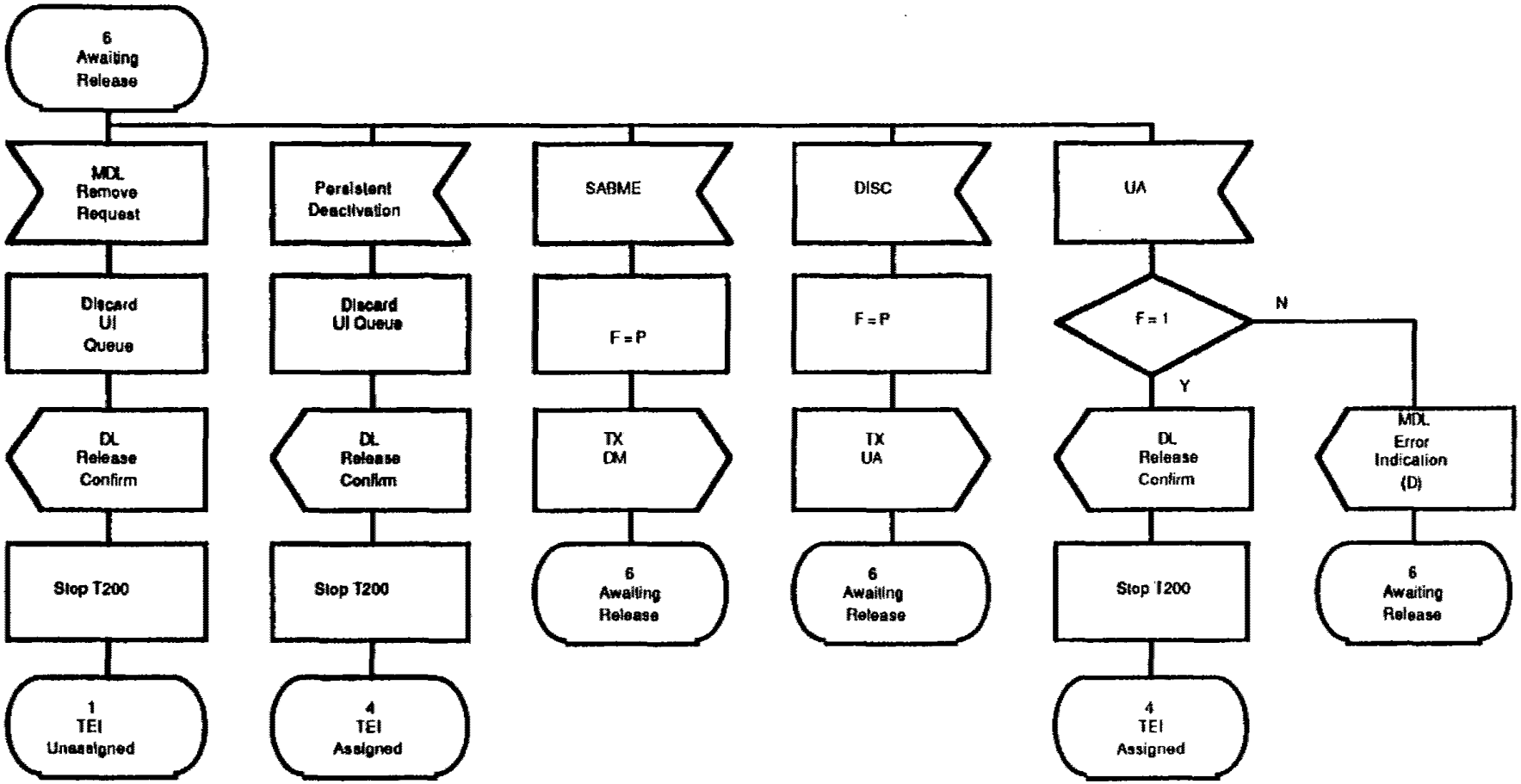

4
TEI
Assigned
DL
Establish
Request
Establish
Data
Link
Set
Layer 3
Initiated
6
Awaiting
Establishment
DL
Release
Request
DL
Release
Confirm
4
TEI
Assigned
MDL
Remove
Request
Discard
UI
Queue
1
TEI
Unassigned
Persistent
Deactivation
Discard
UI
Queue
4
TEI
Assigned
SABME
F = P
N
Able
to
establish
Y
TX
DM
4
TEI
Assigned
TX
UA
CLEAR
Exception
Conditions
V(S) = 0
V(A) = 0
V(R) = 0
DL
Establish
Indication
START T203
7
Multiple
Frame
Established
DISC
F = P
TX
DM
4
TEI
Assigned
UA
MDL
Error
Indication
(C, D)
4
TEI
Assigned
DM
F = 1
N
Y
4
TEI
Assigned
N
Able to
Establish
Y
Establish
Data
Link
CLEAR
Layer 3
Initiated
5
Awaiting
Establishment

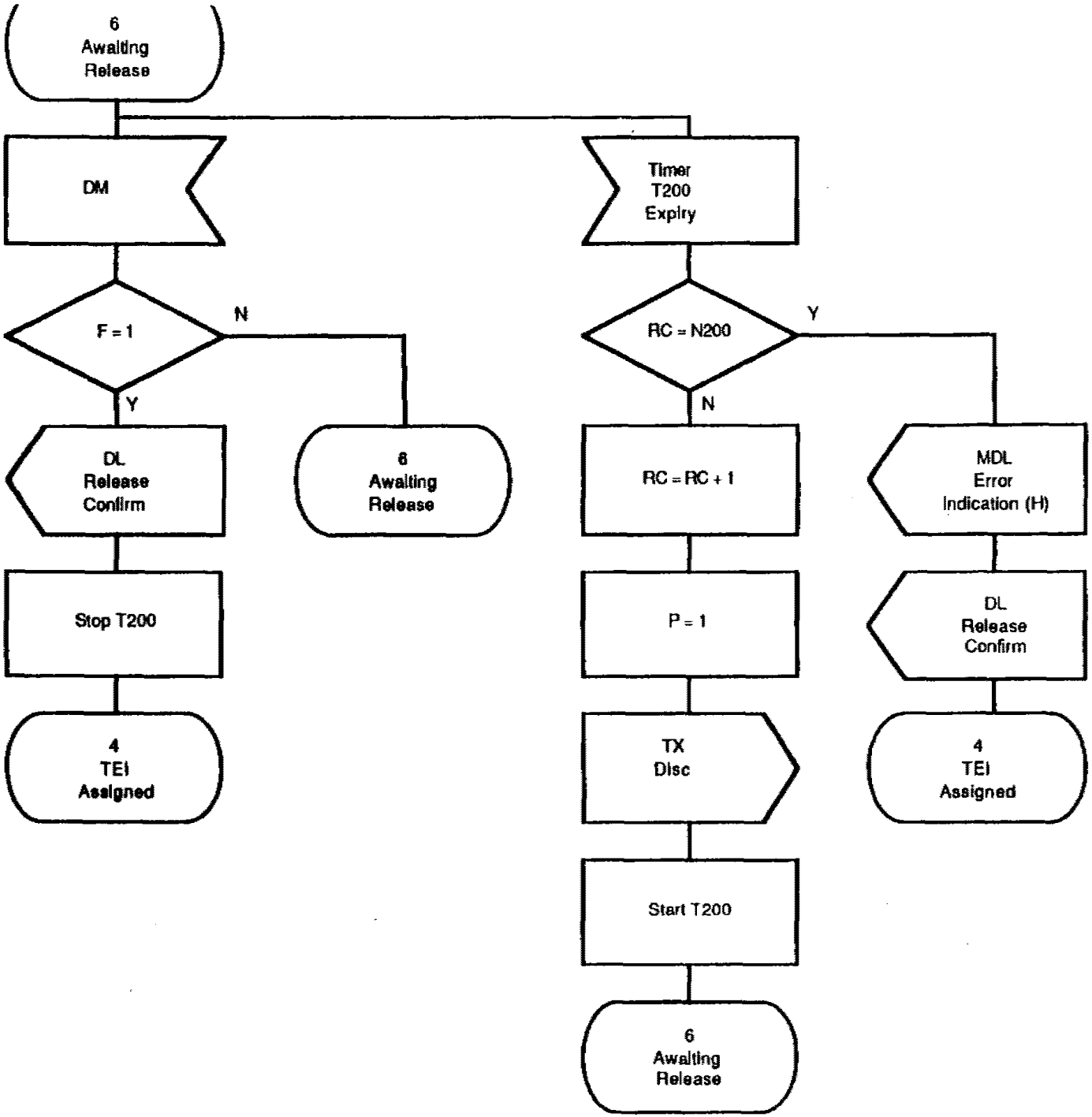


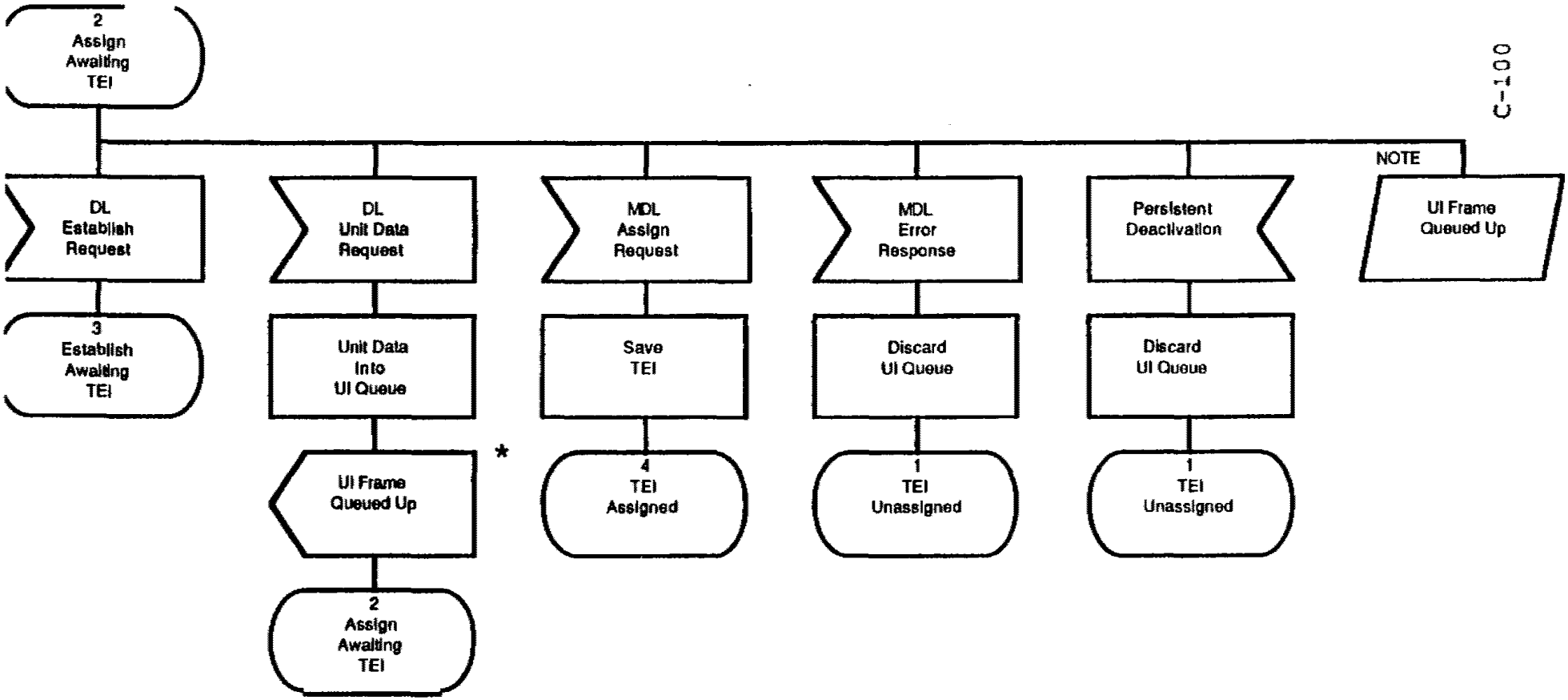
NOTE: Only possible in cases of Layer 2 Initiated re-establishment



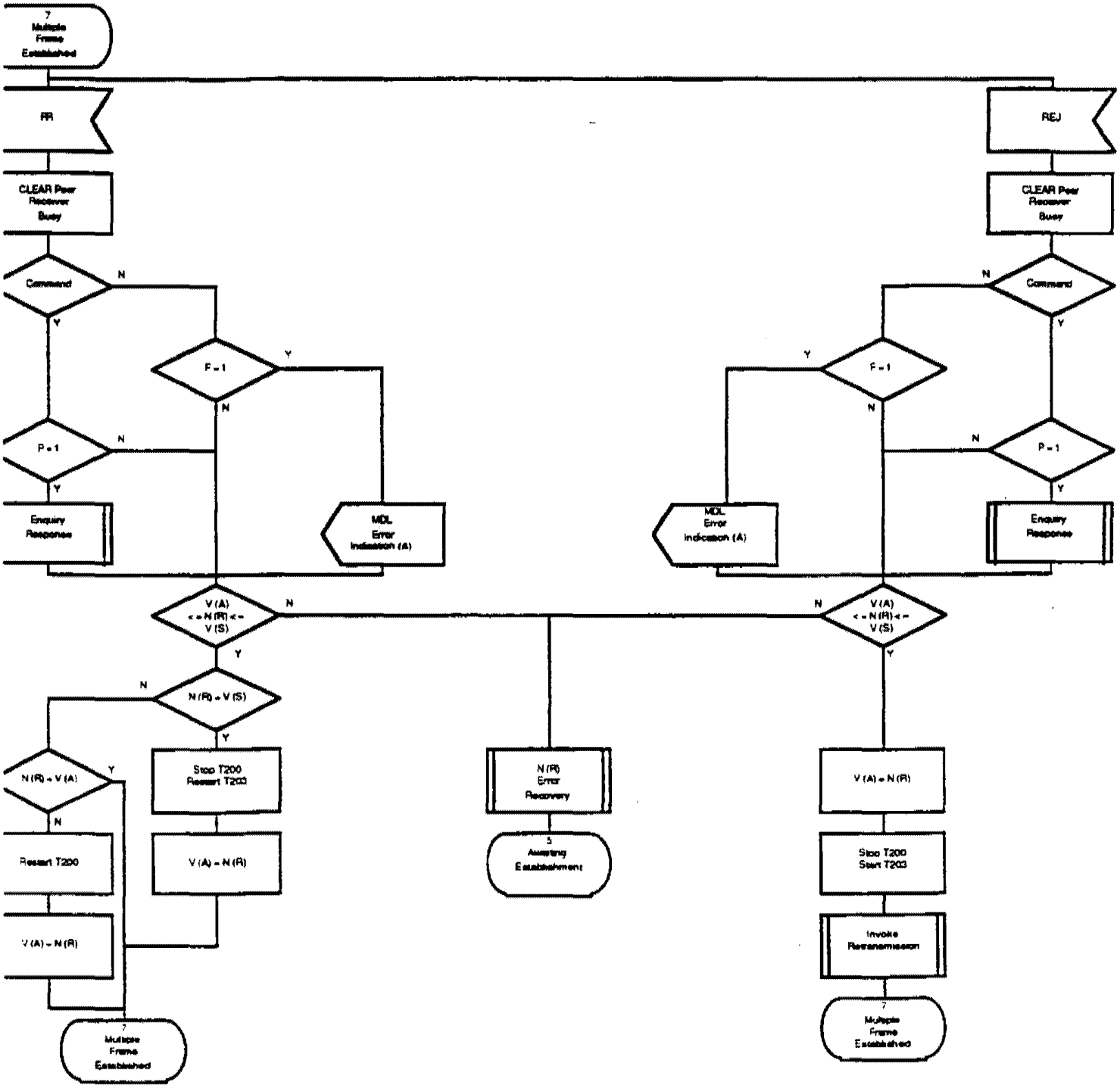
NOTE: Only possible in cases of layer 2 initiated re-establishment

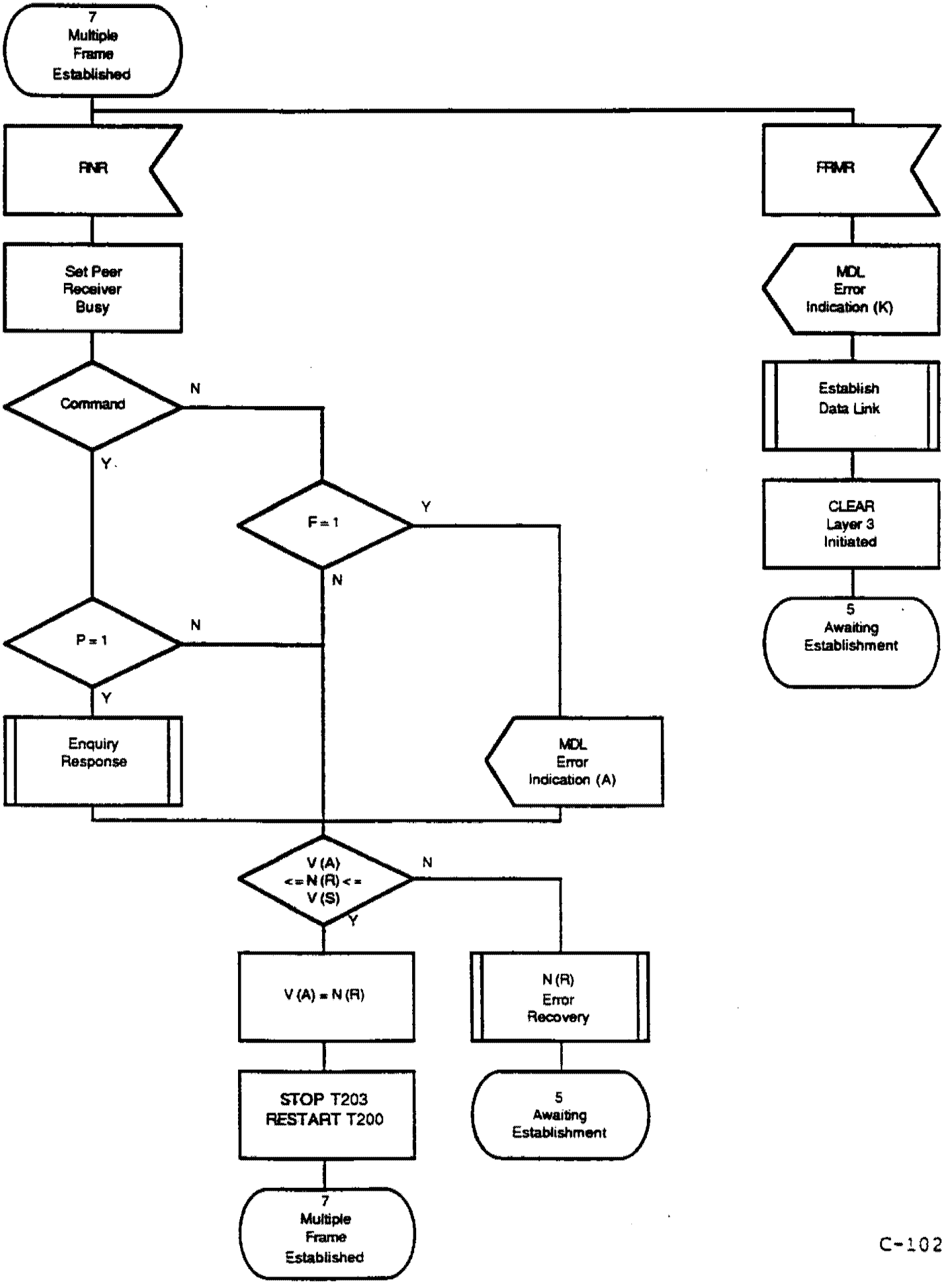

6
Awaiting
Release
MDL
Remove
Request
Discard
UI
Queue
DL
Release
Confirm
Stop T200
1
TEI
Unassigned
Persistent
Deactivation
Discard
UI Queue
DL
Release
Confirm
Stop T200
4
TEI
Assigned
SABME
F = P
TX
DM
6
Awaiting
Release
DISC
F = P
TX
UA
6
Awaiting
Release
UA
F = 1
N
Y
DL
Release
Confirm
Stop T200
4
TEI
Assigned
MDL
Error
Indication
(D)
6
Awaiting
Release

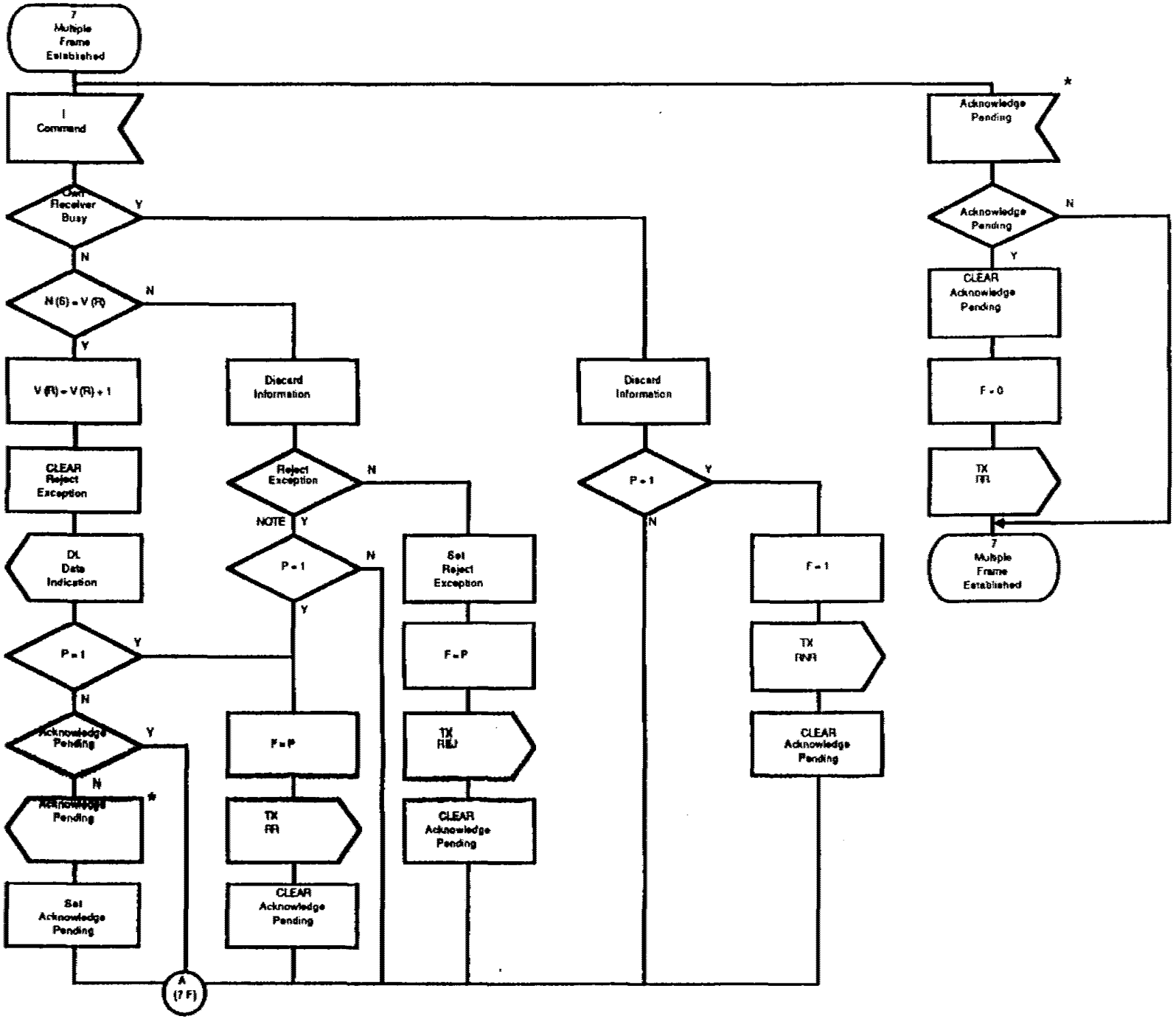

6
Awaiting
Release
DM
F = 1
N
Y
DL
Release
Confirm
6
Awaiting
Release
Stop T200
4
TEI
Assigned
Timer
T200
Expiry
RC = N200
Y
N
RC = RC + 1
MDL
Error
Indication (H)
P = 1
DL
Release
Confirm
TX
Disc
4
TEI
Assigned
Start T200
6
Awaiting
Release



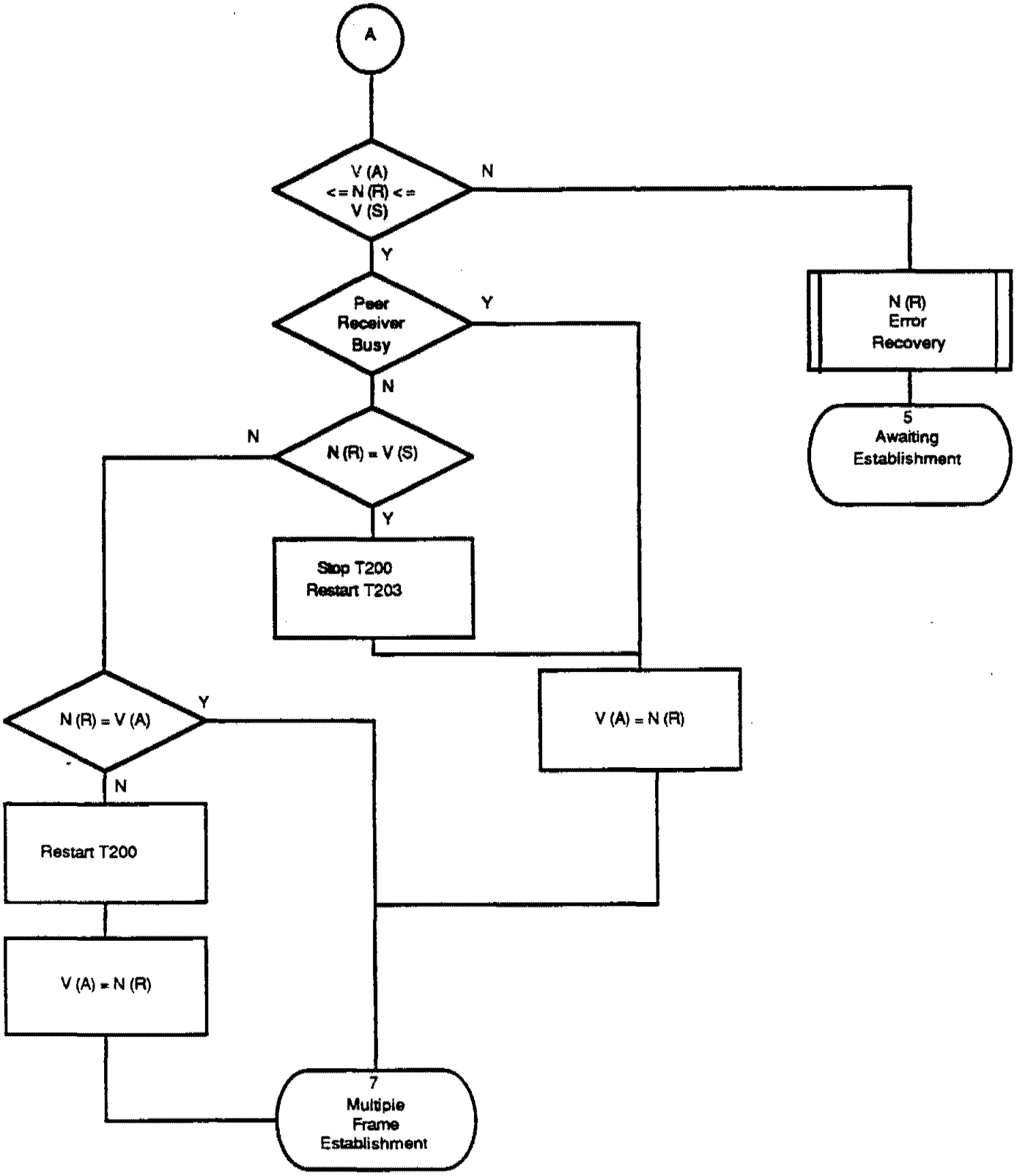
NOTE:
Processing of UI frame queued up is described on REFERENCE P.1.

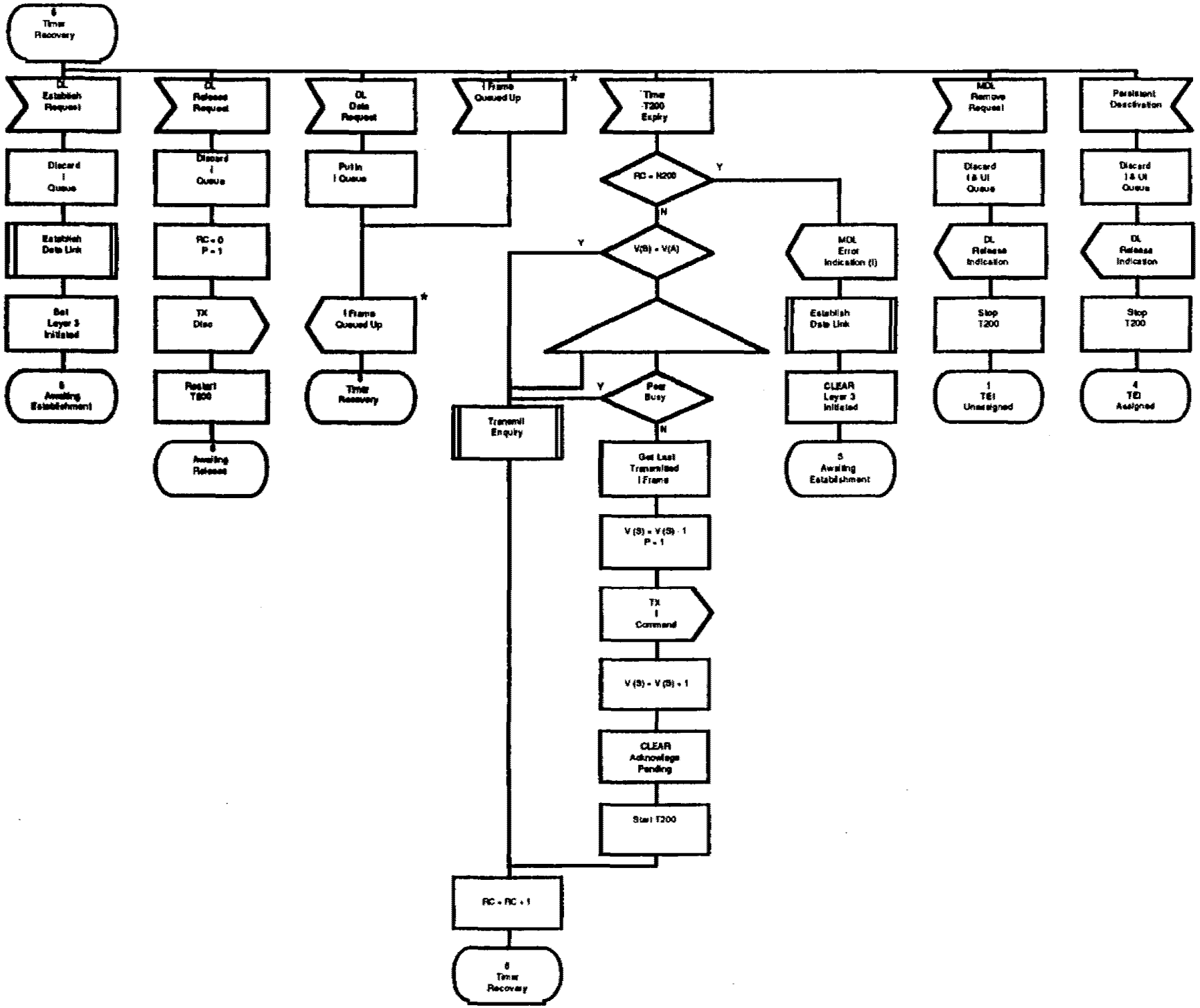

7
Multiple
Frame
Established
RR
CLEAR Peer
Receiver
Busy
Command
N
Y
P = 1
N
Y
Enquiry
Response
F = 1
Y
N
MDL
Error
Indication (A)
REJ
CLEAR Peer
Receiver
Busy
Command
N
Y
F = 1
Y
N
MDL
Error
Indication (A)
P = 1
N
Y
Enquiry
Response
V (A)
<= N (R) <=
V (S)
N
Y
N (R) = V (S)
N
Y
N (R) = V (A)
Y
N
Reset T200
V (A) = N (R)
7
Multiple
Frame
Established
Stop T200
Restart T200
V (A) = N (R)
N (R)
Error
Recovery
5
Awaiting
Establishment
V (A)
<= N (R) <=
V (S)
N
Y
V (A) = N (R)
Stop T200
Start T203
Invoke
Retransmission
7
Multiple
Frame
Established

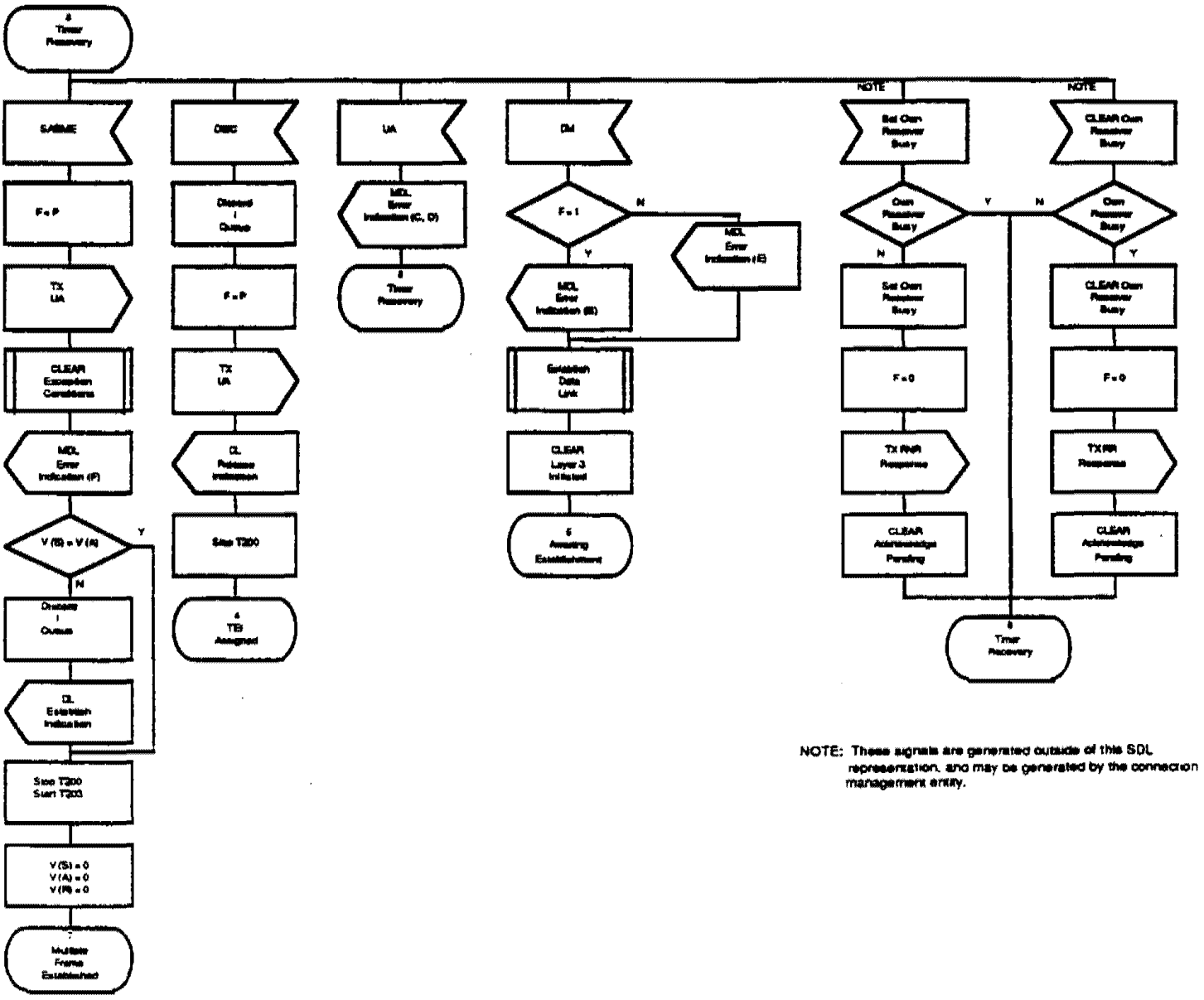

7
Multiple
Frame
Established
RNR
Set Peer
Receiver
Busy
Command
N
Y
F = 1
Y
N
P = 1
N
Y
Enquiry
Response
MDL
Error
Indication (A)
V (A)
<= N (R) <=
V (S)
N
Y
V (A) = N (R)
N (R)
Error
Recovery
STOP T203
RESTART T200
5
Awaiting
Establishment
7
Multiple
Frame
Established
FRMR
MDL
Error
Indication (K)
Establish
Data Link
CLEAR
Layer 3
Initiated
5
Awaiting
Establishment



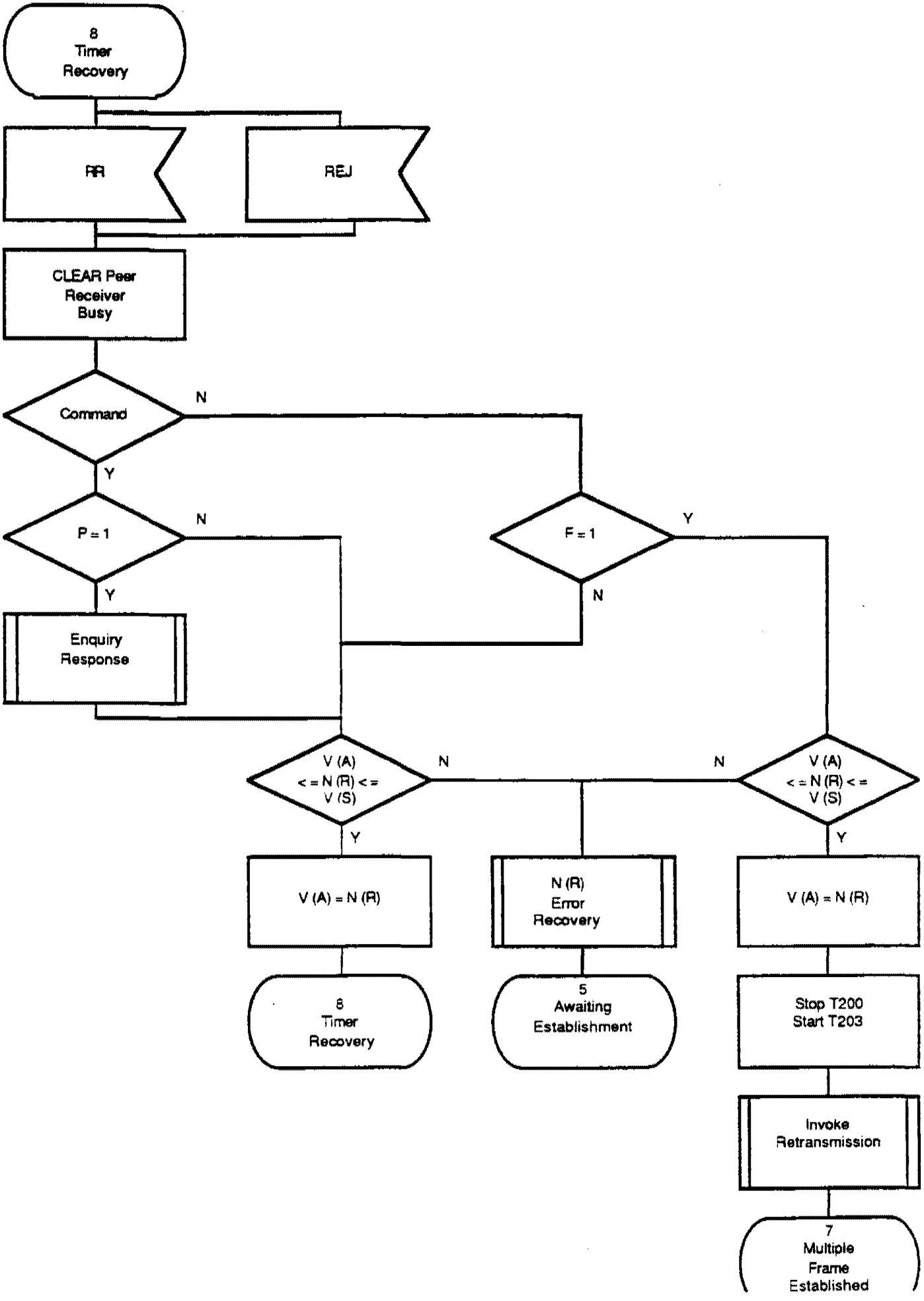
NOTE: This SDL representation does not include the optionals procedure in Appendix C-I.

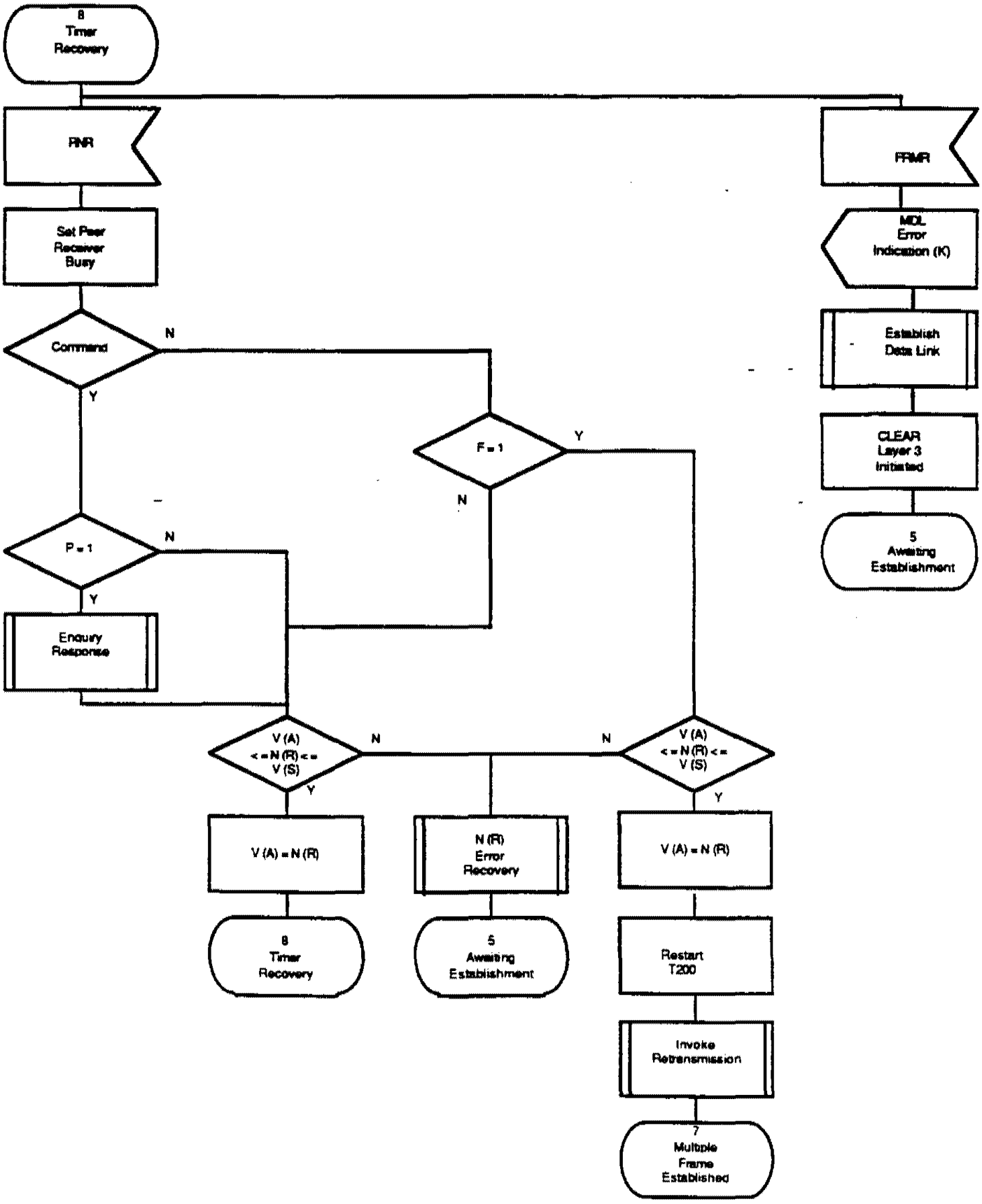

A
V (A)
<= N (R) <=
V (S)
N
Y
Peer
Receiver
Busy
Y
N
N (R)
Error
Recovery
5
Awaiting
Establishment
N
N (R) = V (S)
Y
Stop T200
Restart T203
V (A) = N (R)
N (R) = V (A)
Y
N
Restart T200
V (A) = N (R)
7
Multiple
Frame
Establishment

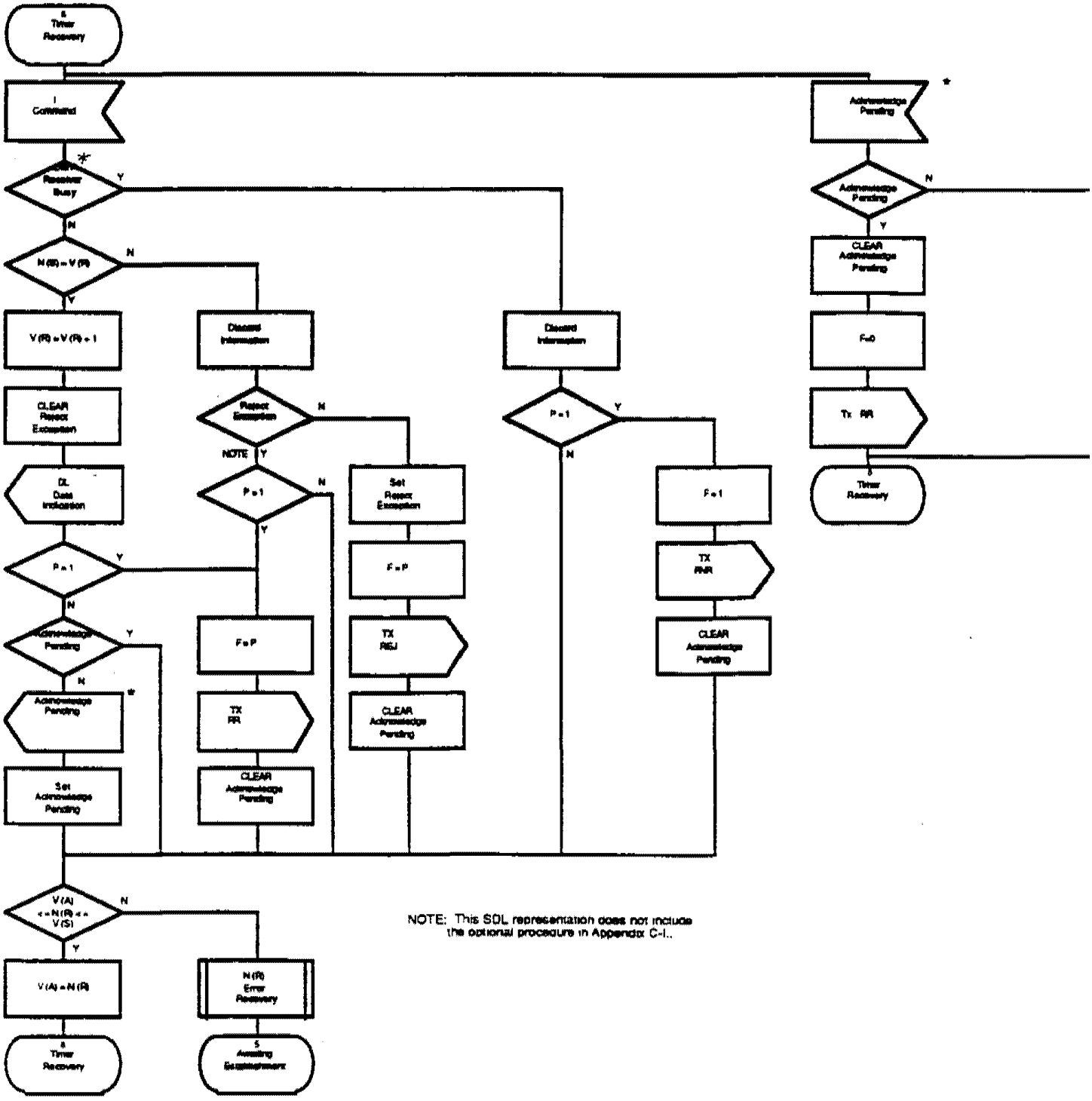

6
Timer Recovery
DL Establish Request
Discard I Queue
Establish Data Link
Set Layer 3 Initiated
5
Awaiting Establishment
DL Release Request
Discard I Queue
RC = 0
P = 1
TX DISC
Restart T200
6
Awaiting Release
DL Data Request
Put In I Queue
I Frame Queued Up
Timer Recovery
I Frame Queued Up
Timer T200 Expiry
RC = N200
Y
N
V(S) = V(A)
Y
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 Acknowledge Pending
Start T200
RC = RC + 1
6
Timer Recovery
MDL Error Indication (I)
Establish Data Link
CLEAR Layer 3 Initiated
5
Awaiting Establishment
MDL Remove Request
Discard I & UI Queue
DL Release Indication
Stop T200
1
TEI Unassigned
Persistent Deactivation
Discard I & UI Queue
DL Release Indication
Stop T200
4
TEI Assigned



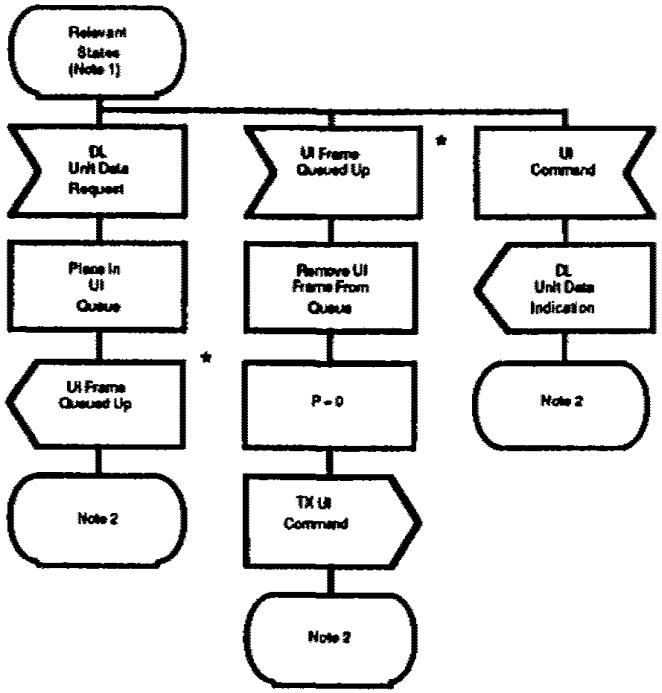
NOTE: These signals are generated outside of this SDL representation, and may be generated by the connection management entity.


8
Timer
Recovery
RR
REJ
CLEAR Peer
Receiver
Busy
Command
N
Y
P = 1
N
Y
Enquiry
Response
F = 1
Y
N
V (A)
< = N (R) < =
V (S)
N
N
V (A)
< = N (R) < =
V (S)
Y
Y
V (A) = N (R)
N (R)
Error
Recovery
V (A) = N (R)
8
Timer
Recovery
5
Awaiting
Establishment
Stop T200
Start T203
Invoke
Retransmission
7
Multiple
Frame
Established


8
Timer
Recovery
RNR
Set Peer
Receiver
Busy
Command
N
Y
P = 1
N
Y
Enquiry
Response
F = 1
Y
N
V (A)
<= N (R) <=
V (S)
N
Y
V (A) = N (R)
8
Timer
Recovery
N (R)
Error
Recovery
5
Awaiting
Establishment
N
V (A)
<= N (R) <=
V (S)
Y
V (A) = N (R)
Restart
T200
Invoke
Retransmission
7
Multiple
Frame
Established
FRMR
MDL
Error
Indication (K)
Establish
Data Link
CLEAR
Layer 3
Initiated
5
Awaiting
Establishment



*own Receiver Busy

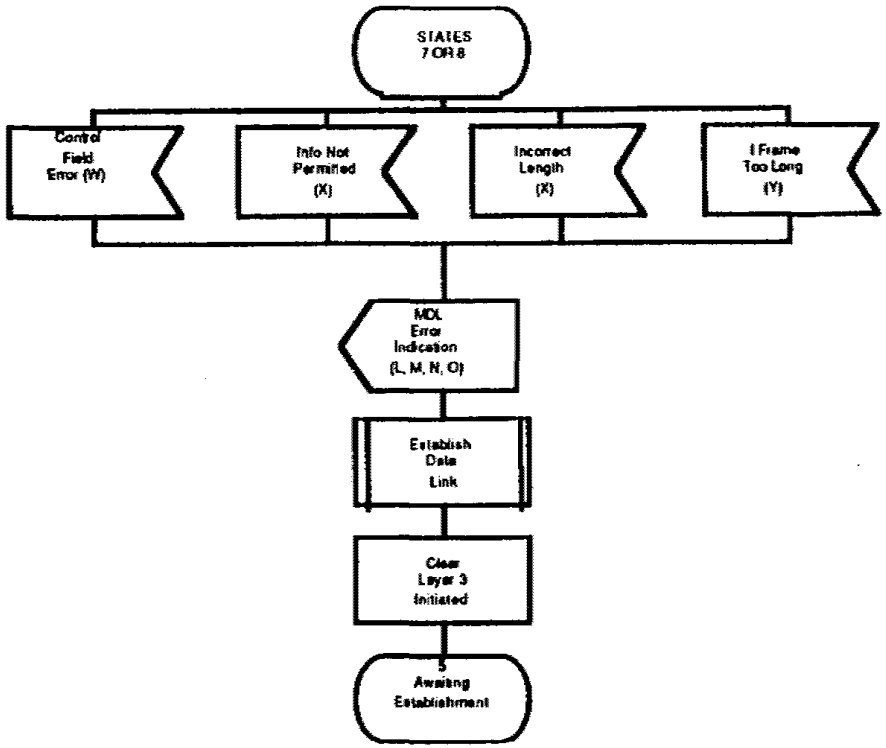


Unnumbered information transfer
on point-to-point data link

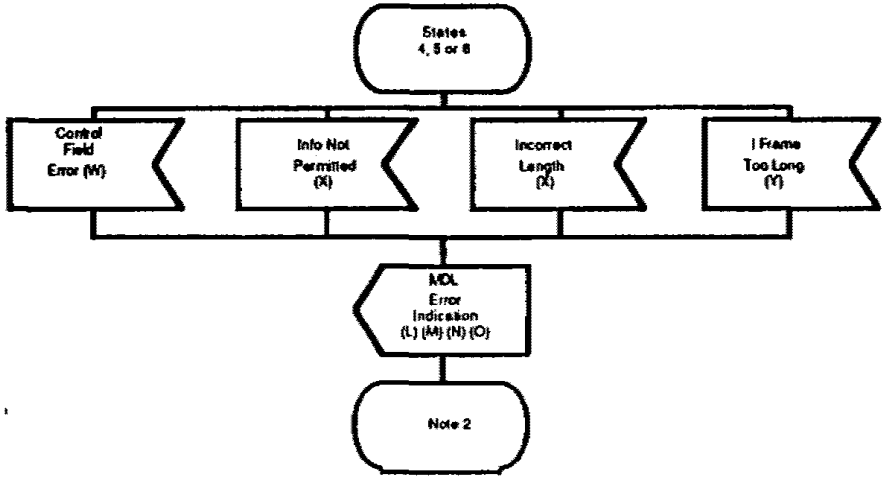
NOTE 1 - The relevant states are as follows:

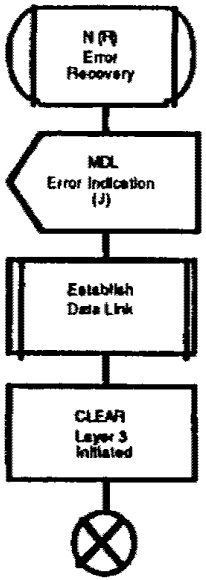
4 TEI-Assigned
5 Awaiting-Establishment
6 Awaiting-Release
7 Multiple-Frame-Established
8 Timer-Recovery

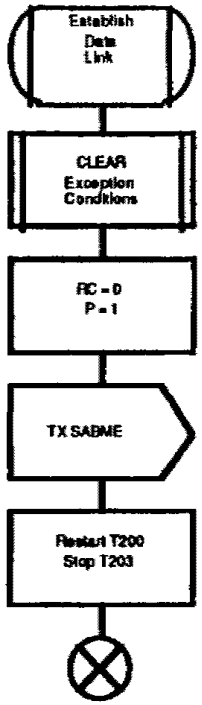
NOTE 2 - The data link layer returns to the state
it was in prior to the events shown

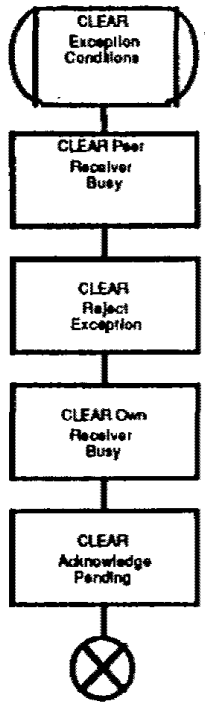


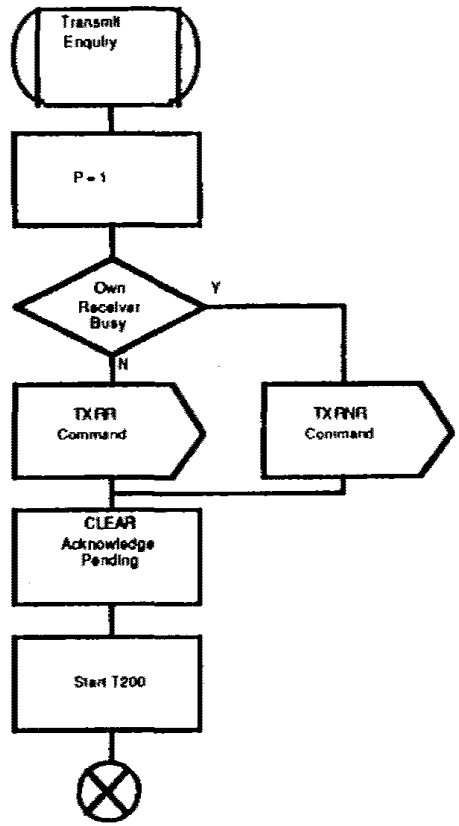
Receiving frame with incorrect format or frame not implemented (FRMR events).

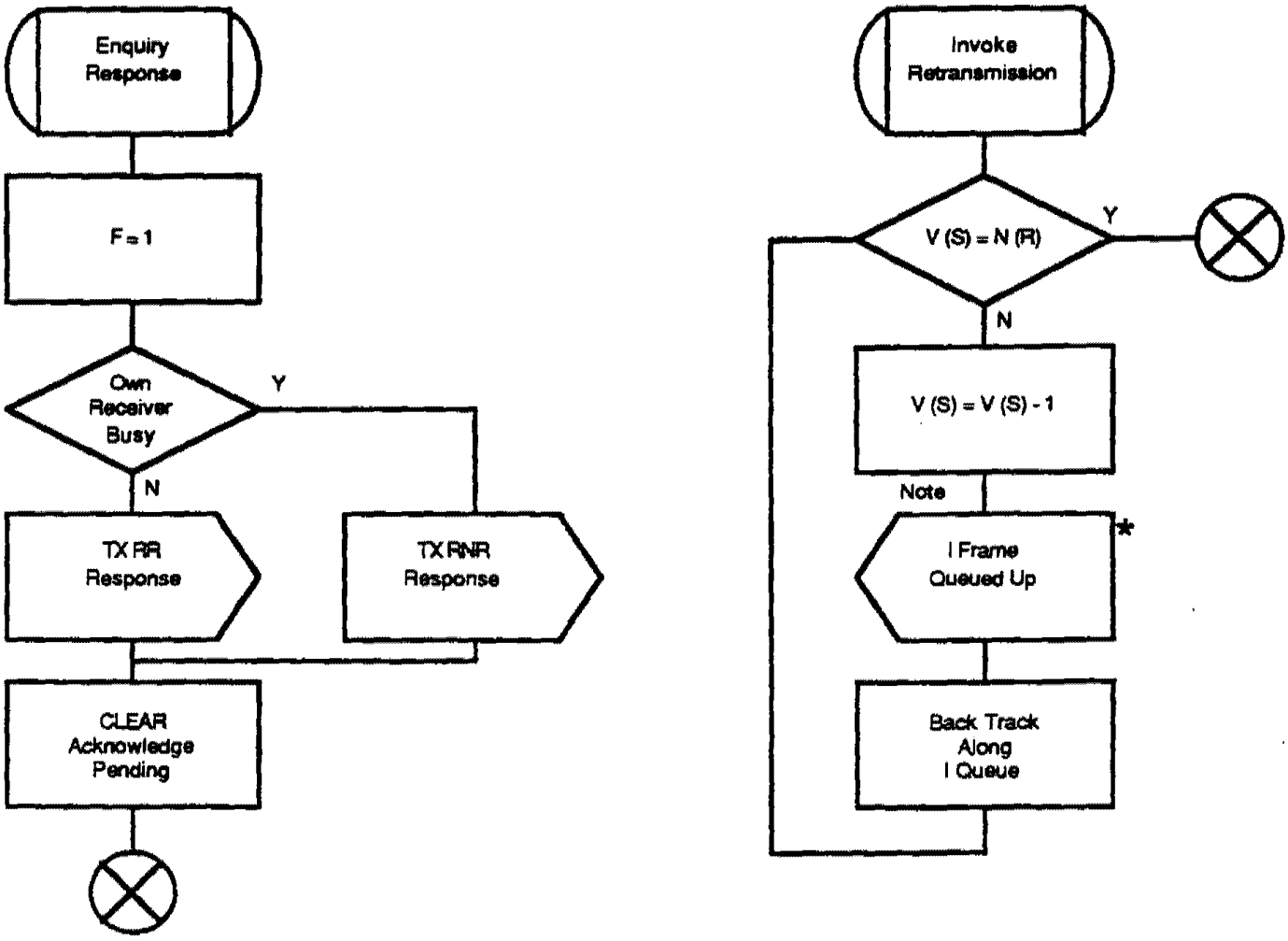



N (R)
Error
Recovery
MDL
Error Indication
(J)
Establish
Data Link
CLEAR
Layer 3
Initiated


Establish
Data
Link
CLEAR
Exception
Conditions
RC = 0
P = 1
TX SABME
Restart T200
Stop T203


CLEAR
Exception
Conditions
CLEAR Peer
Receiver
Busy
CLEAR
Reject
Exception
CLEAR Own
Receiver
Busy
CLEAR
Acknowledge
Pending


Transmit
Enquiry
P = 1
Own
Receiver
Busy
Y
N
TX RR
Command
TX RNR
Command
CLEAR
Acknowledge
Pending
Start T200



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

SECTION D: ISDN BASIC RATE INTERFACE - FUNCTIONAL CALL CONTROL SIGNALING SPECIFICATION

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Appendix C. REMOTE OPERATIONS SERVICE D-248

1.0 GENERAL

The messages, and information element encodings specified here are a complete set of those described in TR268 issue 2 entitled "ISDN Interface Call Control Switching and Signaling Requirements", and TR861 entitled "ISDN Layer 3 Protocol Details for the Support of Supplementary Services". 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 TR268, issue 2, and CCITT recommendations Q.931 and Q.932.

Additional messages, procedures and parameter encodings have also been specified in order 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 (i.e. CCITT, T1S1 and Bellcore), where clear directions have been given.

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

2.0 OVERVIEW OF CALL CONTROL

2.1 CIRCUIT-SWITCHED CALLS

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 in this section.

2.1.1.1 Null (State N0)

No call exists.

2.1.1.2 Call Initiated (N1)

This state exists for an outgoing call when the network has received a call establishment request but has not (yet) responded.

2.1.1.3 Overlap Sending (N2)

This state exists for an outgoing call when the network has acknowledged the call establishment request from the user and is prepared to receive additional information (if any) in the overlap mode.

2.1.1.4 Outgoing Call Proceeding (N3)

This state exists for an outgoing (from the user) call when the network has sent acknowledgement that the network has received all call information necessary to effect call establishment.

2.1.1.5 Call Delivered (N4)

This state exists for an outgoing call when the network has indicated that remote user alerting has been initiated.

2.1.1.6 Call Present (N6)

This state exists for an incoming (to the user) call when the network has sent a call request but has not (yet) received a satisfactory response.

2.1.1.7 Call Received (N7)

This state exists for an incoming call when the network has received indication of alerting but has not (yet) received an answer.

2.1.1.8 Connect Request (N8)

This state exists for an incoming call when the network has received an answer, but the network has not (yet) awarded the call.

2.1.1.9 Incoming Call Proceeding (N9)

This state exists for an incoming call when the network has received acknowledgement that the user has received all call information necessary to effect call establishment.

2.1.1.10 Active (N10)

This state exists for an incoming call when the network has awarded the call to the called user. This state exists for an outgoing call when the network has indicated that the remote user has answered the call.

2.1.1.11 Disconnect Request (N11)

This state exists when the network has received a request from the user to clear the end-to-end connection (if any).

2.1.1.12 Disconnect Indication (N12)

This state exists when the network has disconnected the end-to-end connection (if any) within the network and has sent an invitation to disconnect the user-network connection.

2.1.1.13 Release Request (N19)

This state exists when the network has requested the user to release and is waiting for a response.

2.1.1.14 Call Abort (N22)

This state exists for an incoming call for the point to multipoint configuration, when the call is being cleared before any called user has been awarded the call.

2.2 STATES ASSOCIATED WITH A CALL-INDEPENDENT CONNECTION

2.2.1 Call States at the Network Side of the Interface

2.2.1.1 Null (State N0)

No connection exists.

2.2.1.2 Call Independent Service (State N31)

This state 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.

3.0 PROTOCOL VERSION CONTROL

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 in Section 3.2. Using this protocol information, the network and the terminals then may tailor their respective protocols in order to effect communication.

A primary intention of PVC is to allow a terminal to continue to operate at a given BCS release functionality without forcing firmware upgrades as the office is upgraded to newer BCS 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.

NT BellCore TR-compliant Functional (NTTRF), NT Stimulus, and NT 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 NT Stimulus and NT Meridian Feature Transparency versions the issue is defaulted to a value of 0.

As an example of the application of the PVC feature, consider some ISDN terminals that can support both NTTRF and NTMFT protocols. The use of protocol version control allows the network to tell these terminals which protocol to use to be compatible with the network protocol. As another example, consider the evolution of the NTTRF protocol towards a BellCore Phase 1.1 TR compliance. Issue 0 and Issue 1 of the NTTRF protocol are intermediate issues of this protocol prior to full compliance. PVC allows the network to identify these variations of the functional protocol using issue numbers, thus allowing terminals implementing any one of these variations to maintain compatibility, without change, with the network as it evolves. To facilitate proper service administration, installation and maintenance, it is recommended that terminal equipment label on the bottom of the terminal, through a sticker or by other means, the PVC value which the terminal should be datafilled to in the network to operate properly. The PVC value labeled should correspond to the interface specification which the terminals firmware release was built to. When new firmware releases are instaled in the terminal, the terminal should be re-labeled to reflect the PVC value of the new firmware release.

3.1 PROTOCOL VERSIONS AND ISSUE IDENTIFICATION

The following protocol versions and issues have been identified:

Version Meaning	Issue Code Value	Specification
NT Stimulus	0	NIS S208-2
NT BellCore TR-compliant Functional	0	NIS S208-4
NT BellCore TR-compliant Functional	1	NIS S208-5, Issue 1.0 and and Issue 1.1 except Section I
NT BellCore TR-compliant Functional	2	NIS S208-6, Issue 1.0 and Issue 1.1

As seen in the table above, 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 that has been built to an earlier version of the specification.

As the network interface moves closer to TR compliance , the protocol to support basic call control and supplementary services will evolve. The change in protocol will be captured in an issue release of this specification.

An issue value of 0 within the NTTRF PVC will enable a terminal built to the NIS S208-4 specification to perform compatibly on an interface built to the NIS S208-5 specification . When a terminal specifies it wants to run PVC NTTRF with an issue code value of 0 then the network will not send incompatible protocol to this terminal even though the network version is supporting NIS S208-5. However this does not preclude the sending of new TR compliant optional information elements or optional cause values etc. The terminal is expected to ignore optional elements if it is not expecting them or it does not understand them.

A few examples will illustrate how issue control within PVC actually works.

1. In NIS-S208-5 it states that the channel identification information element is mandatory in the first response from a user to the network. This is new TR compliant protocol. NIS-S208-4 does not have this requirement.

   If a terminal is running under PVC 0 on a DMS-100 that is supporting NIS-S208-5 and the response to the SETUP message

does not contain a channel identification information element then the Network will assume the B-channel specified in the SETUP is the correct one to use. If the terminal was supporting PVC 1 and the channel identification was absent from the first response then the call would be cleared with cause 'mandatory information element missing'. This is a case where PVC 0 will inhibit the DMS from using the new protocol as specified in NIS-S208-5 because this new protocol will cause a terminal incompatibility and cause the call to be dropped.

2. Another example is the introduction of the Progress Indicator information element into the ALERTING message as part of NIS-S208-5. This is an optional information element and its inclusion will not affect the performance of the terminal even if that terminal is operating under PVC 0. The terminal shall ignore this information element if it is not expecting to receive it. This type of protocol change is not considered to be terminal incompatible.

3.2 PROTOCOL DESCRIPTION

There are four protocol version control(PVC) operations:

- version query(user -> network), query current version issue,
- version request(user -> network), version issue negotiation,†
- version response(network -> user), respond to version query,
- version prompt(network -> user), prompt terminal to initiate version query.†

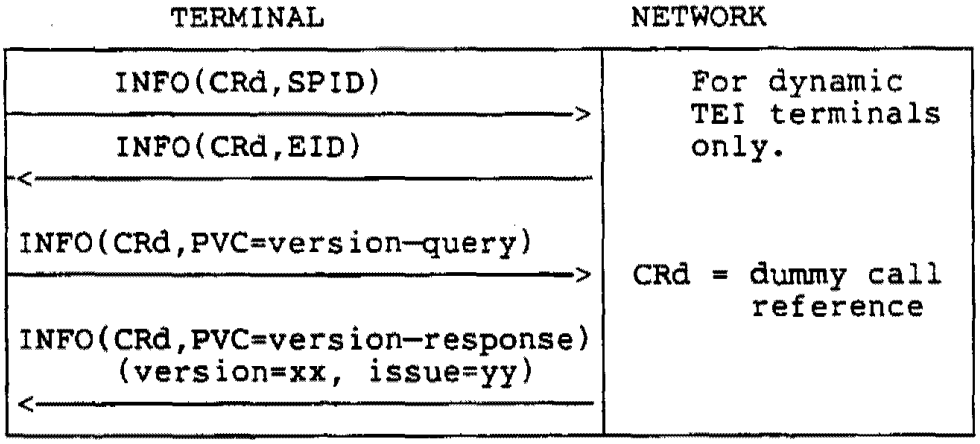
† Not supported at this time.

| Note: Not an NI-1 requirement; DMS-100 option.

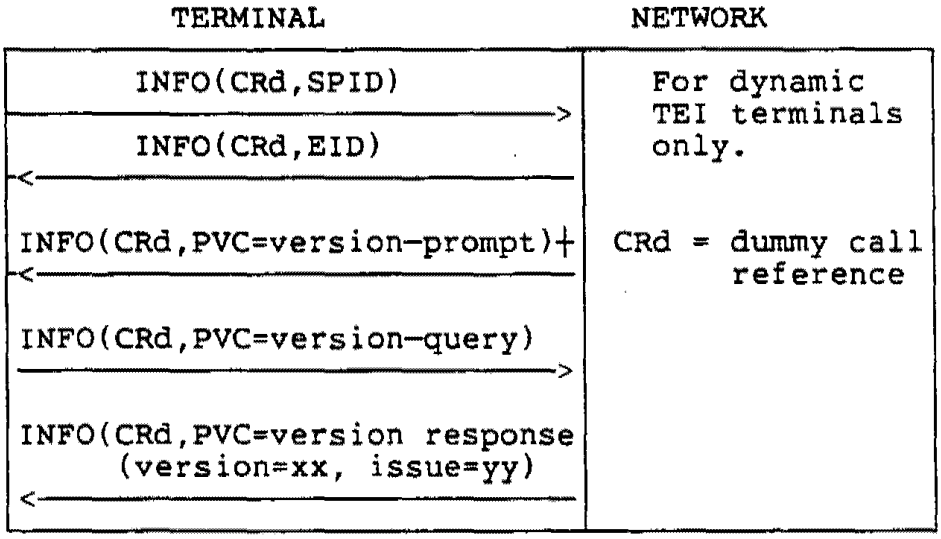
In order for PVC to be applicable to terminals implementing either or both stimulus or functional procedures the INFOrmation message based sequence is used. The following figure details the message exchange between a terminal and network for querying the version-issue information stored in the network for the logical terminal.

The first two messages, SPID (Service Profile Identifier) and EID (Endpoint Identifier), are only required for dynamic TEI terminals. The version query operation should be initiated by a terminal with the terminal initialization sequence. The network will respond with the stored value of the version-issue or default version-issue for this logical terminal using the version response operation.

There is no recovery action for lost messages.



Q.931 messages for Protocol Version Query/Response



Q931 messages for Protocol Version Prompt Operation +

+ Not supported at this time.

Note. Procedures for the Version-request operation are under study at this time. +

4.0 MESSAGE FUNCTIONAL DEFINITIONS

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 specification 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'), optional ('O'), i.e. provided if specified condition exists. 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.

4.1 MESSAGES FOR CIRCUIT-MODE CONNECTIONS

The following table summarizes the messages for circuit-mode connections.

Messages for Circuit-Mode Connection	Reference
Call establishment messages:	
ALERTing	4.1.1
CALL PROCeeding	4.1.2
CONNect	4.1.3
CONNect ACKnowledge	4.1.4
PROGress	4.1.16
SETUP	4.1.23
SETUP ACKnowledge	4.1.24
Call clearing messages	
DISConnect	4.1.5
RELease	4.1.18
RELease COMplete	4.1.19
Miscellaneous messages	
INFOrmation	4.1.10
STATus	4.1.25
STATus ENQuiry	4.1.26
Supplementary service control messages	
HOLD	4.1.7
HOLD ACKnowledge	4.1.8
HOLD REJect	4.1.9
KEY HOLD	4.1.11
KEY RELease	4.1.12
KEY SETUP	4.1.13
KEY SETUP ACKnowledge	4.1.14
NOTIFY	4.1.15
RETRieve	4.1.20
RETRieve ACKnowledge	4.1.21
RETRieve REJect	4.1.22
Call-independent signaling messages	
FACility	4.1.6
REGister	4.1.17
RELease COMplete	4.1.19

4.1.1 ALERTing

This message 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.

ALERTing Message Content

Message type: ALERTing
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 - 3
Message Type	5.4	both	M	1
Channel Identification	5.5.1.11	u—>n	O	3
Progress Indicator	5.5.1.26	n—>u	O	4
Signal	5.5.1.30	n—>u	M	3
Redirecting Number	5.5.1.27	n—>u	O	4 - 16
Redirection Number	5.5.1.28	n—>u	O	6 - 13
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 - *

(*) Denotes codeset change

Channel identification shall be included if the ALERTing message is the first response to the SETUP message for basic call. If the channel identified by the called user is different from the one specified in the SETUP message, the network shall initiate clearing as specified in 6.1.3.

If the incoming SETUP message indicates "no channel", (e.g. additional call offering and Electronic Key Telephone Service) then the channel identification information element may optionally be included in the CONNect message 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 Section E of this specification.

Progress indicator will be included if the user is to be informed of an event that has occurred during the life of a call.

Redirecting number will be included if the call has been redirected and the address where the call was redirected is known.

Redirection number will be included if the call has been redirected and the address to which the call has been redirected is known.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.2 CALL PROCeeding

This message 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.

CALL PROCeeding Message Content

Message type: CALL PROCeeding
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 - 3
Message Type	5.4	both	M	1
Channel Identification	5.5.1.11	both	Note	3
Progress Indicator	5.5.1.26	n—>u	O	4
Notification indicator	5.5.1.22	n—>u	O	3
Information Request	5.5.1.19	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 - 5
Called Party Number	5.5.1.6	n—>u	O	4 - 27
Called Party Subaddress	5.5.1.7	n—>u	O	4 - 23
Redirection Number	5.5.1.28	n—>u	O	6 - 13
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 - *

+ Not supported at this time.
(*) Denotes codeset change

Channel identification is mandatory in the n—>u direction if this message is the first message in response to SETUP. It shall be included in the u—>n direction if this message is the first response to the SETUP message for a basic call. If the channel identified is different from the one specified in the SETUP message, the network will initiate clearing as specified in 6.1.3.

If the incoming SETUP message indicates "no channel", (e.g. additional call offering and Electronic Key Telephone Service) then the channel identification information element may optionally be included in the CONNect message 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 Section E of this specification.

Notification indicator will be included if the user is to be informed of information pertaining to call.

Feature indication will be 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 will be included for supplementary services such as Automatic Dial to inform the user of the actual called number used by the network.

Progress indicator will be included if the user is to be informed of an event that has occurred during the life of a call.

Information request will be included in the network to user direction if the network requests additional information or the network indicates completion of the information request.

Signal will be included if the network is providing additional information describing tones.

Called Party Subaddress will be included, if available, in the network to user direction during call pickup.

Redirection number will be included if the call has been redirected and the address where the call was redirected is known.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.3 CONNect

This message 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.

CONNect Message Content

Message type: CONNect
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 - 3
Message Type	5.4	both	M	1
Connected Number	5.5.1.12	n—>u	O	4 - 16
Channel Identification	5.5.1.11	u—>n	O	3
Progress Indicator	5.5.1.26	n—>u	O	4
Notification Indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication†	5.5.1.16	n—>u	O	4 - 5
User-User†	5.5.1.33	Both	O	3 -131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 - *

† Not supported at this time.
(*) Denotes codeset change

Connected number will be included if the connected number is known and is different from the original called party number.

Channel identification shall be included if this message is the first response to a SETUP message for basic call. If the channel identification is different for the case of an exclusive channel specified in the SETUP message, the network will initiate clearing as specified in 6.1.3.

If the incoming SETUP message indicates "no channel", (e.g. additional call offering and Electronic Key Telephone Service) then the channel identification information element may optionally be included in the CONNect message 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 Section E of this specification.

Notification indicator will be included to inform the user of information pertaining to a call.

Progress indicator will be included if the user is to be informed of an event that has occurred during the life of the call.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

User-user is optionally supported and provides movement of information between ISDN users transparently.

Signal will be included if audible ringing tone was turned on previously.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.4 CONNect ACKnowledge

This message 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.

CONNect ACKnowledge Message Content

Message type: CONNect ACKnowledge
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Connected Number	5.5.1.12	n—>u	O	4 – 16
Channel Identification	5.5.1.11	n—>u	O	3
Notification indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Display Text	5.5.2.2	n—>u	O	4 – *

Connected number will be included when the address of the remote party connected to the call is available to the network.

Channel identification will only be present when the initial incoming SETUP message indicates "no channel". If the channel is successfully assigned it will be indicated as exclusive in the Channel identification information element.

Notification indicator will be included if the user is to be informed of information pertaining to a call.

Signal will be included if the network is providing additional information describing tones.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available, or to clear the display. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.5 DISConnect

This message is sent by the user to request the network to clear an end-to-end connection or is sent by the network to indicate that the end-to-end connection is cleared.

DISConnect Message Contents

Message type: DISConnect
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Cause	5.5.1.10	both	M Note	4 – 5
Information Request	5.5.1.19	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 – 5
Redirection Number	5.5.1.28	n—>u	O	6 – 13
User-User†	5.5.1.33	Both	O	3- 131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 – *

† Not supported at this time.
(*) Denotes codeset change

Note

Cause is mandatory because the DISConnect message is the first clearing message. If a DISConnect message is received with the Cause information element missing or having invalid contents, then the actions taken will be the same as if a DISConnect message with cause value #31 "normal, "unspecified" were received.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Information request will be included in the network to user direction if the network requests additional information or the network indicates completion of the information request.

Signal will be included if the network is providing additional information describing tones.

User-user is optionally supported and provides movement of information between ISDN users transparently.

Redirection number will be included if the call has been redirected and the address where the call was redirected is known.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call for display purpose, or to clear the display. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.6 FACility

This message 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.

FACility Message Contents

Message type: FACility
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Facility	5.5.1.14	both	M	8 – *

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

4.1.7 HOLD

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

HOLD Message Contents

Message type: HOLD
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 - 3
Message Type	5.4	both	M	1
Signal	5.5.1.30	n—>u	O	3
Feature Indication +	5.5.1.16	n—>u	O	4 - 5

+ Not supported at this time.

Signal will be included if the network is providing additional information describing tones.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

4.1.8 HOLD ACKnowledge

This message is sent by the user or network to indicate that the HOLD request has been successfully performed.

HOLD ACKnowledge Message Contents

Message type: HOLD Acknowledge
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 - 3
Message Type	5.4	both	M	1
Notification indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication†	5.5.1.16	n—>u	O	4 - 5
Display Text	5.5.2.2	n—>u	O	4 - *

† Not supported at this time.

Notification indicator will be included if the user is to be informed of information pertaining to a call.

Signal will be included if the network is providing additional information describing tones.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.9 HOLD REJect

This message is sent by the user or network to indicate denial of a request to hold a call.

HOLD REJect Message Contents

Message type: HOLD REJect
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Cause	5.5.1.10	both	M	4 – 5

Endpoint identifier will be 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.

Progress indicator will be included if the user is to be informed of an event that has occurred during the life of a call.

Redirection number will be included if the call has been redirected and the address where the call was redirected is known.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

Protocol Version Control 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. The primary purpose of PVC is to allow a terminal to continue to operate at a given BCS release functionality, without forcing firmware upgrades as the CO is upgraded to newer BCS releases.

Locking Shift will be 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 which specifies the use of another codeset.

4.1.11 KEY HOLD

This message is sent by the network to inform the non-selected members of the EKTS group that the incoming call has been answered.

KEY HOLD Message Content

Message type: KEY HOLD
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 – 3
Message Type	5.4	n—>u	M	2
Cause	5.5.1.10	n—>u	O	4 – 5
Notification indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Display Text	5.5.2.2	n—>u	O	4 – *

Cause will be included under certain supplementary service error conditions.

Notification indicator will be included if the user is to be informed of information pertaining to privacy on an EKTS call.

Signal will be included if the network is providing additional information describing tones.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.12 KEY RELease

This message is sent by the network to notify an EKTS member that the call is not to be cleared.

KEY RELease Message Contents

Message type: KEY RELease
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 – 3
Message Type	5.4	n—>u	M	2
Notification Indicator	5.5.1.22	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 – 5
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 – *

(*) Denotes change of codeset.

Notification indicator will be included to inform the user of information pertaining to a call.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available, or to clear the display. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.13 KEY SETUP

This message is sent by the network, to members of an EKTS group, to indicate that an outgoing EKTS call has been initiated.

KEY SETUP Message Contents

Message type: KEY SETUP
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 - 3
Message Type	5.4	n—>u	M	2
Bearer Capability	5.5.1.4	n—>u	M	4 - 6
Notification indicator	5.5.1.22	n—>u	O	3
Endpoint Identifier	5.5.1.13	n—>u	M	3 - 4
Called Party Number	5.5.1.6	n—>u	M	4 - 27
User-User†	5.5.1.33	n—>u	O	3 -131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 - *
Locking Shift (*)	5.5.1.2	n—>u	O	1
Call Appearance	5.5.3.1	n—>u	O	3 - 4

† Not supported at this time.
(*) Denotes codeset change.

Notification indicator will be included if the user is to be informed of information pertaining to a call.

User-user provides movement of information between ISDN users transparently.

Locking shift will be included if network or national specific information elements are included.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call,

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

Call Appearance will be included to identify the intercom group for an intercom call.

4.1.14 KEY SETUP ACKnowledge

This message is sent by the user in response to a KEY SETUP message sent by the network.

KEY SETUP ACKnowledge Message Contents

Message type: KEY SETUP ACKnowledge
Direction: u—>n

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	u—>n	M	1
Call Reference	5.3	u—>n	M	2 - 3
Message Type	5.4	u—>n	M	2

4.1.15 NOTIFY

This message is sent by the network to indicate information pertaining to a call.

NOTIFY Message Contents

Message type: NOTIFY
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 – 3
Message Type	5.4	n—>u	M	1
Bearer Capability	5.5.1.4	n—>u	O	4 – 6
Cause	5.5.1.10	n—>u	O	4 – 5
Connected Number	5.5.1.12	n—>u	O	4 – 16
Notification Indicator	5.5.1.22	n—>u	M	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 – 5
Calling Party Number	5.5.1.8	n—>u	O	4 – 16
Calling Party Subaddress†	5.5.1.9	n—>u	O	4 – 23
Called Party Number	5.5.1.6	n—>u	O	10
Called Party Subaddress†	5.5.1.7	n—>u	O	4 – 23
Redirecting Number	5.5.1.27	n—>u	O	4 – 16
Redirection Number	5.5.1.28	n—>u	O	6 – 13
User–User†	5.5.1.33	n—>u	O	3 –131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 – *

† Not supported at this time.
(*) Denotes change of codeset.

Connected number will be included for supplementary services such as Executive Busy Override, when the connected number is available.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

Feature indication will be 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 will be included when applicable for supplementary services.

Redirection number will be included when applicable for supplementary services.

Bearer capability will be included to indicate the Bearer capability the NOTify message applies to, as applicable for supplementary services.

Signal will be included if the network is providing additional information describing tones.

Calling party subaddress will be included to update a subaddress associated with the origin of the call.

Called party subaddress will be included to update a subaddress associated with the called interface.

User-user is optionally supported and provides movement of information between ISDN users transparently.

4.1.16 PROGress

This message is sent by the network to indicate the progress of a call, in the event of interworking or in relation with the provision of in-band information/patterns.

PROGress Message Content

Message type: PROGress
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 - 3
Message Type	5.4	n—>u	M	1
Cause	5.5.1.10	n—>u	O	4 - 5
Progress Indicator	5.5.1.26	n—>u	M	4
Notification Indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
User-User†	5.5.1.33	n—>u	O	3 -131
Display Text	5.5.2.2	n—>u	O	4 - *

† Not supported at this time.

Cause will be included to provide additional information when there is in-band treatment applied to the call and there is a cause which maps to that in-band treatment. Otherwise, it will not be included.

Notification Indicator will be included if the user is to be informed of information pertaining to the call.

Signal will be included if the network is providing additional information describing tones.

User-user is optionally supported and provides movement of information between ISDN users transparently.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this infor-

mation element is variable, and the maximum length (*) is dependent on its contents.

4.1.17 REGister

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

REGister Message Contents

Message type: REGister
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Facility	5.5.1.14	both	M	11 – *

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

4.1.18 RELease

This message is sent, from either the user or the network, to indicate that the equipment sending the message has disconnected the channel (if any) and intends to release the channel and call reference, and that the receiving equipment should release the channel and prepare to release the call reference after sending RELease COMplete.

RELease Message Contents

Message type: RELease
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Cause	5.5.1.10	both	Note	4 – 6
Channel Identification†	5.5.1.11	n—>u	O	3
Information Request	5.5.1.19	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 – 5
Redirection Number†	5.5.1.28	n—>u	O	6 – 13
User-User†	5.5.1.33	n—>u	O	3– 131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 – *

† Not supported at this time.

Note

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

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Channel identification is mandatory in the n—>u direction. If not included in the u—>n direction, its absence will be interpreted as "any channel acceptable".

Information request will be included in the n—>u direction to request additional information or indicate completion of the information request.

User-user is optionally supported and provides movement of information between ISDN users transparently.

Locking shift will be included if network or national specific information elements are included.

Redirection number will be included if the call has been redirected and the address to which the call has been redirected is known.

Signal will be included if the network is providing additional information describing tones.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call for display purpose, or to clear the display. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.19 RELease COMplete

This message is sent by the user or the network, to indicate that the equipment sending the message has released the channel (if any) and call reference, the channel is available for reuse, and the receiving equipment shall release the channel and call reference.

RELease COMplete Message Contents

Message type: RELease COMplete
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Cause	5.5.1.10	both	O	4 – 5
Information Request	5.5.1.19	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 – 5
Redirection Number†	5.5.1.28	n—>u	O	6 – 13
User-User†	5.5.1.33	u—>n	O	3 –131
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 – *

† Not supported at this time.
(*) Denotes codeset change.

Note

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

Display Text will be included by the network to notify the user of certain supplementary service information related to the call for display purpose, or to clear the display. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Information request will be included in the n—>u direction if the network requests additional information or indicate completion of the information request.

Signal will be included if the network is providing additional information describing tones.

User-user is optionally supported and provides movement of information between ISDN users transparently.

Redirection number will be included if the call has been redirected and the address to which the call has been redirected is known.

4.1.20 RETRieve

This message is sent by the user or network to request retrieval of a held call.

RETRieve Message Contents

Message type: RETRieve
Direction: Both (Note) +

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	u—>n	M	1
Call Reference	5.3	u—>n	M	2 – 3
Message Type	5.4	u—>n	M	1
Channel Identification	5.5.1.11	Note	Note	3

Notes

+ Direction is shown as "Both", however only the u—>n direction as shown in the message layout above is supported at this time.

Channel identification if not included it is interpreted as "any channel acceptable". In the u—>n direction it is Optional. In the n—>u direction it is mandatory, however the n—>u direction is not supported at this time.

4.1.21 RETRieve ACKnowledge

This message is sent by the user or network to indicate that the retrieve function has been successfully performed.

RETRieve ACKnowledge Message Contents

Message type: RETRieve Acknowledge
Direction: Both(Note) †

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 - 3
Message Type	5.4	n—>u	M	1
Connected Number	5.5.1.12	n—>u	O	4 - 16
Channel Identification	5.5.1.11	Note	M	3
Notification indicator	5.5.1.22	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication†	5.5.1.16	n—>u	O	4 - 5
Locking Shift (*)	5.5.1.2	n—>u	O	1
Display Text	5.5.2.2	n—>u	O	4 - *

† Not supported at this time
(*) Denotes codeset change

Note

† Direction is shown as "Both", however only the n—>u direction as shown in the message layout above is supported at this time.

Channel Identification is to be handled in both directions, however at this time only the n—>u direction is supported.

Connected number will be included to notify the user of the address of the remote party connected to the call, when this information is available to the network.

Notification indicator will be included if the user is to be informed of information pertaining to a call.

Signal will be included if the network is providing additional information describing tones.

Feature indication will be included in the n—>u direction to inform the user of the current status of the identified feature.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call for display purposes. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

4.1.22 RETRieve REJect

This message is sent by the network to indicate an inability to perform the requested retrieve function.

RETRieve REJect Message Contents

Message type: RETRieve REJect
Direction: Both(Note) †

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 - 3
Message Type	5.4	n—>u	M	1
Cause	5.5.1.10	n—>u	M	4 - 5

Note

† Direction is shown as "Both", however only the n—>u direction is supported at this time.

4.1.23 SETUP

This message 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.

SETUP Message Contents

Message type: SETUP
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Bearer Capability	5.5.1.4	both	M	4 – 6
Channel Identification	5.5.1.11	Note 1	O	3
Progress Indicator	5.5.1.26	n—>u	O	4
Keypad	5.5.1.20	u—>n	O	3 –34
Signal	5.5.1.30	n—>u	M	3
Feature Activation	5.5.1.15	u—>n	O	3 – 4
Endpoint Identifier	5.5.1.13	n—>u	O	3 – 4
Information Rate†	5.5.1.18	Note 2	O	6
Transit Delay Selection/ and Indication†	5.5.1.31	Note 2	O	5
Packet Layer Binary Parameters†	5.5.1.23	Note 2	O	3
Packet Layer Window Size†	5.5.1.24	Note 2	O	3 – 4
Packet Size†	5.5.1.25	Note 2	O	3 – 4

† Not supported at this time.

Calling Party Number	5.5.1.8	both	O	4 –16
Calling Party Subaddress	5.5.1.9	both	O	4 –23
Called Party Number	5.5.1.6	both	O	6 –29
Called Party Subaddress	5.5.1.7	both	O	4 –23
Redirecting Number	5.5.1.27	n—>u	O	4 –16
Transit Network Selection	5.5.1.32	u—>n	O	6 – 7
Low-Layer Compatibility	5.5.1.21	both	O	4 –16
High-Layer Compatibility	5.5.1.17	both	O	4 – 5
User-User†	5.5.1.33	both	O	3 –131
Locking Shift (*)	5.5.1.2	u—>n	O	1
Operator System Access	5.5.2.1	u—>n	O	3
Display Text	5.5.2.2	n—>u	0	4 – *
Locking Shift (*)	5.5.1.2	both	O	1
Closed User Group†	5.5.3.2	Note 3	O	4 – 7
Reverse Charging Indication†	5.5.3.6	n—>u	O	3
Redirecting Subaddress†	5.5.3.4	Note 4	O	4 –23
Call Appearance	5.5.3.1	Note 5	O	3 – 4

† Not supported at this time.
(*) Denotes change of codeset.

Progress indicator will be included if an interworking situation has occurred.

Keypad shall be used either for en-bloc or overlap sending when the called party number information element is not used.

Feature activation shall be included in the user to network direction for invocation of supplementary services, as defined in section E of this specification.

Endpoint identifier will be included to identify the terminal(s) to which the message is destined (Only included for EKTS terminals. Not supported for hunt terminals at this time).

Calling party number is required in the u—>n 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 message. In the n—>u direction, this information is made available to the called user upon subscription to Calling Number Delivery service.(See Section G)

Called party number is mandatory in the n—>u direction for basic call. However it may not present when certain supplementary services are in effect (see Section 6.1.2.1 "Incoming Call").

Redirecting number will be included to identify the number from which call redirection was invoked.

Locking shift will be included if network or national specific information elements are included.

Call appearance shall/will be included to identify the intercom group for an intercom call.

Calling party subaddress if subscribed to in the u—>n direction, it can be included to identify a subaddress associated with the origin of the call. This subaddress will be present in the n—>u direction when supplied by the calling user and it is successfully transferred through the network. (For the n—>u direction its presence is only valid if calling party number is also present in the SETUP message)(Note 7)

Called party subaddress will be included to verify a subaddress associated with the called interface.(Note 7)

Low-layer compatibility if subscribed to in the u—>n direction, and provided in the outgoing SETUP message, it will be included to allow remote users to check compatibility unless it could not be successfully transferred through the network. (Note 6)

High-layer compatibility will be included to allow remote users to check compatibility.(Note 6)

Transit network selection should be used to provide information such as Type of network, Network identification plan, and the Network identification. Alternatively, the keypad information element shall be used for this purpose.

User-user. is optionally supported and provides movement of information between ISDN users transparently.+

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 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. +

Operator system access should be used to indicates the required operator through Type of access. Alternatively, the keypad information element should be used for this purpose.

Display Text will be included by the network to notify the user of certain supplementary service information related to the call, when display information is available. The length of this information element is variable, and the maximum length (*) is dependent on its contents.

Reverse charging indication will be included, by the network, in the SETUP message 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. +

Notes

Note 1 - Channel identification information element is mandatory in the n—>u direction. However, for some features (eg. Additional Call Offering 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 u—>n direction, its absence is interpreted as "any channel acceptable".

Note 2 - Included for packet-mode calls when notification is unconditional and in the n—>u 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 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.

+ Not supported at this time.

4.1.24 SETUP ACKnowledge

This message 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.

SETUP ACKnowledge Message Contents

Message type: SETUP ACKnowledge
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 - 3
Message Type	5.4	n—>u	M	1
Channel Identification	5.5.1.11	n—>u	M	3
Progress Indicator	5.5.1.26	n—>u	O	4
Notification indicator	5.5.1.22	n—>u	O	3
Information Request	5.5.1.19	n—>u	O	3
Signal	5.5.1.30	n—>u	O	3
Feature Indication	5.5.1.16	n—>u	O	4 - 5

Notification indicator will be included if the user is to be informed of information pertaining to a call.

Information request will be included in the network to user direction if the network requests additional information or the network indicates completion of the information request.

Feature indication will be included in the network to user direction if the user is to be informed of the current status of the identified feature.

Progress indicator will be included if an interworking situation has occurred.

Signal will be included if the network is providing additional information describing tones.

4.1.25 STATus

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

STATus Message Contents

Message type: STATus
Direction: Both

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	both	M	1
Call Reference	5.3	both	M	2 – 3
Message Type	5.4	both	M	1
Cause	5.5.1.10	both	M	4 – 6
Call State	5.5.1.5	both	M	3

4.1.26 STATus ENQuiry

This message is sent by the network at any time during a call to solicit a STATUS message from the user.

STATus ENQuiry Message Contents

Message type: STATus ENQuiry
Direction: n—>u

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	5.2	n—>u	M	1
Call Reference	5.3	n—>u	M	2 – 3
Message Type	5.4	n—>u	M	1

5.0 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 specified in Section 5. Only those information elements whose use is currently defined in Section 5 currently apply to the message sequences in this software release.

5.1 OVERVIEW

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

a. Protocol Discriminator

b. Call Reference

c. Message Type

d. 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 organization is illustrated in the example shown in Figure 5–1.

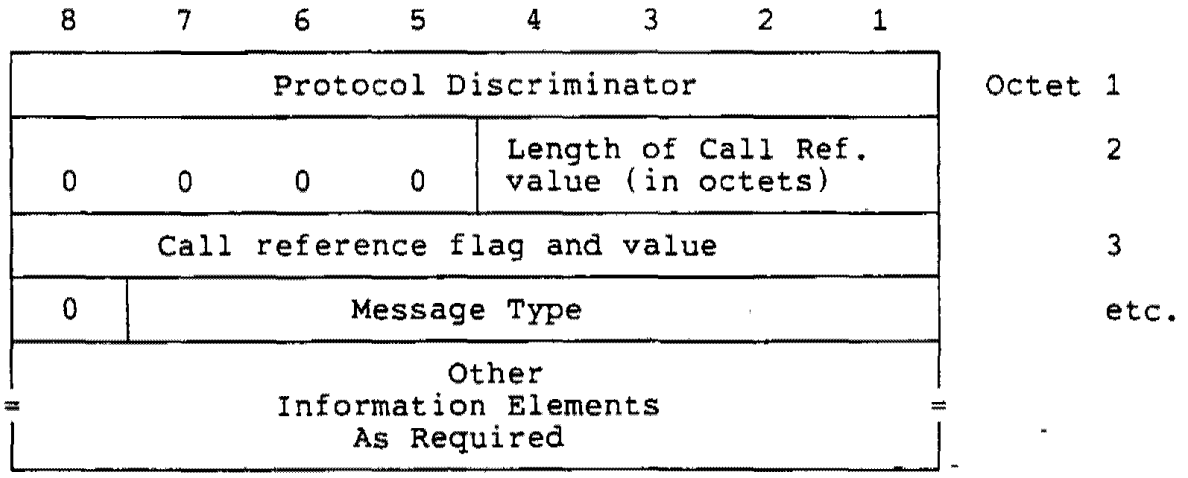


Figure 5–1. General Message Organization Example

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. For example, the calling party number may be ignored by the recipient if that number 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.

5.2 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 according to Figure 5-2.

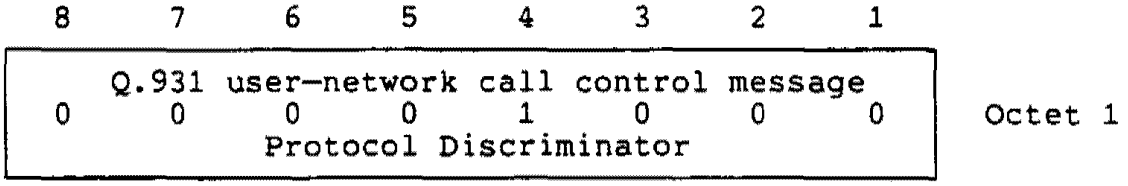


Figure 5-2. Protocol Discriminator

8	7	6	5	4	3	2	1	
0	0	0	0	1	0	0	0	Q.931(I.451) user-network call control messages.

5.3 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.

The maximum length of the call reference value is two octets. The terminal should support call reference lengths of both one and two 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 Figures 5-5 and 5-6).

The call reference information element includes the call reference value and the call reference flag.

Call reference values are assigned by the origination side of the interface for a call. These values are unique to the origination side only within a particular D-channel layer two logical link connection. The call reference value is assigned at the beginning of a call and remains fixed for the lifetime of a call. After a call ends, the associated call reference value may be reassigned to a later call. Two identical call reference values on the same D-Channel layer two logical link connection may be used when each value pertains to a call originated at opposite ends of the link.

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.

The call reference information element containing a dummy or null call reference is one octet long and is coded "0000 0000", as shown in Figure 5-4. The dummy call reference is used for stimulus invocation of supplementary services only.

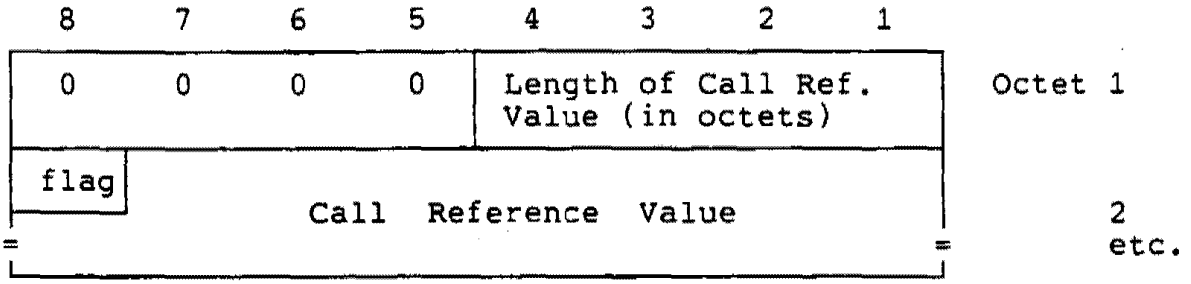


Figure 5-3. Call Reference information element

Call Reference Flag (octet 2)

Bit
8

0 The message is sent from the side that originates the call reference.
1 The message is sent to the side that originates the call reference.

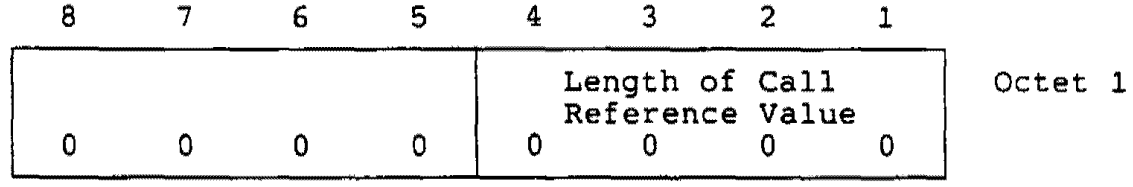


Figure 5-4. Dummy Call Reference

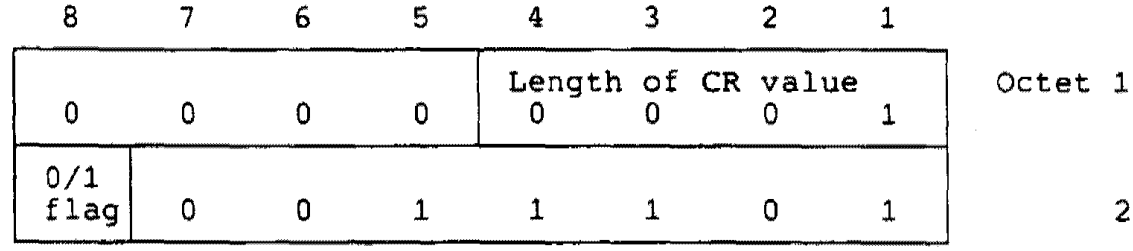


Figure 5-5. One-octet Call Reference Value

8	7	6	5	4	3	2	1	
0	0	0	0	Length of CR value 0	0	1	0	Octet 1
0/1 flag	0	0	0	0	0	0	0	2
0	0	0	1	1	1	0	1	3

Figure 5-6. Two-octet Call Reference Value

Examples of Encoding for Call Reference

5.4 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. The message type is coded as shown in the following tables.

Bit 8 is reserved for possible future use as an extension bit.

8	7	6	5	4	3	2	1	
0	Message Type							Octet 1
1	Network Specific Message Type							2*

* included if octet 1 is coded "0000 0000".

Message Types

8	7	6	5	4	3	2	1	
0	0	0	0	0	0	0	0	Escape to network specific message types
0	0	0	–	–	–	–	–	Call establishment 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	0	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	1	1	–	–	–	–	–	Miscellaneous messages:
			0	0	0	1	0	– FACility
			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

5.4.1 Network Specific Message Types

A 2-octet element shall be used to encode network specific message types for supplementary services. The first octet shall be encoded as all zeros, indicating an escape to a network specific coding scheme. Bit 8 of octet 2 is coded as '1'.

Message Types (Octet 2)

8	7	6	5	4	3	2	1	
1	–	–	–	–	–	–	–	Network-specific messages:
	1	1	1	1	0	1	1	– KEY HOLD
	1	1	1	1	1	0	0	– KEY RELease
	1	1	1	1	1	0	1	– KEY SETUP
	1	1	1	1	1	1	0	– KEY SETUP ACKnowledge

5.5 OTHER INFORMATION ELEMENTS

5.5.1 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 shown in figures 5-7 and 5-8 :

a. Single Octet Information Elements

b. Variable Length Information Elements

For the information elements listed below, the coding of the information element identifier bits for codeset 0 is summarized in Figure 5-9 . The 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, the information element will be ignored.

Single octet information elements may appear at any point in the message. These information elements are considered valid over all codesets.

In the DMS-100, information elements will be transmitted in ascending order of information element identifier value within a specific codeset. All information elements belonging to the CCITT Q.931 codeset will appear at the beginning of each message.

Upon initial examination the active codeset is assumed to be zero (ie. 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 (eg. 6="network specific"). See "Locking Shift Procedure" on page D-67 for more information on locking shift.

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 shall not be rejected simply because a spare bit is set to "1".

Octet 2 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. 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.

a. 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.

b. Optional octets are marked with asterisks (i.e. *).

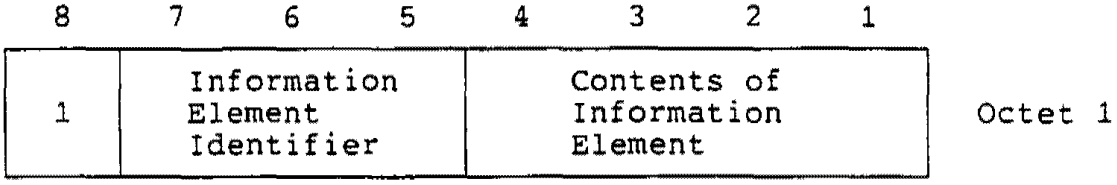


Figure 5-7 Single Octet Information Element Format

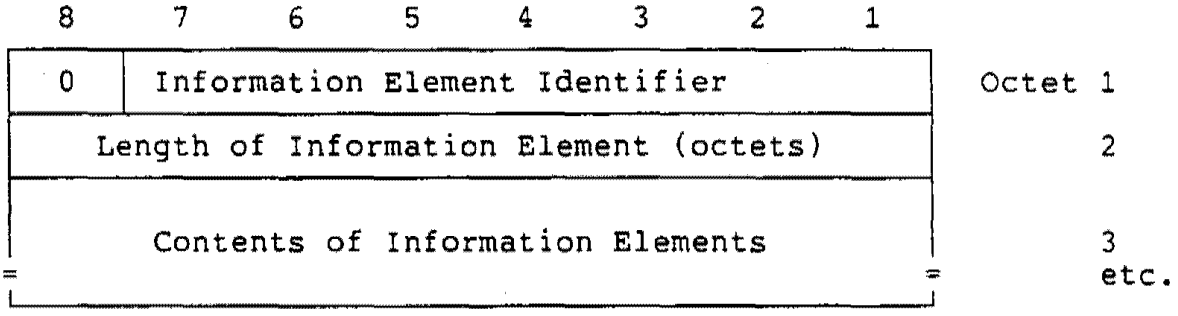


Figure 5-8 Variable Length Information Element Format

Formats of Information Elements

Information Element Identifier								
8	7	6	5	4	3	2	1	
1	:	:	:	—	—	—	—	Single Length Information Element
1	0	0	1	0	X	X	X	Locking shift
0	:	:	:	:	:	:	:	Variable Length Information Element
	0	0	0	0	1	0	0	Bearer Capability
	0	0	0	1	0	0	0	Cause
	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	0	0	Facility
	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 Identification
	0	1	1	1	0	1	1	Endpoint Identifier
	1	0	0	0	0	0	0	Information Rate †
	1	0	0	0	0	1	1	Transit Delay Selection and Indication †
	1	0	0	0	1	0	0	Packet Layer Binary Parameters †
	1	0	0	0	1	0	1	Packet Layer Window Size †
	1	0	0	0	1	1	0	Packet Size †
	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	1	0	0	Low-Layer Compatibility
	1	1	1	1	1	0	1	High-Layer Compatibility
	1	1	1	1	1	1	0	User-User Information ††

Figure 5-9 Information Element Identifier Coding (Codeset 0)

† For packet-mode calls and not supported at this time.
†† Not supported at this time.

5.5.1.1 Extensions of Codesets

There are 136 possible information element identifier values using the formatting rules described in 5.5.1, 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 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 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 5.5.1 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 terminal shall have the capability to recognize a shift information element and to determine the length of the following 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 it should be able to interpret.

5.5.1.2 Locking Shift Procedure

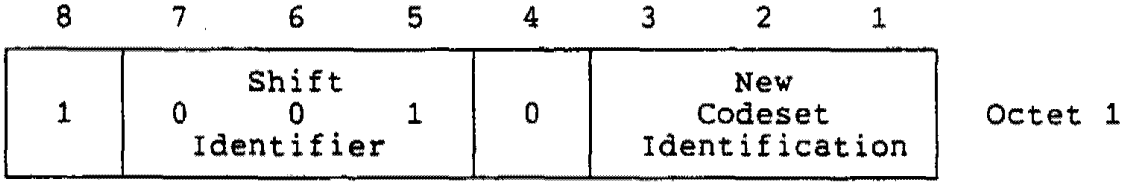
The locking shift procedure employs the locking shift information element (single octet) to indicate the new active codeset. The specified codeset remains active until another locking shift in-

formation 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 codeset 5., i.e. a National specific codeset, is encountered, the next information elements will typically be interpreted according to the information element identifiers assigned in codeset 5. For a locking shift to codeset 6 the same procedure will follow until another 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 element uses the single octet information information element format and coding.



Note – Bit 4=0; implies locking shift procedure

Locking Shift Information Element

Locking shift element

Codeset Identification (bits 1–3)

Bits 3 2 1	
0 0 0	Codeset 0 (Q.931 information elements)
1 0 1	Codeset 5 (national specific information elements)
1 1 0	Codeset 6 (information elements specific to local serving network)

5.5.1.3 Nonlocking Shift Procedure

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

When the network receives a message containing the nonlocking shift information element, it will recognize the nonlocking shift information element and ignore the information element following it. Both the nonlocking shift information element and the element following it are then discarded, and the network takes action as follows:

- If, after discarding the nonlocking shift and following information element, the remaining message is missing a mandatory information element (e.g., the discarded IE following the nonlocking shift IE was a mandatory information element), the network returns cause # 96 "mandatory information element missing" in a subsequent message as described in section 6.1.4.6.2.

- Otherwise, the network follows the procedures for handling an unrecognized, non-mandatory information element as described in section 6.1.4.7.

The nonlocking shift element uses the single octet information information element format and coding.

8	7	6	5	4	3	2	1	
1	0	Shift 0	1	1	New Codeset Identification			Octet 1
		Identifier						

Note – Bit 4=1; implies nonlocking shift procedure

Nonlocking Shift Information Element

5.5.1.4 Bearer Capability

This information element indicates provision by the network, of one of the bearer capabilities as defined in TR268 issue 2 and CCITT Recommendations I.230, I.231 and I.232 (1988).

No default bearer capability will be assumed by the absence of this information element.

The Bearer capability information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Bearer Capability Information Element Identifier							Octet 1
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.	0 Layer 1 Id	1	User information layer 1 protocol					5*
1 Ext.	0	0	user rate					5a* a)
1 Ext.	User information layer 2 protocol							6+(Note)*
1 Ext.	User information layer 3 protocol							7+(Note)*

+ Not implemented in this release,
Bearer capability information element

a) This octet will be present if octet 5 is set to 0010 0001, indicating rate adaption.

Note. Octets 6 and 7 are only included for packet-mode.

Extension Bit (Octets 4, 5, - Bit 8)

0 description continues through next octet
1 last octet of description

Coding standard (Octet 3)

Bits	7 6	
	0 0	CCITT standard as in Recommendation Q.931

All other values are reserved

Information Transfer Capability (Octet 3)

Bits	5 4 3 2 1	
	0 0 0 0 0	Speech
	0 1 0 0 0	Unrestricted Digital Information
	0 1 0 0 1	Restricted Digital Information (Note 1)
	1 0 0 0 0	3.1 kHz audio (Note 2)
	1 0 0 0 1	7 kHz audio

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.

All other values are reserved

Transfer Mode (Octet 4)

Bits	7 6	
	0 0	circuit mode
	1 0	packet-mode #

This value is not implemented

All other values are reserved

Information Transfer Rate (Octet 4)

Bits	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 TR268 issue 2. 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.

Layer and Protocol Identification (Octets 5, 5a)

This field identifies the protocols and data rate adaption used upon the user information on the access channel at the user/network interface.

User Information Layer 1 Protocol (Octet 5)

Bits	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 are reserved

User Rate (Octet 5a)

Bits	5 4 3 2 1	Synchronous Rate
	0 1 1 1 1	Rate adaption from 56kbs (Rec. I.463)

All other values are reserved

User Information Layer 2 Protocol (Octet 6)#

Bits	7 6 5 4 3 2 1	Meaning
	1 0 0 0 0 1 0	LAPD (Recommendation Q.921/I.441)#
	1 0 0 0 1 1 0	LAPB (Recommendation X.25, link level)#

This value is not implemented

All other values are reserved

User Information Layer 3 Protocol (Octet 7)#

Bits	7 6 5 4 3 2 1	Meaning
	1 1 0 0 1 1 0	Recommendation X.25, packet level #

This value is not implemented

All other values are reserved

Encoding: The encodings of this information element, for the bearer services implemented by DMS-100 are:

ATTRIBUTE	ENCODING	OCTET
(1) Speech, circuit-mode		
Transfer capability = speech	1 00 00000	3
Transfer mode and rate = circuit-mode 64 kbps	1 00 10000	4
Layer 1 protocol ID = Mu-law	1 01 00010	5
Octets 5a, 6, and 7 are not present		
(2) 3.1 kHz, circuit-mode		
Transfer capability = 3.1 KHz	1 00 10000	3
Transfer mode and rate = circuit, 64 kbps	1 00 10000	4
Layer 1 protocol ID = Mu-law	1 01 00010	5
Octet 5a, 6 and 7 are not present		
(3) 64 kbps, unrestricted digital information, rate adapted from 56 kbps		
Transfer capability = unrestr. digital	1 00 01000	3
Transfer mode and rate = circuit-mode 64 kbps	1 00 10000	4
Layer 1 protocol ID = Rate adaption	0 01 00001	5
Data rate = 56 kbps	1 00 01111	5a
Octets 6 and 7 are not present		
(4) 64 kbps, unrestricted digital information, circuit-mode		
Transfer capability = unrestr. digital	1 00 01000	3
Transfer mode and rate = circuit-mode 64 kbps	1 00 10000	4
Octets 5, 5a, 6, and 7 are not present.		
(5) 64 kbps restricted, circuit-mode (note)		
Transfer capability = restricted digital	1 00 01001	3
Transfer mode and rate = circuit, 64 kbps	1 00 10000	4
Octets 5, 5a, 6# and 7# are not present.		

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

ATTRIBUTE	ENCODING	OCTET
(6) 7 kHz audio, circuit mode		
Transfer capability = 7 kHz	1 00 10001	3
Transfer mode and rate = circuit, 64 kbps	1 00 10000	4
Layer 1 protocol ID = Recomm. G.722/G.725	1 01 00101	5
Octet 5a, 6, and 7 are not present		

5.5.1.5 Call State

The purpose of the Call state information element is to describe the current status of the call.

The Call state information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Call State Information Element Identifier							Octet 1
								2
								3

Length of call state contents

Call State Value (state value is coded in binary)

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	(not applicable)	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 message from the network if in the Active state. It is recommended that terminals should track all states, and respond to a STATus ENQuiry message from the network when in any state other than Null.

5.5.1.6 Called Party Number

The purpose of the Called party number information element is to identify one called party of a call.

The Called party number information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Called Party Number 1 1 1 0 0 0 0 Information Element Identifier							Octet 1
Length of called party number contents								2
1 Ext.	Type of Number			Numbering Plan Identification				3
= 0	Number digits (IA5 characters)						=	4 etc.

Called party number information element

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.

Type of Number (octet 3)

Bits	7	6	5	
	0	0	0	unknown (Note 1)
	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.

Prefix and escape digits are not included for all values except "unknown".

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, e.g. prefix or escape digits may be present.

Numbering plan identification (octet 3)

Bits 4 3 2 1	Numbering plan
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) +
1 0 0 1	Private numbering plan

+ For packet-mode calls and not supported at this time.

All other values are reserved.

Number digits (octets 4, etc.)

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

NOTE: Use of "*" and "#" is only valid if the TON/NPI associated with the Called Party Number is coded to Unknown/Unknown.

5.5.1.7 Called Party Subaddress

The Called party subaddress information element identifies a subaddress associated with the called interface. It is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Called Party Subaddress 1 1 1 0 0 0 1 Information Element Identifier							Octet 1
Length of called party subaddress information								2
1 Ext	Type of Subaddress		odd/ even indic	0	0	0 Spare		3
Subaddress Information								4 etc.

Called party subaddress information element

The various parts of the called party subaddress information element are coded as follows.

Type of subaddress (octet 3)

Bits	7	6	5	Meaning
	0	0	0	NSAP (X.213/ISO 8348 AD2)
	0	1	0	user specified

All other values are reserved

Odd/even indicator (octet 3)

Bit	4	Meaning
	0	even number of digits in subaddress
	1	odd number of digits in subaddress

Note: Subscription parameters are found in Section "G".

5.5.1.8 Calling Party Number

The purpose of the Calling party number information element is to identify the origin of a call.

The Calling party number information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Calling Party Number 1 1 0 1 1 0 0 Information Element Identifier							Octet 1
Length of calling party number contents								2
0/1 Ext.	Type of Number			Numbering Plan Identification				3
1 Ext.	Present. Indicator		0 0 0 Spare				Screening Indicator	3a*
= 0 Spare	Number digits (IA5 characters)						=	4* etc.

* This octet may be omitted

Calling party number information element

The number digit in octet 4 precedes digit in octet 5, etc.

Type of Number (octet 3)

Bits 7 6 5	
0 0 0	unknown
0 0 1	international number
0 1 0	national number
0 1 1	network specific number †
1 0 0	subscriber number (Note 1)
1 1 0	abbreviated number

All other values are reserved.

† Not supported at this time.

Notes: 1. Only supported in user to network direction.

2. Prefix and escape digits are not to be included in the "Number Digits" field.

Numbering plan identification (octet 3)

Bits 4 3 2 1	Numbering plan
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) +
1 0 0 1	Private numbering plan

All other values are reserved.

+ Not supported at this time.

Presentation Indicator (octet 3a)

Bits 7 6	
0 0	Presentation allowed (note)
0 1	Presentation restricted (note)
1 0	Number not available due to interworking
1 1	Reserved

Note: Only "Presentation allowed" is supported in the user to network direction. If omitted in the user to network direction the subscription default of "Presentation allowed" or "Presentation restricted" is assumed. All Presentation Indicator values except "Reserved" are supported in the network to user direction; however, "Presentation restricted" is currently only used when the calling user has subscribed to presentation restriction of their number.

Screening Indicator (octet 3a)

Bits 2 1	
0 0	User-provided, not screened (note)
0 1	User-provided, verified and passed (note)
1 0	User-provided, verified and failed (note)
1 1	Network-provided (note)

Note: 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 always coded as Network Provided.

Number digits (octets 4, etc.)

Bits 7 6 5 4 3 2 1	Address digit value
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

5.5.1.9 Calling Party Subaddress

The calling party subaddress information element identifies a subaddress associated with the origin of a call. It is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Calling Party Subaddress 1 1 0 1 1 0 1 Information Element Identifier							Octet 1
Length of calling party subaddress information								2
1 Ext.	Type of Subaddress			odd/ even indic	0	0 Spare	0	3 4 etc.
Subaddress Information								

Calling party subaddress information element

The various parts of the calling party subaddress information element are coded as follows.

Type of subaddress (octet 3)

Bits	7	6	5	Meaning
	0	0	0	NSAP (X.213/ISO 8348 AD2)
	0	1	0	user specified

All other values are reserved

Odd/Even indicator (octet 3)

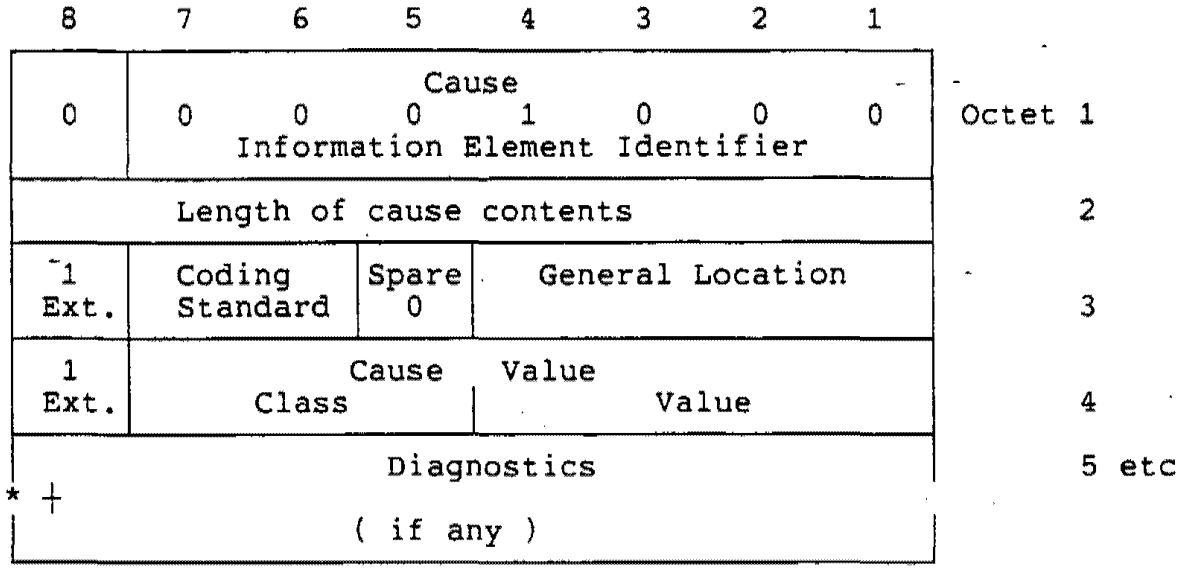
Bit	4	Meaning
	0	even number of digits in subaddress
	1	odd number of digits in subaddress

Note: Subscription parameters are found in Section "G".

5.5.1.10 Cause

The purpose of the Cause information element is to describe 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.

The Cause information element is coded as shown in the following figure. Diagnostic information is not available for every cause value.



* This octet will be omitted, unless diagnostics are to be provided.

Cause information element

\+ More than one optional octet (i.E. octet 5) is not supported at this time.

Coding standard (octet 3)

Bits	7	6	
	0	0	CCITT standard
	1	1	Network-specific 1-4
	1	0	National SPecific

All other values are reserved

General Location (octet 3)

Bits	4	3	2	1	
	0	0	0	0	user (note 1)
	0	0	0	1	private network serving local user (note 2)
	0	0	1	0	public network serving local user (note 1)
	0	0	1	1	transit network (note 2)
	0	1	0	0	public network serving remote user (note 2)
	0	1	0	1	private network serving remote user (note 2)
	0	1	1	1	international network (note 2)
	1	0	1	0	network beyond interworking point (note 2)

All other values are reserved.

Notes:

1. Only codeset of 0010 will be used in the n—>u direction. In the u—>n direction, the codepoint of 0000 for general location of "user" should be used.

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

Cause Value (octet 4)/Diagnostics (octets 5 etc.*)

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

CCITT Standardized Cause Values

Cause value								Cause Number	Cause	Diagnostics
Class			Value							
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	
0	0	1	1	0	1	0		26.+	non-selected user 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 ENQ	none
0	0	1	1	1	1	1		31.	normal unspecified	
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.	sw equip congestion	none
0	1	0	1	0	1	1		43.	user information discarded	info element identifier
0	1	0	1	1	0	0		44.	requested circ/channel not available	none
0	1	0	1	1	1	1		47.	resources unavailable, unspecified	

+ Not supported at this time.

CCITT Standardized Cause Value

Cause Value	Cause Number	Cause	Diagnostics
Class Value 7 6 5 4 3 2 1			
0 1 1 0 0 1 0	50.	requested facility not subscribed	none
0 1 1 0 1 1 0	54.	incoming calls barred	
0 1 1 1 0 0 1	57.	bearer capability not authorized	none
0 1 1 1 0 1 0	58.	bearer capability not presently available	
0 1 1 1 1 1 1	63.	service or option not available, unspecified	
1 0 0 0 0 0 1	65.	bearer capability not implemented	none
1 0 0 0 0 1 0	66.†	channel type not implemented	
1 0 0 0 1 0 1	69.	requested facility not implemented	none
1 0 0 0 1 1 0	70.	only restricted digital information bearer capability is available	
1 0 0 1 1 1 1	79.	service or option not implemented, unspecified	
1 0 1 0 0 0 1	81.	invalid call reference value	none
1 0 1 0 0 1 0	82.	identified channel does not exist	
1 0 1 1 0 0 0	88.	incompatible destination	none
1 0 1 1 1 1 1	95.	invalid message, unspecified	

† Not supported at this time.

Cause value							Cause Number	Cause	Diagnostics
Class			Value						
7	6	5	4	3	2	1			
1	1	0	0	0	0	0	96.	mandatory inform. element is missing	info. elem. 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.	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	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

† Not supported at this time.

All other values are reserved.

Note: Information element 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.

Network-specific Cause Values

Cause value							Cause Number	Cause	Diagnostics
Class			Value						
7	6	5	4	3	2	1			
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-no. unassigned	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)
1	1	0	0	1	0	1	101.+	protocol error threshold exceeded	none

+ Not supported at this time.

All other values are reserved.

National-specific Cause Values

Cause value							Cause Number	Cause	Diagnostics
Class			Value						
7	6	5	4	3	2	1			
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 1 dialed in error	none
0	0	0	0	1	0	0	10.	prefix 1 not dialed	
0	0	0	1	1	1	0	11.+	Excessive digits received; call is proceeding	none

+ Not supported at this time.

All other values are reserved.

Definition of CCITT-standardized Causes

The following list contains definitions for each of the causes.

NORMAL CLASS

- Cause 1 – Unassigned (unallocated) number

  This cause indicates that the destination requested by the calling user cannot 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

  This cause indicates that the equipment sending this cause has received a request to route the call through a particular transit network which it does not recognize. The equipment sending this cause does not recognize the transit network either because the transit network does not exist or because that particular transit network, while it does exist, does not serve the equipment which is sending this cause.

- Cause 3 – No route to destination

  This cause indicates the destination requested by the calling user cannot be reached because the network (through which the call has been routed) does not serve the destination desired.

- Cause 6 – Channel unacceptable

  This cause indicates that a called user cannot negotiate for a B-channel other than that specified in the SETUP message.

- Cause 7 – Call awarded and being delivered in an established channel

  This cause indicates 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

  This cause indicates that the call is being cleared because one of the users involved in the call has requested that the call be cleared.

- Cause 17 – User busy

  This cause is used when 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

  This cause is 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 allocated.

- Cause 19 – User alerting, no answer

  This cause indicates that no valid CONNect message has been received and the call has been cleared. The network will sent a call clearing message to the calling user.

- Cause 21 – Call rejected

  This cause indicates that the equipment sending this cause does not wish to accept this call, although it could have accepted the call because the equipment sending this cause is neither busy nor incompatible.

- Cause 22 – Number changed

  This cause is returned to a user when the called number, indicated by the calling party number, is no longer assigned.

- Cause 26 – Non–selected user clearing

  This cause indicates the user has not been awarded the incoming call.

- Cause 27 – Destination out of order

  This cause indicates that the destination specified by the user cannot 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; e.g. 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, etc.

- Cause 28 – Invalid number format (incomplete number)

  This cause indicates that the destination indicated by the calling user cannot be reached because the number is not in a valid format or is not complete.

- Cause 29 – Facility rejected

  This cause is returned when a facility requested by the user cannot be provided by the network.

- Cause 30 – Response to STATus ENQuiry

  This cause is included in the STATus message when the reason for generating the STATus message was the prior receipt of a STATus ENQuiry message.

- Cause 31 – Normal, unspecified

  This cause is used to report a normal event only when no other cause in the normal class applies.

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.

- Cause 41 – Temporary failure

  This cause indicates that the user or network is not functioning correctly and that the condition is not likely to last a long period of time.

- Cause 42 – Switching equipment congestion or B-channel negotiation

  This cause indicates that the switching equipment generating this cause is experiencing a period of high traffic.

- Cause 43 – User information discarded

  This cause indicates that the network could not deliver user information to the remote user as requested, e.g., user-to-user information, low layer compatibility or subaddress etc. (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

  This cause indicates that the channel requested by the user during local channel negotiation is not currently available (e.g., engaged or out of service for maintenance).

- Cause 47 – Resource unavailable

  This cause is 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

  This cause indicates that the user has not subscribed to this facility and therefore cannot access the facility at this time.

- Cause 54 – Incoming calls barred

  This cause indicates that the called user will not accept the call delivered in the SETUP message.

- Cause 57 – Bearer capability not authorized

  This cause indicates that the user has requested a bearer capability which is implemented by the equipment which generated this cause, but the user is not authorized to use it.

- Cause 58 – Bearer capability not presently available

  This cause 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

  This cause 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

  This cause indicates that the equipment sending does not support the bearer capability requested.

- Cause 66 – Channel type not implemented

  This cause indicates that the called party has reached a channel type not supported.

- Cause 69 – Requested facility not implemented

  This cause indicates that the requested facility is not implemented and therefore cannot be accessed at this time.

- Cause 70 – Only restricted digital information bearer capability is available

  This cause indicates that the user has requested an unrestricted bearer service 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

  This cause is used to report 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

  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.

- Cause 82 – Identified channel does not exist

  This cause indicates that 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

  This cause indicates that the equipment sending this cause has received a request to establish a call to a destination in which the required compatibility attributes (e.g. data rate) cannot be accommodated.

- Cause 95 – Invalid message, unspecified

  This cause is used to report an invalid message event only when no other cause in this class applies.

PROTOCOL ERRORS CLASS

- Cause 96 – Mandatory information element is missing

  This cause indicates that the equipment sending this cause has received a message with one or more mandatory information elements missing. Therefore, the message cannot be processed.

- 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 101 – Message not compatible with call state

  This cause indicates that the equipment sending this cause has received a message that procedures indicate is not a permissible message to receive at this time.

- Cause 102 – Recovery on timer expiry

  This cause indicates no further call progress in call establishment has been received, and has timed out. A clearing message should be sent to the user.

- Cause 111 – Protocol error, unspecified

  This cause is used to report a protocol error event only when no other cause in this class applies.

INTERWORKING CLASS

- Cause 127 – Interworking, unspecified

  This cause indicates that 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 cannot be ascertained.

Definition of Network-specific Causes

The following list contains definitions for each of the causes.

NORMAL CLASS

- Cause 1 – Vacant code

  This cause is included in the PROGress message to the calling user when the NPA or NXX is unassigned and the call routed to vacant code treatment.

- Cause 2 – Prefix 0 dialed in error

  This cause indicates the prefix 0 is invalid for the entered number.

- Cause 3 – Prefix 1 dialed in error

  This cause is included in the PROGress message 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

  This cause is included in the PROGress message 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

  This cause indicates that the call is proceeding at the destination interface.

- Cause 14 – Excessive digits received, call is proceeding

  This cause indicates that more address digits than expected as part of code interpretation procedures for a call origination, and the received address information has been truncated.

SERVICE OR OPTION NOT AVAILABLE CLASS

- Cause 51 – Bearer capability incompatible with service request

  This cause indicates a request for an action was rejected because the action is not compatible with the bearer capability of the call.

- Cause 53 – Service operation violated

  The cause indicates the user has violated the service operation.

PROTOCOL ERROR CLASS

- Cause 101 – Protocol error threshold exceeded

  This cause indicates the call is cleared because a threshold is being exceeded for multiple protocol errors occurring during an active call.

5.5.1.11 Channel Identification

The purpose of the Channel identification information element is to identify a channel within the interface controlled by these signaling procedures.

The Channel identification information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Channel Identification Information Element Identifier							Octet 1
	0	0	1	1	0	0	0	
Length of channel identification contents								2
1 Ext.	0 Int id pres.	0 Int type	0 Spare	Pref/ Excl	D-ch ind	Channel Information Selection		3

Channel identification information element

Bit 6 of Octet 3 is coded for Basic Rate Interface

Extension Bit (Octets 3, 3a, 3b, 3c)

0 this octet continues through next octet +
1 last octet of the description

+ Optional octets 3a, 3b, 3c as described in CCITT Recommendation Q.931 are not applied/implemented on Basic Rate Interface at this time.

Interface Identifier Present (Octet 3 - Bit 7)

0 interface implicitly identified
(The interface that includes the D channel carrying this information element is indicated.)
1 interface explicitly identified in optional octet 3a +

+ Not supported at this time.

Preferred/Exclusive (Octet 3 - Bit 4)

0 preferred - indicated channel is preferred
1 exclusive - only the indicated channel is acceptable

Note: This bit will always be set to 1 in the n->u direction. In the u->n direction this bit shall be set to: 1 for the first response to an incoming SETUP message; 0 for the selection of 'Any channel'; and either 0 or 1 as appropriate for all other cases.

D-Channel Indicator (Octet 3- Bit 3)

0 D channel not indicated
1 D channel indicated †

Note: The D-channel Indicator will always be set to 0 for circuit-mode calls; for the packet mode it may be set to either 0 or 1.

† Not supported at this time.

Channel Selection Information (Octet 3)

Bits 2 1	Meaning
0 0	no B channel indicated
0 1	channel B1
1 0	channel B2
1 1	any channel

Note: "No channel" will be sent in the n->u direction for some supplementary services.eg. Additional Call Offering, and Electronic Key Telephone Service.

5.5.1.12 Connected Number

The purpose of the Connected number information element is to indicate which number is connected to a call. The connected number may be different from the calling or called party number(s) because of changes (e.g. call redirection) during the lifetime of the call.

The Connected number information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Connected Number Information Element Identifier							Octet 1
Length of connected number contents								2
0/1 Ext.	Type of Number			Numbering Plan Identification				3
1 Ext.	Present. Indicator		0	0 SPARE	0	Screening Indicator		3a*
= 0 Spare	Number digits (IA5 characters)						=	4* etc.

* This octet may be omitted.

Note: May not be supported in the future.

Connected number information element

Note: The contents of this information element are coded as for the Calling party number information element.

5.5.1.13 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.

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.

Endpoint identifier information element

User Service Identifier (USID) (octet 3)

The User Service Identifier (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 has 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.

When used in messages broadcast at layer 2 to select the terminals which share a service profile, this parameter is coded with a unique value which corresponds 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 will consider 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 all terminals associated with a particular service profile and USID value are to be selected, octet 4 is not needed and may be omitted.

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 will 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 has values from 0 to 63.

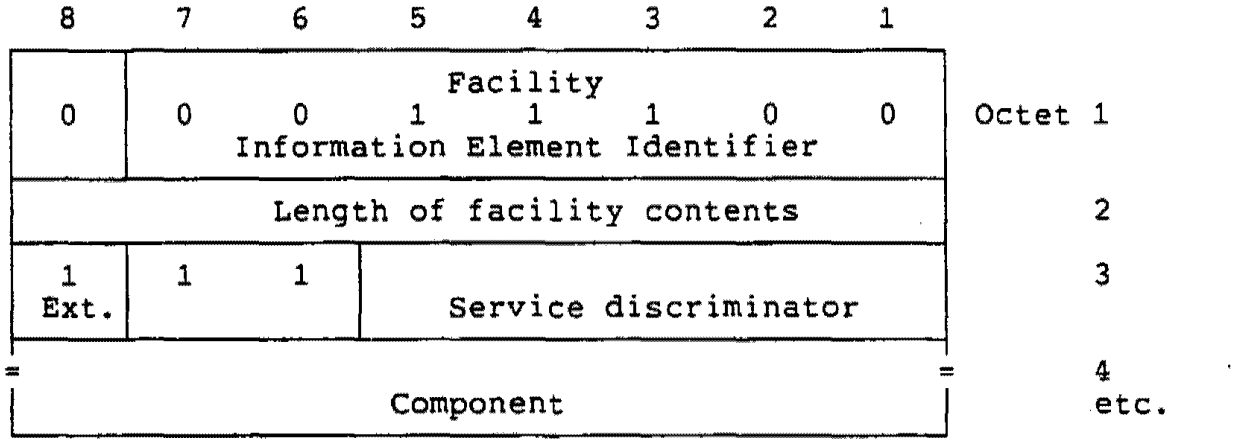
When used in the initialization procedures, it is coded from 0 to 62. To identify a particular terminal, the TID is coded with the value assigned in the initialization procedure. When all terminals which share a service profile are to be selected, octet 4 is not necessary and may be omitted. However, if octet 4 is included, the TID is coded as all "1"s (63).

5.5.1.14 Facility

The purpose of the Facility information element is to indicate the invocation and operation of services identified by the service discriminator, and the operation value within the component.

The maximum length of the Facility information element in a given message is service dependent, consistent with the maximum length of the message.

The Facility information element is coded as shown in the following figure.



Facility information element

Service discriminator (octet 3)

Bits	5 4 3 2 1	
	1 0 0 0 1	Supplementary services
	1 0 0 1 0	Management services

All other values are reserved.

Note: 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 future become the standard mechanism to realize this requirement. Other values for bits 7 to 6 are reserved.

Component: A component is a sequence of data elements each of which is made up of a tag, a length, and contents. There are 4 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 the following set of diagrams.

Invoke Component

Invoke Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	D-106 D-105	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	D-106 D-105	Mandatory	6 7 8
Linked identifier tag Linked identifier length Linked identifier	D-106 D-105	Optional	9 10 11
Operation value tag Operation value length Operation value	D-106 D-105 (Note 3)	Mandatory	12 13 14
Argument (Note 2)	(Note 3)	Optional	15 etc.

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.

Return Result Component

Return Result Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 3)	D–106 D–105	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	D–106 D–105	Mandatory	6 7 8
Sequence tag Sequence length (Note 4)	D–111	Optional (Note 1)	9 10
Operation value tag Operation value length Operation value	D–106 D–105 (Note 6)	Optional (Note 2)	11 12 13
Result (Note 5)	D–108 (Note 6)	Optional	14 etc.

Note 1: If the Return result component does not include any result, then the sequence and operational value will be omitted. Section 5.5.1.13 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.

Note 4: 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 5: This is a parameter of the Return result component type.

Note 6: The coding is service dependent.

Return Error Component

Return Error Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	D-106 D-105	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	D-106 D-105	Mandatory	6 7 8
Error value tag Error value length Error value	D-107 D-105	Mandatory	9 10 11
Parameter (Note 2)	D-111 (Note 3)	Optional	12 etc.

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.

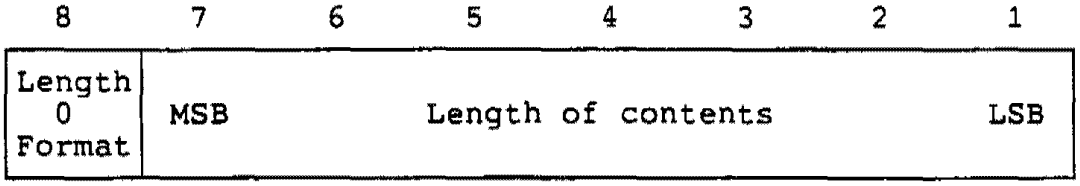
Note 3: The coding is service dependent.

Reject Component

Reject Component	Reference	Mandatory Indication	Octet Group
Component type tag Component length (Note 1)	D-106 D-105	Mandatory	4 5
Invoke identifier tag Invoke identifier length Invoke identifier	D-106 D-105	Mandatory	6 7 8
Problem tag Problem length Problem	D-107 D-105 D-107	Mandatory	9 10 11

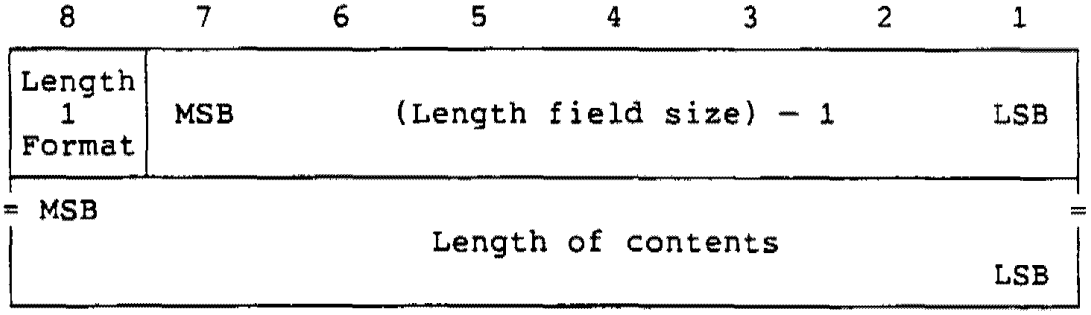
Note 1: The component length is coded to indicate the number of octets contained in the component, excluding the component type tag and the component length octets.

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).



Format of the length field (short form)

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 most significant bit (MSB) and bit 1 is the least significant bit (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 most significant bit (MSB) and bit 1 of the last octet is the least significant bit (LSB). The length of contents should be coded using the minimum number of octets, with no leading octets having the value 0.



Format of the length field (long form)

Component Types: Every component is specified with a component type tag. The following table contains the tags for the component types.

Component Type Tags

Bits	8	7	6	5	4	3	2	1	
	1	0	1	0	0	0	0	1	Invoke
	1	0	1	0	0	0	1	0	Return result
	1	0	1	0	0	0	1	1	Return error
	1	0	1	0	0	1	0	0	Reject

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.

Component Identifier Tags

Bits	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	1	0	Invoke identifier
	1	0	0	0	0	0	0	0	Linked identifier
	0	0	0	0	0	1	0	1	Null

Operations: The operation value 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.

Operation Value Tags

Bits	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	1	0	Operation value – Integer

Supplementary Services Operation Values

Bits	8	7	6	5	4	3	2	1	
	0	0	0	1	1	0	0	0	Additional information

Management Services Operation Values

Bits	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	0	1	Service Profile Management begin
	0	0	0	0	0	0	1	0	Service Profile Management info

Errors: Operations report errors as specified for each operation.

Error Value Tags

Bits	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	1	0	Error value – Integer

Problems: Protocol problems are indicated in groups. The first of the following tables specifies the tags for these groups. The remaining tables specify the problem values associated with each problem group.

Problem Tags

Bits	8	7	6	5	4	3	2	1	
	1	0	0	0	0	0	0	0	General problem
	1	0	0	0	0	0	0	1	Invoke problem
	1	0	0	0	0	0	1	0	Return result problem
	1	0	0	0	0	0	1	1	Return error problem

Coding of general problem

Bits	8	7	6	5	4	3	2	1	
	0	0	0	0	0	0	0	0	Unrecognized component
	0	0	0	0	0	0	0	1	Mistyped component
	0	0	0	0	0	0	1	0	Badly structured component

Coding of Invoke problem

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Duplicate invocation
0 0 0 0 0 0 0 1	Unrecognized operation
0 0 0 0 0 0 1 0	Mistyped argument
0 0 0 0 0 0 1 1	Resource limitation
0 0 0 0 0 1 0 0	Initiator releasing
0 0 0 0 0 1 0 1	Unrecognized linked identifier
0 0 0 0 0 1 1 0	Linked response unexpected
0 0 0 0 0 1 1 1	Unexpected child operation

Coding of Return result problem

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Unrecognized invocation
0 0 0 0 0 0 0 1	Result response unexpected
0 0 0 0 0 0 1 0	Mistyped result

Coding of Return error problem

Bits 8 7 6 5 4 3 2 1	
0 0 0 0 0 0 0 0	Unrecognized invocation
0 0 0 0 0 0 0 1	Error response unexpected
0 0 0 0 0 0 1 0	Unrecognized error
0 0 0 0 0 0 1 1	Unexpected error
0 0 0 0 0 1 0 0	Mistyped parameter

The specific problem codes for each problem class are described below.

General Problems

Unrecognized component – signifies that the received component is not one of the RO defined components (i.e. the component type tag is invalid).

Mistyped component – signifies that the content of the received component does not conform to the expected content of the specific component (e.g. an Invoke component is missing an operation).

Badly structured component – signifies that the received component does not conform to the data element encoding rules (e.g. a data element is encoded with an invalid length field).

Invoke Problems

Duplicate invocation - signifies that the received invoke identifier parameter is already in use and is not available for reuse.

Unrecognized operation - signifies that the received operation is not a valid operation value or is a valid operation value but is received in a state or message that it is not allowed in.

Mistyped argument - signifies that the contents of the argument for the received Invoke component are invalid.

Resource limitation - signifies that the end receiving the operation is not able to perform the operation as a result of resource limitations.

Initiator releasing - signifies that the end receiving the operation is unwilling to perform the operation because it is about to release the connection.

Unrecognized linked identifier - signifies that there is no operation in progress with an invoke identifier equal to the specified linked identifier.

Linked response unexpected - signifies that 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 - signifies that the child operation is not one that the parent operation identified by the linked identifier allows.

Return result problems

Unrecognized invocation - signifies that no operation with the specified invoke identifier is in progress.

Result response unexpected - signifies that the invoked operation does not report a result, but a Return result was received.

Mistyped result - signifies that the contents of the result for the Return result component are invalid.

Return error problems

Unrecognized invocation – signifies that no operation with the specified invoke identifier is in progress.

Error response unexpected – signifies that the invoked operation does not report a failure, but a Return error was received.

Unrecognized error – signifies that the reported error is not a valid value.

Unexpected error – signifies that 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 (e.g. an error value is returned associated with an optional parameter that was not included in the Invoke component).

Mistyped parameter – signifies that the contents of the parameter of the Return error component are invalid.

Parameters: Parameters included with a component (i.e. 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 shall 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.

Sequence and Set Tags

Bits	8	7	6	5	4	3	2	1	
	0	0	1	1	0	0	0	0	Sequence tag
	0	0	1	1	0	0	0	1	Set tag

All other values are reserved

5.5.1.15 Feature Activation

The purpose of the Feature activation information element is for a terminal to provide information on actions at the man-machine interface; i.e. to indicate that a feature activator has been activated.

The Feature activation information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Feature Activation 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 activation information element

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
0 0 0 0 0 1 0	feature number 2
. .	. .
1 0 0 0 0 0 0	feature number 64

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 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.

Examples of the meaning that may be assigned the feature identifier are:

- Automatic callback retry acceptance
- automatic flexible routing
- ISDN call pickup for assigned pickup group
- call forwarding 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) *

* Feature identifier value 0 shall be reserved for the Contextual Feature Operator (CFO) and it is not supported at this time.

5.5.1.16 Feature Indication

The purpose of the Feature indication information element is for the network to optionally convey feature indications to a terminal.

The Feature indication information element may be repeated in a message to convey multiple feature indications to a terminal.

The Feature indication information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Feature Indication Information Element Identifier							Octet 1
Length of feature indication contents								2
0/1 Ext.	Feature Identification Number							3
1	Feature Identification Number (Continuation)							3a*
Spare 0	0	0	0	Status Indicator				4

* This octet may be omitted.

Feature indication information element

Feature Identification Number (octets 3 and 3a)

This field is coded as described for the Feature activation information element.

Status Indicator(octet 4, bits 1-4)

The status indicator field identifies the current status to supplementary service.

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	prompt for user input (Note 1)
0 0 1 1	pending	feature is pending (Note 2)

All other values are reserved

Note 1. Currently applicable to features which require programming, e.g. Call Forwarding activation.

Note 2. Currently applicable to features requiring delayed notification.

The feature identifier value should be coded as the binary coding of a decimal number. Only one octet should be used for numbers from 1 to 127, and two octets should be used for 128 to 16383.

Examples of the meaning that may be assigned to the feature identifier are:

- Automatic callback
- 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)

5.5.1.17 High-Layer Compatibility

The high-layer compatibility information element, along with the bearer capability information element, provides a way for the remote user to check compatibility. It will not be interpreted by the network but will be 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 will ensure 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 will accept is illustrated in the following figure.

8	7	6	5	4	3	2	1	
0	High-Layer Compatibility 1 1 1 1 1 0 1 Information Element Identifier							Octet 1
Length of high-layer compatibility information								2
1 Ext.	Coding Standard		Interpretation		Presentation method of protocol profile			3
0/1 Ext.	High layer characteristics identification							4
1 Ext.	Extended high layer characteristics identification							4a* (Note)

High-layer compatibility information element

Note. This octet may be present when octet 4 indicates Maintenance or Management.

Coding at Originating Party Interface

The high-layer compatibility information element 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 5 octets).

If these conditions are met the high-layer compatibility information element will be passed to the terminating side of the call; if the conditions are not met, it will be discarded. The high-layer compatibility information element is not required for the SETUP message, but will 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 message.

Note: Subscription parameters are found in Section "G".

Coding standard (Octet 3)

Bits 7 6	Meaning
0 0	CCITT standardized coding, as described below
0 1	Reserved for other international standards (Note)
1 0	National standard (Note)
1 1	Standard defined for the network (public or private) present at the network side of the interface(Note)

Note: These other coding standards should be used only when the desired high layer compatibility can not be represented with the CCITT standardized coding.

Interpretation (Octet 3)

Bits 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.

Note 1: "Interpretation" indicates how the "High layer characteristics identification" (in Octet 4) should be interpreted.

Note 2: Currently, Interpretation" has only a single value. However, "Interpretation", when enhanced, will be able to indicate how the "High layer characteristics identification" in the same information element shall be interpreted when multiple "High layer characteristics identifications" are used and exact relationship among them needs to be identified (e.g., sequential usage, alternative list, simultaneous usage). Such enhancements in conjunction with the possible negotiation procedures is left for further study.

Presentation method of protocol profile (Octet 3)

Bits 2 1	Meaning
0 1	High layer protocol profile (without specification of attributes)

All other values are reserved.

Note: Currently, "presentation method of protocol profile" has only a single value, i.e., a "profile value" is used to indicate a service to be supported by high layer protocols as required. Necessity of other presentation methods, e.g., service indications in the forum of layer-by-layer indication of protocols to be used in high layers, is left for further study.

High layer characteristics identification (Octet 4)

Bits 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 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.

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.

Note 1: Further compatibility checking will be executed by the OSI high layer protocol.

Note 2: When this coding is included, octet 4 may be followed by octet 4a.

Extended high layer characteristics identification (Octet 4a)

Bits 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.

5.5.1.18 Information Rate †

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 below.

8	7	6	5	4	3	2	1	
0	Information Rate Information Element Indicator							Octet 1
0	0	0	0	0	0	1	0	2
Length of information rate-information element								
1 Ext.	0 0 Spare		Incoming information transfer rate					3
1 Ext.	0 0 Spare		Outgoing information transfer rate					4
1 Ext.	0 0 Spare		Minimum incoming information transfer rate					5
1 Ext.	0 0 Spare		Minimum outgoing information transfer rate					6

Information-Rate Information Element

† Note. This information element is not supported at this time.

Incoming information (Octet 3)

Bits 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 bps
0	0	1	0	0	150 bps
0	0	1	0	1	300 bps
0	0	1	1	0	600 bps
0	0	1	1	1	1200 bps
0	1	0	0	0	2400 bps
0	1	0	0	1	4800 bps
0	1	0	1	0	9600 bps
0	1	0	1	1	19.2 kbps
0	1	1	0	0	48.0 kbps
0	1	1	0	1	reserved
0	1	1	1	0	reserved
0	1	1	1	1	reserved

Note. 16kbps and 64 kbps throughput classes will be added when CCITT provides codepoints for them.

5.5.1.19 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 the following figure.

8	7	6	5	4	3	2	1	
0	Information Request Information Element Identifier							Octet 1
Length of information request contents								2
1 Ext.	Info. Req. Ind	Type of Information						3

Information request information element

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 0 0	undefined
0 0 0 0 0 1	authorization code †
0 0 0 0 1 0	address digits
0 0 0 0 1 1	terminal identification

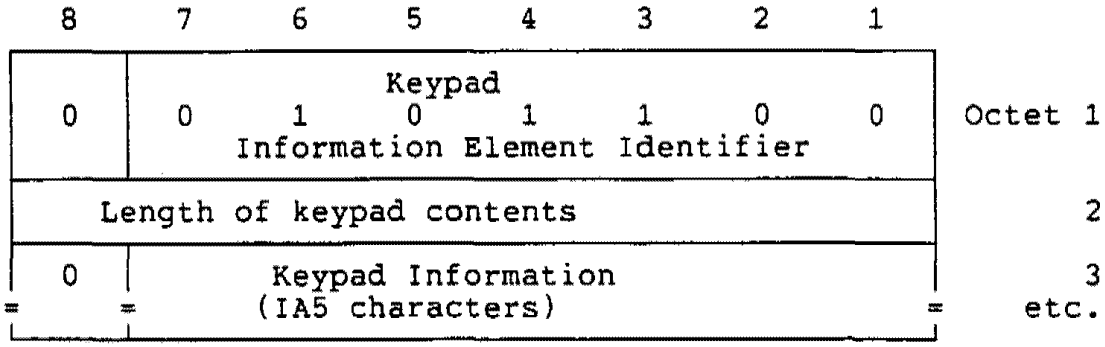
† Not supported at this time, the value for "undefined" should be used for the time being to support "authorization code" only.

All other values are reserved.

5.5.1.20 Keypad

The purpose of the Keypad information element is to convey IA5 characters, e.g. entered by means of a terminal keypad.

The Keypad information element is coded as shown in the figure below.



Keypad information element

Keypad Information (octet 3 etc.)

The IA5 characters which can be used are coded as in the following table.

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	#

All other values are reserved

Example Encodings of Called Party Number in Keypad

Public Network Dialing 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 etc.)
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 + NXX–XXXX

Notes

- NXX–XXXX is a 7 digit number coded as:

  'N' in the range 2–9

  'X' in the range 0–9

- NPA represents a string of 3 digits which are coded as:

  'N' in the range 2–9

  'P' represents '0' or '1'

  'A' in the range 2–9

- TNS = Transit Network Selection

  is in the range 0–999.

5.5.1.21 Low-Layer Compatibility

The low-layer compatibility information element, in conjunction with the bearer capability information element, provides a way for the remote user to check compatibility. This information element is not interpreted by the network, but rather is carried transparently and delivered to the remote user(s).

The contents of the low-layer compatibility information element will not be inspected by the network; rather, the network will simply ensure that the maximum allowed length of this information element is not exceeded. Coding of this information element can be found in CCITT Recommendation Q.931. The encoding that the switch will accept is shown in the following figure.

8	7	6	5	4	3	2	1	
0	Low-Layer Compatibility Information Element Identifier							Octet 1
Length of low-layer compatibility information								2
Compatibility Information								3 etc.

Low-layer compatibility information element

Coding at Originating Party Interface

The lower-layer compatibility information element will be accepted in a SETUP message 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 will pass the information to the terminating side of the call; if the conditions are not met, it will be discarded. Low-layer compatibility is an optional information element that shall only be included in a SETUP message.

Codings at Terminating Party Interface

The low-layer compatibility information element will be sent in a SETUP message if it was supplied by the calling party and passed by the originating network.

Note: Subscription parameters are found in Section "G".

5.5.1.22 Notification Indicator

The purpose of the Notification indicator information element is to indicate information pertaining to a call.

The Notification indicator information element can appear twice in a message to report multiple events.

The structure of the Notification indicator information element is shown in the following figure.

8	7	6	5	4	3	2	1	
0	Notification Indicator 0 1 0 0 1 1 1 Information Element Identifier							Octet 1
Length of notification indicator contents								2
1	Notification Description							3

Notification indicator information element

Notification description (octet 3)

Bits 765 4321	Meaning
010 0000	connected via conf facility (controller) *
010 0001	connected via conference facility (conferee) *
010 0010	two party call *
010 0011	conference facility released *
010 0100	connected to Emergency Service Bureau *
010 0101	connected to Attendant Console *
010 0110	remote party disconnected *
010 0111	bridged call
010 1000	call no longer bridged *
010 1001	retrieve held call *
010 1010	no longer connected to Attendant Console *
010 1101	conference bridge full *
010 1110	conference bridge port available *
110 0000	call is a waiting call
111 0001	call information/event
111 0101	user bridged onto call
111 0110	ACB monitoring discontinued †
111 0111	call on hold
111 1000	monitored user idle †
111 1001	remote-hold †
111 1010	remote-hold-released †
111 1011	call is forwarded †
111 1100	privacy enabled
111 1101	privacy disabled
111 1110	call retrieved from hold

† Not supported at this time.
* These Notification Indicator values may not be supported in the future.

All other values are reserved.

5.5.1.23 Packet-Layer Binary Parameters +

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 below.

8	7	6	5	4	3	2	1	
0	Packet-Layer Binary Parameters 1 0 0 0 1 0 0 Information Element Identifier							Octet 1
0	0 0 0 0 0 0 1 Length of packet-layer binary parameters information element							2
1 Ext	0 0 Spare		Fast Select	Exp. Data	Receipt Conf.	Modulus		3

Packet-Layer Binary Parameters

+ Note. This information element is not supported at this time.

The various parts of the packet-layer binary parameters information element should be coded as follows.

Fast select (Octet 3)

Bits 5 4	Meaning
0 X	fast select not requested
1 0	fast select requested with no restriction
1 1	fast select requested with restriction

Expedited data (Octet 3)

Bit 3	Meaning
0	no request
1	request indicated

Delivery confirmation (Octet 3)

Bit 2	Meaning
0	link-by-link confirmation
1	end-to-end confirmation

Modulus (Octet 3)

Bit 1	Meaning
0	modulus 8 sequencing
1	modulus 128 sequencing

5.5.1.24 Packet-Layer Window Size +

The packet-layer window size 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.

It should be coded as shown below.

8	7	6	5	4	3	2	1	
0	Packet-Layer Window Size 1 0 0 0 1 0 1 Information Element Identifier							Octet 1
Length of packet-layer window size information element								2
1 Spare	Forward Value							3
1 Spare	Backward Value							4*

*May be omitted. When omitted indicates a request for a default window size.

Packet-Layer Window Size Information Element

+ Note. This information element is not supported at this time.

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

5.5.1.25 Packet Size +

The packet size 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.

The packet size information element should be coded as follows.

8	7	6	5	4	3	2	1	
0	Packet Size 1 0 0 0 1 1 0 Information Element Identifier							Octet 1
Length of packet size information element								2
1 Spare	Forward Value							3
1 Spare	Backward Value							4*

*May be omitted. When omitted indicates request for default packet size.

Packet Size

+ Note. This information element is not supported at this time.

The fields of the packet size information element should be coded as follows.

Forward value

Packet size value, binary encoded

Note. the value 0000000 is reserved

Backward value

Packet size value, binary encoded

Note. the value 0000000 is reserved

5.5.1.26 Progress Indicator

The purpose of the Progress indicator information element is to describe an event which has occurred during the life of a call.

The structure of the Progress indicator information element is shown in the following figure.

8	7	6	5	4	3	2	1	
0	Progress Indicator 0 0 1 1 1 1 0 Information Element Identifier							Octet 1
Length of progress indicator contents								2
1 Ext.	Coding Standard		Spare 0	General Location				3
1 Ext.	Progress Description							4

Progress indicator information element

Coding standard (octet 3)

Bits	7	6	Meaning
	0	0	CCITT standard
	0	1	Reserved
	1	0	National standard
	1	1	Network-Specific standard

General Location (octet 3)

Bits 4 3 2 1	
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.

† Not supported at this time.

Notes:

1. The "transit network" codepoint does not apply to the CCITT-standardized coding standard.

2. The "international network" codepoint applies only to the Network-specific coding standard.

3. These values may not be sent in all situations.

Progress Description (octet 4)

CCITT Standardized Values (Coding Standard=00)

Bits 765	4321	No.	Meaning
000	0001	1	Call is not end-to-end ISDN further call progress information may be available in-band
000	0010	2	Called equipment is non-ISDN
000	0011	3	Calling equipment is non-ISDN
000	1000	8	In-band information or appropriate pattern is now available
All other values are reserved			

National Standard (coding Standard = 10)

Bits 765 4321	No.	Meaning
000 1010	10	Delay in response at called interface
All other values are reserved		

5.5.1.27 Redirecting Number

The purpose of the Redirecting number information element is to identify the number from which call redirection/ diversion was invoked.

The Redirecting number information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Redirecting Number 1 1 1 0 1 0 0 Information Element Identifier							Octet 1
Length of redirecting number information								2
0/1 Ext.	Type of Number			Numbering Plan Identification				3
0/1 Ext.	Present. Indicator		0 0 0 Spare			Screening Indicator		3a*
1 Ext.	0 0 0 Spare			Reason for Redirection				3b*
= 0 Spare	Number digits (IA5 characters)						=	4* etc.

* This octet may be omitted.

Redirecting number information element

Reason for Redirection (Octet 3b)

Bits 4 3 2 1	Meaning
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 †
1 0 1 0	call forwarding by the called equipment †
1 1 0 1	call transfer
1 1 1 0	call pickup
1 1 1 1	call forwarding unconditional

† Not supported at this time.

All other values are reserved

Note: The balance of the contents for this information element is coded the same as the Calling party number information element, (5.5.1.7).

5.5.1.28 Redirection Number

The purpose of the Redirection number information element is to identify the number to which call redirection/ diversion should be or has been invoked.

The Redirection number information element is coded as shown in the following figure.

8	7	6	5	4	3	2	1	
0	Redirection Number 1 1 1 0 1 1 0 Information Element Identifier							Octet 1
Length of redirecting number contents								2
0/1 Ext.	Type of Number			Numbering Plan Identification				3
0/1 Ext.	Present. Indicator		0	0 Spare		0	Screening Indicator	3a*
1 Ext.	0	0 Spare	0	Reason for Redirection				3b*
= 0 Spare	Number digits (IA5 characters)						=	4* etc.

* This octet may be omitted.

Redirection number information element

Reason for Redirection (Octet 3b)

Bits 4 3 2 1	Meaning
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 †
1 0 1 0	call forwarding by the called equipment †
1 1 0 1	call transfer
1 1 1 0	call pickup
1 1 1 1	call forwarding unconditional

† Not supported at this time.

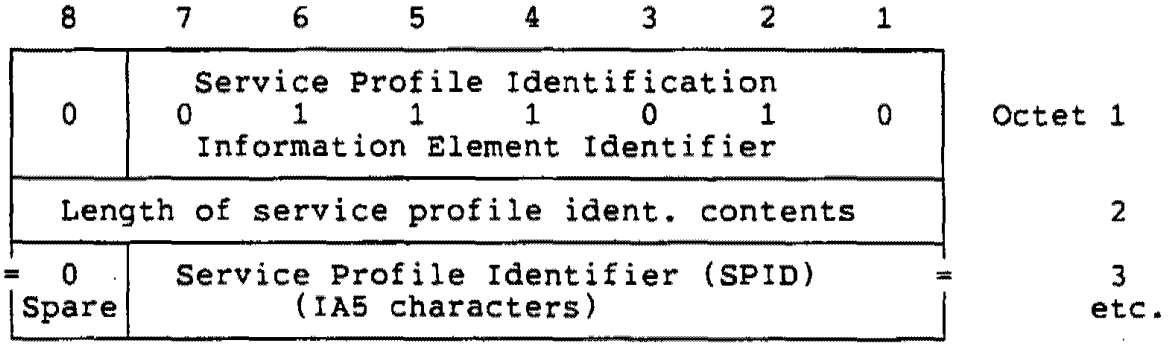
All other values reserved

Note: The balance of contents for this information element is coded the same as the Calling party number information element, (5.5.1.7).

5.5.1.29 Service Profile Identification

The purpose of the Service profile identification information element is to allow the user to initiate automatic assignment of the user service identifier and terminal identifier.

The structure of the Service profile identification information element is shown in the following figure.



Service Profile Identification information element

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.

5.5.1.30 Signal

The purpose of the Signal information element is to allow the network to optionally convey information to a user regarding tones and alerting signals.

The Signal information element is coded as shown below.

8	7	6	5	4	3	2	1	
0	Signal Information Element Identifier							Octet 1
0	0	0	0	0	0	0	1	2
	Length of Signal contents							
	Signal Value							3

Signal information element

Signal Value (octet 3)

Signal Value	Bits 8765	Bits 4321	Meaning
0	0000	0000	dial tone on
1	0000	0001	ring back (audible ring) tone on
3	0000	0011	network congestion/reorder tone on
4	0000	0100	busy tone on
5	0000	0101	confirm tone on
7	0000	0111	call waiting tone(additional call tone) +
63	0011	1111	tones off
64	0100	0000	alerting on – pattern 0 : normal alerting
65	0100	0001	alerting on – pattern 1 : incoming call (distinctive)
66	0100	0010	alerting on – pattern 2 : requested call offered
67	0100	0011	alerting on – pattern 3 : intercom alerting
68	0100	0100	alerting on – pattern 4 : reminder ring
70	0100	0110	alerting on – pattern 6 : English ringing
79	0100	1111	alerting off

Network–specific signal value (Octet 3)

Signal Value	Bits 8765	Bits 4321	Meaning
1	0001	0001	recall dial tone on
2	0001	0010	barge–in tone on
122	1111	1010	incoming additional call tone
123	1111	1011	priority additional call tone
125	1111	1101	expensive route warning tone +

All other values reserved

+ Not supported at this time. However, it is recommended that terminal manufacturers support these values in order to avoid any incompatibility with future features or network enhancements that may use these values.

5.5.1.31 Transit Delay Selection and Indication †

The transit delay selection and indication information element requests the maximum permissible transit delay applicable on a per virtual call basis.

It should be coded as follows

8	7	6	5	4	3	2	1	
0	Transit Delay Selection and Indication 1 0 0 0 0 1 1 Information Element Identifier							Octet 1
Length of transit delay selection and indication								2
0 Ext	0	0	0	0	0 Spare		Transit delay selection and indication value	3
0 Ext	Transit delay selection and indication value							3a
1 Ext	Transit delay selection and indication value							3b

Transit Delay Selection and Indication Information Element

† This information element is not supported at this time.

The fields of the transit delay selection and indication information element should be coded as follows.

Extension bit (Octets 3, 3a, 3b)

Bit 8	Meaning
0	this octet continues through the next octet
1	last octet

Transit delay selection and indication value (Octet 3,3a,3b)

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.

5.5.1.32 Transit Network Selection

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 will 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 IE is present in conjunction with the transit network selection information element or the called number party information element, then the digits in the keypad information element represent a feature access code. The first digits in the called number will be those in the keypad information element.

The Transit Network Selection (optional) is only present in the SETUP message at the originating party interface and will not be present in any message at the terminating party interface.

8	7	6	5	4	3	2	1
0	Transit Network Selection Information Element Idendifier						
	1	1	1	1	0	0	0
Length of transit network selection							
1 Ext	Type of Network Identification			Network Identification Plan			
0 Spare	Network Identification						

Transit network selection information element

The various parts of the transit network selection information element should be encoded as described below.

Type of Network Identification (octet 3)

Bits	7 6 5	Meaning
	0 0 0	user specified (private identification)
	0 1 0	nationally-standardized identification

+ Not supported at this time.

All other values are reserved

Network Identification Plan (octet 3)

Bits	4 3 2 1	Meaning
	0 0 0 0	unknown +
	0 0 0 1	interLATA carrier identification code
	0 0 1 0	user-specified identification code

+ Not supported at this time.

All other values are reserved

Note: Subscription parameters are found in Section "G".

5.5.1.33 User-user †

The purpose of the user-user information element is to convey 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 user-user information will not be inspected and all codings of the protocol discriminator and user information fields will be accepted by the network. The network will not allow the maximum length (131 octets) to be exceeded.

The structure of the User-user information element is shown in the following figure.

8	7	6	5	4	3	2	1	
0	User-user Information Element Identifier							Octet 1
Length of user-user information								2
Protocol discriminator								3
User information								4 etc.

User-user Information Element

† Note. This Information Element is not supported at this time.

5.5.2 National-Specific Information Elements(codeset 5)

The information elements defined in this section are national-specific and should be coded using the Locking Shift to codeset 5.

National-Specific Information Element

Information Element Identifier								
8	7	6	5	4	3	2	1	
0	:	:	:	:	:	:	:	Variable Length Information Element
	0	0	0	0	0	0	1	Operator System Access
	0	1	0	1	0	1	0	Display Text

Information Element Identifier Coding (Codeset 5)

5.5.2.1 Operator System Access

The Operator system access indicates the required operator system services through Type of Access field:

- Public/Principal access is used to direct the call to an operating company operator.
- Public/Alternative access is used to direct the call to an interexchange carrier operator.
- Private/Principal access is used to direct the call to private network attendant systems or private branch exchange (PBX).

The optional Operator system access information element shall only be present in the SETUP message at the originating party interface, and will not be present in any message at the terminating party interface.

8	7	6	5	4	3	2	1
0	Operator System Access 0 0 1 1 1 0 1 Information Element Identifier						
	Length of operator system access						
1 Ext	Type of Service				Type of Access		

Operator system access information element

The various parts of the operator system access information element should be coded as described on following page.

Type of Service (octet 3)

Bits	7 6 5 4 3	Meaning
	0 0 0 0 0	Unspecified

All other values are reserved

Type of Access (octet 3)

Bits	2 1	Meaning
	0 0	public/principal—default operator system
	0 1	public/alternate—operator system determined by user subscription
	1 0	Private/Principal used for attendant services

All other values are reserved

5.5.2.2 Display Text

The purpose of the Display text information element is to supply network formatted display information that may be displayed on a terminal having a display capability when supporting this information element and its associated procedures. The Display text information element can be included in any message (e.g. CONNect ACKnowldge, HOLD ACKnowldge, KEY HOLD, or PROGress) sent by the network in the n—>u direction. 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. For additional information about the Display text information element protocol and procedures, refer to 'American National Standard T1.610A-1990 Display Procedures'.

8	7	6	5	4	3	2	1	
0	Display Text 0	1	0	1	0	1	0	Octet 1
Length of display text information element								2
1	Display Type							3
Display Information (Note)								4 etc.

Display Text Information Element

Note. One or more groups of display information may be included depending on specific service requirements.

Display type

8	Bits 7 6 5 4 3 2 1	Meaning
1	0 0 0 0 0 0 0	normal

All other values reserved

Display information

Display information will be 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 the Display Text information element for display purposes are required to at least comprehend the blank and skip tags. The display tags and corresponding codings are listed below. The definitive encodings for the display tags are contained in the ANS T1.610A document, which at the time of printing of NIS S208-6, Issue 1.0 are contained in T1S1/91-288R. If there are any discrepancies with the codings of display text tags as shown in this document and the codings as contained in ANS T1.610A, then the codings in ANS T1.610A take precedence. Before printing Issue 1.1 of NIS208-6, the values of the display text tags were confirmed.

8	Bits 7 6 5 4 3 2 1	Meaning
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 (e.g. ASCII)

All other values are reserved

Figure 1. Coding of Display Text and Control Tags

Note: Only the starred (*) tags are implemented for the current Calling Name and Reason feature.

Note: 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 – This tag always has a 1 octet length and a value from 1 – 255 that tells the terminal how many ASCII characters

to skip over before operating on the next display tag. This value will be interpreted as an unsigned integer.

Blank– This tag always has a 1 octet length and a value from 1 – 255 that tells the terminal how many successive blank characters to append to any previous text. This value will be interpreted as an unsigned integer.

When processing the Display text information element, the terminal shall format the ASCII characters beginning at the upper left hand corner of the display unit.

The network will send 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 Blank and Skip tags shall be processed by Stimulus terminals).

Terminals are required to clear the display associated with a call when the call is released.

5.5.3 Network-Specific Information Elements (Codeset 6)

The information elements defined in this section are network-specific and should be coded using the Locking Shift to codeset 6.

Network-Specific Information Element

Information Element Identifier								
8	7	6	5	4	3	2	1	
0	:	:	:	:	:	:	:	Variable Length Information Element
	0	1	1	1	1	1	0	Protocol Version Control
	1	0	0	0	0	0	1	Closed User Group +
	1	0	0	0	0	1	0	Reverse Charging Indication +
	1	1	1	0	1	0	1	Redirecting Subaddress +
	1	1	1	1	0	1	1	Call Appearance

Figure 5-10 Information Element Identifier Coding (Codeset 6)

+ Not supported at this time.

5.5.3.1 Call Appearance

The purpose of the Call appearance information element is to identify the selected intercom group for an intercom call, or call appearance for a particular directory number.

The structure of the Call appearance information element is shown in the following figure.

8	7	6	5	4	3	2	1	
0	Call Appearance Information Element Identifier							Octet 1
Length of call appearance contents								2
0/1 Ext.	Call appearance identifier							3
1 Ext.	Call appearance identifier continuation, if needed							3a*

* This octet may be omitted.

Call Appearance Information Element

Call Appearance Identifier (octets 3 and 3a)

The call appearance identifier is a unique number assigned to an intercom appearance, or call appearance of a directory number.

Bit 8 in octet 3 is used to extend the call appearance identifier 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.

5.5.3.2 Closed User Group +

The closed user group (CUG) 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.

8	7	6	5	4	3	2	1	
0	Closed User Group 1 0 0 0 0 0 1 Information Element Identifier							Octet 1
Length of closed user group information								2
1 Ext.	0 0 0 0 Spare				CUG Indication			3
0 Spare	CUG Index Code (IA5 characters)							4 etc.

Closed User Group

+ Note. This Information Element is not supported at this time.

The various parts of CUG information element should be coded as follows.

CUG Indication (Octet 3)

Bits 7 6 5	Meaning
0 0 1	closed user group selection
0 1 0	closed user group with outgoing access selection and indication

All other values reserved

CUG Index Code (Octet 4, etc.)

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

All other values reserved

Note 1 – CUG information element shall not be used 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 message for a packet-mode call shall include the CUG information element.

5.5.3.3 Protocol Version Control

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 3, terminals can query this stored PVC information and effect communication by tailoring their respective protocols to the protocol version and issue 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.

8	7	6	5	4	3	2	1	
0	Protocol Version Control 0	1	1	1	1	1	0	Octet 1
Length of protocol version control information								2
1	0 spare	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.

Protocol Version Control Information Element

Notes

Note. 1 – 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 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 Most Significant Bit (MSB) is bit 5 of octet 3. The Least Significant Bit (LSB) is bit 1 of octet 3a.

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.

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.

Version Codes(Octet 4a)

Bits 7 6 5 4 3 2 1	Meaning
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

Issue Codes(Octet 4b)

Bits 7 6 5 4 3 2 1	Issue Codes
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
. . . .	. . . .
1 1 1 1 1 1 1	issue number 127

NOTE: The current versions and code values supported and the relevant NT specifications that apply to each version and issue code are as follows:

Version Meaning	Issue Code Value	Specification
NT Stimulus	0	NIS S208-2
NT Meridian Feature Transparency	0	NIS S208-5, Issue 1.0, Sections A,B,C,I
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-1	2	NIS S208-6, Issue 1.1

5.5.3.4 Redirecting Subaddress †

The purpose of the redirecting subaddress information element is to identify a subaddress associated with the redirecting party of a call.

8	7	6	5	4	3	2	1
0	Redirecting Subaddress Information Element Identifier						
Length of redirecting subaddress information							
1	Reserved (see Note)						
Subaddress Information							

Redirecting Subaddress Information Element

† Note. This Information Element is not supported at this time.

5.5.3.5 Reverse Charging Indication +

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.

The reverse charging indication should be coded as follows.

8	7	6	5	4	3	2	1	
0	Reverse Charging Indication 1 0 0 0 0 1 0 Information Element Identifier							Octet 1
Length of reverse charging indication information								2
1 EXt.	0 0 0 0 Spare				Rev. Charging Indication			3

Reverse Charging Indication Information Element

+ Note. This information element is not supported at this time.

Reverse Charging Indication (Octet 3)

Bits 3 2 1	Meaning
0 0 1	reverse charging requested

All other values reserved.

Codings at Originating Interface

The reverse charging indication information element should not be used at the originating party interface.

Codings at Terminating Party Interface

The network will include the reverse charging indication information element in a SETUP message 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.

6.0 CALL CONTROL PROCEDURES

This section describes the procedures for functional call setup. The following notes are provided as guidance to terminal manufacturers.

Note. 1 – In order to identify and associate with an appropriate service profile, all terminals using dynamic TEIs must undergo the terminal identification procedures described in section 4.0, section E of this specification. Service profile initialization should be performed immediately after layer 2 data link establishment and must occur before any other layer 3 call/service requests are sent over the TEI by the terminal to the network.

Note. 2 – It is recommended that the data link connection should be kept up and running all the time when layer 1 is up.

Note. 3 – Although optional, it is recommended that terminals support Service Profile Management which is described in section H of this specification.

6.1 PROCEDURES FOR CIRCUIT–SWITCHED CALLS

Circuit–switched calls are controlled by a sequence of messages flowing across the user–network interface. This section describes the sequence.

The information elements contained in each message type are dependent on the direction of the message flow. The information elements that are contained in each message are as described in Section 4.

Call reference values are assigned by the origination side of the interface for a call. The call reference flag can have the values "0" or "1". The call reference flag identifies which end of the Layer 2 logical link allocated the call reference. The side that allocated the call reference value always sets the call reference flag to "0". The other side always sets the call reference flag to "1". An exception is the global call reference flag which currently has a value of "0" in both directions.

6.1.1 Call Establishment at the Originating Interface

Before these procedures are invoked, a reliable data link connection must be established between the user (TE/NT2) and the network. All layer 3 messages shall be sent to the data link layer using a DL-DATA-REQ primitive. The data link services described in section C of this interface specification are assumed.

6.1.1.1 Call Request

1. A user initiates call establishment by transferring a SETUP message across the user network interface. The message shall always contain the call reference selected according to the procedures given in section 5.3. The Bearer capability information element is mandatory in the SETUP message, even in the case of overlap sending.

   After sending the SETUP message, the user shall optionally start timer T303. If no response (CALL PROCeeding/SETUP ACKnowledge/RELease COMplete) is received from the network within time interval T303, the SETUP message is retransmitted and timer T303 is restarted. If no response is received before timer T303 expires the second time, the user shall initiate clearing as described in section 6.1.3.

   If a subsequent SETUP message with identical call reference is received after the network has responded with CALL PROCeeding or SETUP ACKnowledge to a SETUP message, the subsequent SETUP message shall be ignored by the network.

   The SETUP message may contain all or none, of the call information (i.e. 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 "Call Information Sending" below.

2. B-Channel Selection - Originating

   If the Channel identification information element is set to "preferred any channel" or is not present in the SETUP message from a user, the network will interpret this as any available B-channel may be used. If a channel is available, the network will set the Channel identification information element to be returned to the user with that channel indicated as exclusive. If no channel is available, the call will be rejected.

If the Channel identification information element indicates a preferred channel (i.e. "prefer B1" or "prefer B2") in the outgoing SETUP message and the requested channel is available, the network will assign that channel to the call and set the Channel identification information element to be returned to the user with that channel indicated as exclusive. If the requested channel is unavailable, the network will find the first available B channel, assign that channel to the call, and set the Channel identification information element to be returned to the user with that channel indicated as exclusive. If no channel is available, the call will be rejected.

The Channel identification information element will be present containing an exclusive channel (ie. "exclusive B1" or "exclusive B2"). If the requested channel is available, the network will assign that channel to the call and the Channel identification information element is returned to the user with that channel indicated as exclusive. If the requested channel is unavailable, the call will be rejected.

In all of the above scenarios where a channel is successfully assigned, the network will include the Channel identification information element in the first response to the SETUP message (i.e. a SETUP ACKnowledge or CALL PROCeeding message).

In all of the above scenarios where the call is rejected due to the unsuccessful assignment of a channel, the network will respond with a RELease COMplete message with an appropriate cause value. If channel selection failure is due to having no channel in the network available (i.e. both channels are assigned), then the network will include cause value #34, "no channel/circuit available". Otherwise, channel selection failure occurs because the requested channel is not available and the network will include a cause value #44, "requested circuit/channel not available". In all of the above cases the clearing procedures in 6.1.3 are used.

3. Bearer Capability Validation

If the bearer capability indicated in the SETUP message is not authorized for the calling user, or if the bearer service is authorized but not presently available or implemented, then the network will reject the SETUP message by sending a message as described in 6.1.3.

After an idle B-channel has been reserved and the bearer capability validation has successfully been completed, the network will proceed to process the call information.

4. Calling Party Number

If the SETUP message for a circuit-switched call contains Calling Party Number (CGN) information, it will be validated by the network. (See "Calling Number Identification" in Section E for more details on CGN validation.) If the user-provided CGN 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.

5. Calling Party Subaddress

If the SETUP message for a circuit-switched call contains Calling Party Subaddress (CGS) information, it will transported transparently through the network unless

- A valid calling party number is not present in the SETUP
- The calling party does not subscribe to CGS Information Transfer, or
- The CGS information element 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 message with cause value #43, "user information discarded (location: public network serving local user), diagnostic byte coded to "#6d" (information element identifier value associated with the CGS information element), and the call state information element coded as call state 1 "call initiated". Regardless of whether the CGS information is discarded, call processing continues as normal.

6. Called Party Subaddress

If the SETUP message for a circuit-switched call contains Called Party Subaddress (CDS) information, it will be transported transparently through the network unless:

- The calling party does not subscribe to CDS Information Transfer, or
- The CDS information element either (1) exceeds the maximum allowable length or (2) is less than minimum declared length.

In the above cases, the network discards the CDS information by sending the calling user a STATus message with cause value #43, "user information discarded (location: public network serving local user), diagnostic byte = #71, and the call state information element coded as call state 1 "call initiated". Regardless of whether the CDS information is discarded, call processing continues as normal.

7. High/Low-Layer Compatibility

If the SETUP message for a circuit-switched call contains High/Low-Layer Compatibility information, it will transported transparently through the network unless:

- The calling party does not subscribe to HLC/LLC Information Transfer, or
- The HLC/LLC information element either (1) exceeds the maximum allowable length or (2) 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 message with cause value #43, "user information discarded (location: public network serving local user), diagnostic byte = information element identifier value associated with the HLC/LLC information element (as appropriate), and the call state information element coded as call state 1 "call initiated". Regardless of whether the HLC/LLC information is discarded, call processing continues as normal.

8. 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 E-5.0.

Where combinations of enbloc and/or overlap are used to send information to the network, terminals are required to be able to accept the Information Request information element to prompt the user for supplemental information in either a SETUP ACKnowledge or INFOrmation message. The network will return an Information Request information element on receipt of a complete access code (for example a routing code) or feature request during call establishment where supplemental address information is required.

a. Enbloc Sending

Enbloc sending during call initiation refers to the case where the user has included all the information in the SETUP message 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 accesssed, the feature request/address information should be encoded in any one or acceptable combination of Keypad information element, Called Party Number information element, Transit Network Selection information element, Feature

Activation information element, and/or Operator System Access information element.

The combination of Keypad information element and any one of Called Party Number, Transit Network Selection, or Operator System Access in the SETUP message will be treated by the network as an error and the call will be 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 Operator System Access information element or the Transit Network Selection information element in the SETUP message, the network will attempt 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, then depending on the specific service, the network may require the user to send supplemental address information, in which case the network will prompt for supplemental address information. Refer to section E-5.0 for description of the generic procedures for supplementary service access supported by the network.

b. Overlap sending

Overlap sending during call initiation refers to the case where the user includes none or partial information in the SETUP message necessary to establish a call or to access a supplementary service. Overlap access to supplementary service is described in section E-5.0 of this specification.

When establishing a call using overlap sending, the user shall send address digits in either the Keypad information element, or the Called Party Number information element with the associated Type of Number and Numbering Plan Identification each coded to "unknown".

On receipt of such a SETUP message, the network starts timer T400 (the value is found in Section 7.1), and sends a SETUP ACKnowledge message 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 will contain signal #0, "dial tone on" and progress indicator #8, "inband information or appropriate pattern now available."

After receiving the SETUP ACKnowledge message, the user shall stop timer T303 (if started) and send the call information (if any) in the Keypad information element contained in one or more INFOrmation messages. Upon receiving the first INFOrmation message from the user, timer T400 is stopped and timer T401 is started. If dial tone was turned on as part of the SETUP ACKnowledge, the network will also send an INFOrmation message containing signal #63, "tones off" after receiving the first INFOrmation message from the user.

Note: Besides the called party number information, the INFOrmation messages may contain additional call information (i.e. for supplementary services). The interpretation of the contents of Keypad information elements is network-specific and in accordance with the dialing plan provided to that user. Timer T401 is used for interdigit timing and is started on receipt of each INFOrmation message until end of dialing is determined.

If T400 expires and the network has not received enough information to route the call or timer T401 expires, the action taken by the network will depend on the Bearer capability of the call. For end-to-end ISDN speech or 3.1 khz audio calls, a PROGress message with cause #28, progress indicator #8, and signal #3 will be sent to the calling user by the network, while for end-to-end ISDN circuit-mode data calls, a call clearing message with cause #28 and signal #3 is sent to the calling user.

9. Invalid Call Information

For the case of a SETUP message containing a Bearer capability value which is not implemented by the network, the network will initiate call clearing and send a RELease COMplete message to the user with cause value # 65, "Bearer capability not implemented".

If, during overlap sending the network determines that the call information received from the user is invalid (i.e. invalid address or access to any services and facilities requested is not authorized for the user), or if access to the requested services and facilities is authorized but not presently available, then the action taken by the network will depend on the Bearer capability of the call. For ISDN speech or 3.1 khz audio calls, a PROGress message with the appropriate cause, progress indicator and signal numbers will be sent to the calling user by the network, while for ISDN circuit-mode data calls, a call clearing message with the appropriate cause and signal numbers will be sent to the calling user.

If, during enbloc sending, the network determines that the call information received from the user is invalid, the network will first return a CALL PROCeeding message specifying the B-channel to connect to, followed by a PROGress message containing the appropriate cause, and progress indicator values.

6.1.1.2 Call Proceeding

When the network determines that sufficient information to route a call has been received or access to the requested service and facilities is authorized and available, a CALL PROCeeding message will be sent to the user to indicate that the call is being established. If an Information Request information element was sent to prompt for supplemental information, the CALL PROCeeding message will contain the Information Request information element coded to indicate that the request for supplemental information is complete.

In the case where all the necessary information has been received in the SETUP message (i.e enbloc case), the CALL PROCeeding message will contain the B-channel allocated to the call.

If during overlap sending, the network has received a 'sending complete' indication (eg. the # character) in an INFOrmation message, or analysis by the network shows that all call information necessary to effect call establishment has been received, the network will stop timer T401 and, if access to the requested service and facilities is authorized and available, then the network will send a CALL PROCeeding message to the user.

If timer T401 expires during overlap sending, the network action depends on the Bearer capability of the call as described in Section 6.1.1.1.

6.1.1.2.1 Call Proceeding Timer

If the user receives a CALL PROCeeding message in response to a SETUP message, timer T303 (if started) is cancelled and timer T310 may optionally be initiated. If the user subsequently does not receive any response from the network prior to expiration of timer T310, the user shall initiate call clearing as described in 6.1.3.

6.1.1.2.2 Progress Indication at the originating interface

During call establishment, the network may send a PROGress message to the user. This indicates either an interworking situation has occurred, or that a network announcement will be provided in the information channel. One of the following progress indicator values will be included in the Progress indicator information element in the PROGress message sent to the user:

a. #1 - "call is not end-to-end ISDN, further call progress information may be available in-band

b. #8 - "in-band information or pattern now available", or

c. #10 - "delay in response at called interface".

The PROGress message shall have no effect on the protocol state machine when sent or received at this time. But any supervisory timers started (e.g. T310) shall be stopped. The user shall connect to the B-channel (if not already done so) and monitor the B-channel for further in-band information.

6.1.1.3 Termination to a Non-ISDN Line: Calling Party Alerting

When an ISDN user originates a call which terminates on a non-ISDN line, the network will send an ALERTing message containing progress indicator #8 and signal #1 to the calling user indicating it has begun notifying the called line that a call is present.

6.1.1.4 Termination to an ISDN Line: Called Party Alerting

Upon receiving an indication that user alerting has been initiated at the called address, the network will send an ALERTing message 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 message with progress indicator #8 and signal #1, while end-to-end ISDN circuit-mode data calls are sent an ALERTing message containing signal #1.

6.1.1.5 Call Connected

Upon receiving an indication that the call has been accepted, the network will send a CONNect message across the user–network interface to the calling user and enter the Active state.

The CONNect message may contain Signal #63 (if Signal #1 had previously been sent in an ALERTing message), and Progress Indicator #2 (if the called party is non–ISDN).

This message indicates to the calling user that a connection has been established through the network and stops a possible local indication of alerting.

On receipt of the CONNect message, the calling user shall stop timers T301, T303, and T310 (if running) and may optionally send a CONNect ACKnowledge message and shall enter the Active state. The network will not take any action on receipt of a CONNect ACKnowledge message when it perceives the call to be in the Active state.

6.1.1.6 Call Rejection

Upon receiving an indication that the remote user (or network) is unable to accept the call, the network will initiate clearing as described in section 6.1.3.

6.1.2 Call Establishment at the Destination Interface

This procedure assumes that a data link connection providing services described in the Layer 2 procedures (described in section C of this interface 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 of the users before they respond to the SETUP message. The call reference contained in all messages relating to this call that are exchanged across the user–network interface shall contain the call reference value specified in the SETUP message delivered by the network. For incoming calls, the SETUP message will contain Signal #64 for circuit–mode calls.

6.1.2.1 Incoming Call

The network will indicate the arrival of a call at the user–network interface by transferring a SETUP message across the interface. This message is sent if the network can select an idle B–channel. The Channel identification information element is mandatory in the SETUP message and indicates the B–channel to be used for the call, with no acceptable alternative.

In some circumstances (e.g. additional call offering), the SETUP message 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 message must contain the Called party number information element if the interface supports multiple DNs. After sending the SETUP message, the network starts timers T303 and T312.

Timer T312 is used to supervise the retention of the call reference when the SETUP message was transmitted by a broadcast data link. The value of timer T312 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 call reference. Refer to 6.1.3 for procedures to be followed on expiry of timer T312.

The SETUP message is the only message sent on the broadcast data link for an incoming call.

The SETUP message for any call will contain the following information elements, as appropriate:

- Protocol Discriminator (always present)
- Call Reference (always present)
- Message Type (always present)
- Bearer Capability (always present)
- Channel Identification (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, and if 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 message received from the calling user equipment, and 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 message rather than the Called party number information element.
- Called Party Subaddress is included if the SETUP message received from the calling user equipment included it and the network accepted it for transfer to the called party.
- Low-Layer Compatibility (included if the SETUP message 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 message 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 (is included in order to identify the terminals to which a call is directed, and it is always present for incoming EKTS calls).
- Call Appearance (is 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 message, the network should retransmit the SETUP message, restart timers T303 and T312, and send a PROGress message to report a delay at the called interface. A PROGress message should also be sent if a CALL PROC message is received after the first expiry of T303. The contents of this PROGress message vary according to the the Bearer capability of the call.

For end-to-end ISDN speech or 3.1 khz audio calls, the network will send the calling user equipment a PROGress message containing progress indicators # 10 and # 8, and also include signal # 1, while sending progress indicator # 10 and signal # 1 for circuit-mode data call.

When the incoming SETUP message contains the low-layer compatibility information element; if the information in that information element conflicts with the information in the bearer capability information element , then the terminal should ignore the low-layer compatibility information element.

6.1.2.2 B-Channel Selection - Destination

Except with certain supplemental service (ie. Additional Call Offering and EKTS), the network always uses the Channel identification 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 shall send a RELease COMplete message, with cause value #44 "requested circuit/channel not available", to the network.

In the case of Additional Call Offering or EKTS, the network sends a SETUP with the Channel identification information element coded as "no channel indicated", and channel negotiation takes place according to the channel identifier specified by the called user in response to the incoming SETUP.

6.1.2.3 Call Confirmation

6.1.2.3.1 Response to SETUP

When an idle user equipment determines that sufficient call setup information has been received, compatibility requirements have been satisfied and the B-channel indicated in the SETUP message is acceptable, the user responds with either a CALL PROCeeding, ALERTing, or CONNect message.

The CALL PROCeeding message should be sent by user equipment which cannot respond to a SETUP message with an ALERTing, CONNect or RELease COMplete message before expiration of timer T303. (See section 6.1.2.3.2 for more details).

When the network receives the first ALERTing message from the called user after channel negotiation is successful, T310 or T303 (if running) are cancelled by the network in conjunction with the start of timer T301. On receipt of a CONNect message timer T301 is stopped.

User equipment receiving a SETUP message shall perform compatibility checking before responding to the SETUP message. At the minimum for basic calls (Note), the user shall check that the bearer service offered by the network in the Bearer capability information element and the called number specified in the number digits subfield of the Called party number information element match with the bearer services and directory numbers supported by the user equipment.

Basic call terminals supporting terminal initialization procedures (As defined in Section E, 4.2) and, for example, the supplementary service of Electronic Key Telephone Service shall check for a match of the endpoint identifier information element contents with the endpoint identifier stored in the terminal.

If a mismatch is detected, then the user is defined as "incompatible". After the SETUP message is delivered via the broadcast data link, an incompatible user shall either:

a. Ignore the incoming call; or,

b. Respond by sending a RELease COMplete message with cause value #88 "incompatible destination" and enter the Null state. The network currently ignores this RELease COMplete message.

If an incompatible user responds to the SETUP message with either an ALERTing or CONNect message, the network will initiate clearing for this specific user by sending a RELease COMplete message, with cause value #88 "incompatible destination". The user, upon receiving the RELease COMplete message, shall turn off alerting (if any), release the call reference and return to the Null state.

Busy user's equipment which satisfies the compatibility requirements indicated in the SETUP message will respond with a RELease COMplete message, with cause value #17 "user busy".

If the user wishes to refuse the call, a RELease COMplete message shall be sent with cause value #21 "call rejected".

After the user has responded with CALL PROCeeding/ALERTing/CONNect to the first SETUP message, if a subsequent SETUP with identical call reference is received, this subsequent SETUP message shall be ignored by the user.

At the destination user to network interface, the channel identification information element is mandatory in the first response from the user to the incoming SETUP message, except in the case of Additional Call Offering or EKTS. (In these two instances, the channel identification information element may be included in the CONNect message.)

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 identification information element is included in the first response and the channel specified is different from the one indicated in the incoming SETUP message, the network will initiate call clearing to the specific user by sending a RELease message, with cause value #6 "channel unacceptable". If the channel identification information element is not included in the response, the network takes action as specified for messages with missing mandatory information elements (see section 6.1.4.6.2).

6.1.2.3.2 Receipt of Call Proceeding

Receipt of the CALL PROCeeding message by the network stops timer T303 and starts timer T310. Receipt of an ALERTing or CONNect message in the case where a CALL PROCeeding message has not been received, stops timer T303. Receipt of an ALERTing or CONNect message subsequent to receipt of a CALL PROCeeding message cancels timer T310.

Receipt of an ALERTing message causes a corresponding ALERTing message to be sent to the calling user. Where multiple ALERTing messages are received in a multipoint access line, only the first occurrence will trigger a message to be sent to the calling user.

6.1.2.3.3 Call Failure Procedures

If the network does not receive any response to the retransmitted SETUP message prior to the second expiration of timer T303, the network will release the call reference and initiate clearing to the originating user in accordance to the procedures specified in 6.1.3.

If the network does not receive an ALERTing, CONNect or DISConnect message prior to expiration of timer T310, it will initiate clearing procedures to the calling user as specified in 6.1.3. The clearing cause sent to the calling user equipment is cause #18, "no user responding". The value of T303 and T310 are specified in section 7.1.

On a point-to-multipoint interface structure, if a RELease COMplete message is received while T303 or T310 is running, the message cause will be retained by the network. If timer T303 or T310 expires (i.e. if no valid message such as ALERTing or CONNect has been received), the cause previously retained when a RELease COMplete message was received is sent back to the calling user in a RELease message.

Note: The cause value to be returned to the calling user when multiple RELease COMplete messages (and causes) from multiple terminals on the access loop have been received, will be determined by the network. Normally the first cause received will be returned to the user.

6.1.2.4 Call Accept

When an ISDN user answers the call, the terminal shall send a CONNect message to the network and the terminal starts timer T313. The network then establishes a connection between the calling and called user. When cut-through is completed, the network sends the called user a CONNect ACKnowledge message containing signal #79.

If an ALERTing or PROgress message containing signal information indicating ringback/audible ringing tone on, had previously been sent by the calling user then signal # 63 will be included in the CONNect message to the calling user.

When the network receives a CONNect message from the called user, timers T301, T303, and T310 are stopped if running.

6.1.2.5 Active Indication

On receipt of the first CONNect message, the network completes the circuit switched path to the selected B-channel and subsequently sends a CONNect ACKnowledge message to the user which first accepted the call. It is presumed that the B-channel that was agreed earlier is being used for the call. The network also initiates procedures to send a CONNect message towards the calling user.

The CONNect ACKnowledge message 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 message, the user stops timer T313. At this point, the call enters the Active state where it remains until clearing is initiated.

If timer T313 expires prior to receipt of a CONNect ACKnowledge message from the network, the user shall initiate call clearing by sending a RELease message and start timer T308.

The user which has received the SETUP via the broadcast data link and has been awarded the call, shall connect to the B-channel only after it has received the CONNect ACKnowledge message. Only the user that is awarded the call will receive the CONNect ACKnowledge message.

6.1.2.6 Non-Selected User Clearing

6.1.2.6.1 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 will also be stopped.

6.1.2.6.2 Call Contention Supported †

In addition to sending the CONNect ACKnowledge message to the terminal selected for the call, the network sends a RELease message with cause value #26, "non selected user clearing", to all other terminals at the interface which had sent a CALL PROCeeding, ALERTing or CONNect message in response to a SETUP message. This message is used to notify these terminals that the call is no longer offered to them. Any user which has previously sent a CONNect message and started timer T313 and which subsequently received a RELease message, shall stop timer T313. Each user receiving the RELease message shall return a RELease COMplete message and release the call reference.

† Not supported at this time.

6.1.2.7 Additional Functionality (Non Ringing Terminals)

A DN can be subscribed, in the network, not to ring. To support this capability a terminals decision to ring or not shall be based on the signal information element included in a SETUP message sent to the terminal.

Incoming SETUP messages sent for a non-ring DN will have the signal information element coded to # 79 "Alerting off". Upon receiving the signal value of # 79, the terminal shall not ring.

6.1.3 Call Clearing

6.1.3.1 Terminology

The following terms are used in the description of the clearing procedures:

- A channel is "connected" when the channel is part of a circuit-switched ISDN connection established according to this document.
- A channel is "disconnected" when the channel 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 the channel 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.

6.1.3.2 Exception Conditions

Under normal conditions, call clearing is initiated by the user or the network sending a DISConnect message and following the procedures defined in 6.1.3.3 or 6.1.3.4. Exceptions to this rule are as follows:

a. Call clearing due to protocol violations

Protocol violations are:

- Message type errors as defined in 6.1.4.4
- Mandatory information element errors, as defined in 6.1.4.6
- Call reference errors, as defined in 6.1.4.3.2 (a).
- other protocol violations for which a cause value is not specified. In this case, cause value #111 "protocol error, unspecified" should be used.

With the exception of message type errors which are handled as described in section 6.1.4.4, 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 (i.e. any state except 0, 1, 6 and 19), it will clear the call by sending a RELease message.

- If no previous message has been sent or received which identified a channel to be connected for the call (i.e. States 0, 1 and 6), a RELease COMplete message will be sent.

- If a RELease message had previously been sent, the message will be ignored.

Note: This procedure will be followed regardless of whether the user has subscribed to in-band tone options.

b. Call rejection by network during call initiation

In response to a SETUP message, the network will clear a call due to unavailability of B-channels by responding with a RELease COMplete message, with cause value #34 "no channel/circuit available".

If the bearer capability requested in the SETUP message is not authorized or not presently available or implemented, the network will reject the SETUP by sending a RELease COMplete message 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 message with a transit network selection that it does not recognize, the network will reject the origination. Depending on the calling bearer capability ISDN speech or 3.1 khz audio calls will be rejected by the network and sent a CALL PROCeeding message with the channel identification information element followed by a PROGress message with cause #2, progress indicator #8, and signal #3. For ISDN circuit-mode data calls the network will reject the origination by sending the calling user a call clearing message with cause #2 and signal #3.

If the network receives a SETUP message with the transit network selection requesting a carrier that is not allowed to carry intraLATA calls, the network will reject the origination. Depending on the calling user bearer capability for ISDN speech or 3.1 khz audio calls, the network will send the calling user a CALL PROCeeding message with the channel identification information element followed by a PROGress message with cause #3, progress indicator #8 and signal #3. For ISDN circuit-mode data calls, the network will reject 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 will process the call information provided by the user. If the call information is invalid, or the requested services and facilities are authorized but not presently available, the following procedures will apply:

1) In the case of en-bloc sending, the network will reject the origination depending upon the bearer service requested. For speech or 3.1kHz audio calls, the network will send the calling user a CALL PROCeeding message containing the channel identification information element followed by a call PROGress message with the appropriate cause value, progress indicator #8, and signal #3. For ISDN circuit-mode data calls, the network will send the calling user a call clearing message with cause #28, and signal #3.

2) In the case of overlap-sending, the network will reject the origination depending on the requested bearer service. For speech or 3.1kHz audio calls, the network will send a PROGress message, with the appropriate cause value, progress indicator #8, and signal #3, since the network has already returned a SETUP ACKnowledge message specifying the B-channel to connect to (see section 6.1.1.1 - 4 (b)). For circuit-mode data calls, the network will send the calling user a call clearing message with cause #28, and signal #3.

   Call clearing will be initiated if timer T401 expires before all digits are received during overlap sending.

3) 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", or
   - #50 "requested facility not subscribed"
   - #63 "service or option not available, unspecified", or
   - #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"

4) After receiving the PROGress message, the user may initiate call clearing by sending a DISConnect message and following the procedures described in 6.1.3.3. If no DISConnect message is received after a network-specified time period, the network will clear the call by sending a RELease message to the user and applying the procedures specified in 6.1.3.4. (More than one PROGress message may be sent in the event a call is routed to multiple tones and/or announcements).

   The PROGress message will/shall have no effect on the protocol state machine when sent or received. But any supervisory timers started (e.g. T400) shall be stopped. The user shall connect to the B-channel (if not already done so) and monitor the B-channel for further in-band information.

c. 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, i.e. network congestion (cause value #42 "switch equipment congestion");
- Destination number unassigned (cause #1) or number changed (cause #22);
- Destination number was 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. In this instance, the network sends the calling party a PROGress message with cause #17, progress indicator #8, and signal #4 for end-to-end ISDN speech or 3.1 khz audio calls. 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 message (DISConnect, RELease, or RELease COMplete) from called user while T301 is running. Here, the network will notify the calling user that the call cannot be completed as follows:
  - For end-to-end ISDN speech or 3.1 khz audio calls the network will send the calling user a PROGress message 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 will be sent to the calling user.

In the event that the destination user clears the call after first sending ALERTing but prior to CONNect being sent, and the network has applied in-band audible ringing to the originating user, then the network will complete call clearing to the destination user, but will continue sending in-band audible ringing to the originating user.

d. Call clearing by network to destination user, prior to answer

If a network disconnect indication is received after a SETUP has been sent to the called user, but prior to the expiry of timer T312, timer T303 or T310 is stopped (if running). Any user which has responded, or subsequently responds before T312 expires, will be cleared by a RELease message and the procedures of 6.1.3.4 are then followed for that user. Upon expiry of T312, the network will enter the Null state. However, the network will not release the call reference for re-use until the clearing procedures of 6.1.3.4 have been completed for all responding users.

e. Clearing of non-selected terminals at the destination exchange

In the case of multipoint terminal configuration, the procedure described in section 6.1.2.7 above applies to clearing of non-selected terminal.

f. Clearing by calling user during call establishment

After retransmitting a second SETUP message to the network, if no response is received before timer T303 expires the second time, the user shall send a RELease COMplete message, with cause value #31 "normal, unspecified" to the network.

The user may optionally start timer T310 after receiving a CALL PROCeeding message. If no response is received from the network prior to expiration of timer T310, the user shall initiate clearing by sending a RELease message with cause value #31 "normal, unspecified" and start timer T308.

If the calling user goes on-hook during call establishment, i.e. before the network has sent a CONNect message, this would be considered as normal clearing and the procedures specified in 6.1.3.3 should be followed.

g. Clearing by network due to destination not responding

If the network does not receive any response to a retransmitted SETUP message (ie. on the second expiration of timer T303), then the network will initiate clearing to the originating user. When the SETUP message is delivered by a broadcast data link, the network will also initiate clearing procedures towards the called user in accordance with 6.1.3.2 (d).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 will send the calling user a PROGress message with cause #18, progress indicator #8, and signal #1, while for circuit-mode data calls, the network will send a call clearing message with cause #18 and signal #1 to the calling user.

If the network does not receive a valid CONNect message from the called user before T301 expires, it will clear the call at the called interface, sending a RELease message with cause #102 to the called user equipment from which a CALL PROCeeding or ALERTing message was the last message received by the network. The network will send a call clearing message with cause #19 and signal #63 to the calling user.

A CALL PROCeeding message may be sent by the called user to the network when it cannot respond to the SETUP message with an ALERTing, CONNect, or call clearing message before T303 expires. If the network receives a CALL PROCeeding message from the called user, the network will stop T303 and initiate T310. If T310 expires, the network will send the called party a RELease message 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 will send a PROGress message with cause #18, progress indicator #8, and signal #1, while for end-to-end ISDN circuit-mode data calls the calling user equipment will be sent a call clearing message with cause #18 and signal #1.

h. Clearing by network due to unavailable equipment/facilities

If a network condition of unavailable equipment/facilities or internal or other failure occurs the network will send the calling user a CALL PROCeeding message identifying the channel, followed by a PROgress or DISConnect message based on the bearer capability of the calling user:

- For end-to-end ISDN speech or 3.1 khz audio calls the network will send a PROGress message containing cause #34 "circuit/channel congestion", progress indicator #8, and signal #3.
- For end-to-end ISDN circuit-mode data calls the network will send a call clearing message containing cause #34, and signal #3.

6.1.3.3 Clearing by the User

a. Apart from the exceptions identified in sections 6.1.3.2 and 6.1.4, the user shall initiate normal clearing by sending a DISConnect message, starting timer T305 and disconnecting the B-channel.

b. On receipt of the DISConnect message by the network, the B-channel used in the call is disconnected; a RELease message is sent to the user and timer T308 is started. The network will also initiate procedures to clear the network connection and the call to the remote user.

On receipt of the RELease message, the user shall cancel timer T305, release the B-channel, send a RELease COMplete message, release the call reference and return to the Null state. Following the receipt of a RELease COMplete message from the user, the network will stop timer T308, release both the B-channel and call reference and return to the Null state.

If a RELease COMplete message is not received by the network before the first expiry of timer T308, the network will retransmit the RELease message and restart timer T308. If no RELease COMplete message is received from the user before timer T308 expires a second time, the network will release the call reference and the B-Channel on the network side and return to the Null state.

If the user does not receive a RELease message in response to the DISConnect message before expiry of timer T305, it shall send a RELease message to the network with the cause value originally contained in the DISConnect message, and start timer T308. On receipt of the RELease COMplete message from the network, the user shall stop timer T308, release both the B-channel and the call reference and return to the Null state. If the user does not receive a RELease COMplete message prior to the first expiry of timer T308, the RELease message shall be retransmitted and timer T308 shall be restarted. If no RELease COMplete is received from the network before timer T308 expires the second time, the user shall release both the B-channel and call reference and enter the Null state.

c. In some cases, a RELease message may be received without having received a previous DISConnect message. In these cases, the receiver of the RELease message shall release the B-channel and call reference and then return a RELease COMplete message to the originator of the RELease message.

d. The Signal information element, set to "tones off", will be included in the appropriate network clearing message if tones were previously turned on and have not been previously turned off.

6.1.3.4 Clearing by the Network

a. Apart from the exceptions identified in sections 6.1.3.2 and 6.1.4, the network will initiate normal clearing by sending a DISConnect message, starting timer T305 and disconnecting the B-channel.

b. On receipt of the DISConnect message, the user shall disconnect the B-channel, send a RELease message and start timer T308.

On receipt of this RELease message, the network will stop timer T305, release the B-channel, send a RELease COMplete, release the call reference and enter the Null state. Following the receipt of a RELease COMplete message from the network, the user shall cancel timer T308, release both the B-channel and call reference and return to the Null state.

If the network does not receive a RELease message in response to the DISConnect message before expiry of timer T305, it will send a RELease message to the user with the cause value originally contained in the DISConnect message, and start timer T308. On receipt of the RELease COMplete message from the user, the network will stop timer T308, release both the B-channel and the call reference and return to the Null state. If a RELease COMplete message is not received before timer T308 expires, the RELease message will be retransmitted and timer T308 will be restarted. If no RELease COMplete is received from the user before timer T308 expires the second time, the network will release the call reference and the B-channel on the network side.

If a RELease COMplete message is not received by the user before the first expiry of timer T308, the user shall retransmit the RELease message and restart timer T308. If no RELease COMplete message is received from the network before timer T308 expires a second time, the user shall release the call reference and B-channel and return to the Null state.

c. In some cases, a RELease message may be received without having received a previous DISConnect message. In these cases, the receiver of the RELease message shall release the B-channel and call reference and then return a RELease COMplete message to the originator of the RELease message.

d. 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 will send the calling user a PROGress message with cause #41, progress indicator #8, and signal #4, while for end-to-end ISDN circuit-mode data calls a call clearing message with cause #41 and signal #4 is sent to the calling user equipment by the network.

e. The Signal information element, set to "tones off", will be included in the appropriate clearing message if tones were previously turned on and have not been previously turned off.

6.1.3.5 Clear Collision

Clear collision occurs when the user and the network simultaneously transfer a DISConnect message specifying the same call. Both the user and the network shall stop timer T305, send a RELease message, start timer T308 and follow the procedures as described in 6.1.3.3 or 6.1.3.4

Clear collision can also occur when both sides simultaneously transfer a RELease message related to the same call. The entity receiving such a RELease message will/shall stop timer T308, release the B-channel and call reference and enter the Null state.

6.1.4 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 which are either incorrect or not understood. Once the threshold is exceeded for call-related protocol errors, then the call may be cleared. Once the threshold is exceeded for non-call related protocol errors, then the data link may be disconnected.

In this section, "ignore" means discard and do nothing, as if the message had never been received.

6.1.4.1 Protocol Discriminator Errors

When a message is received with a protocol discriminator not in accordance with section 5.2, that message will be ignored.

6.1.4.2 Message Too Short

When 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), then that message will be ignored.

6.1.4.3 Call Reference Errors

6.1.4.3.1 Invalid call reference format

If the call reference information element octet 1, bits 5 through 8, do not equal 0000, then the message will be ignored.

If the call reference information element octet 1, bits 1 through 4, indicate a length greater than two octets, the message will be ignored.

6.1.4.3.2 Call reference procedure errors

The network handles call reference procedure errors as follows and as specified in section 8.1.4.3.2.

a. Whenever the network or user receives any message except SETUP or RELease COMplete, specifying a call reference which it does not recognize as relating to an active call or a call in progress, it sends a RELease COMplete message using the call reference in the received message, with cause value #81 "invalid call reference value".

b. If a RELease COMplete message is received, specifying a call reference which is not recognized as relating to an active call or a call in progress, then no action will be taken.

c. When a SETUP message is received with the call reference flag value incorrectly set to 1, then the SETUP message will be ignored.

d. When a SETUP message is received specifying a call reference which is recognized as relating to an active call or to a call in progress, this SETUP message will be ignored.

e. Any message specifying the global call reference will be ignored.

f. When any message, except INFOrmation is received specifying the dummy call reference, the message will be ignored.

6.1.4.4 Message Type Errors

6.1.4.4.1 Unrecognized Message Type

If a message is received containing a message type which is either not implemented or not understood, then no action will be taken on that message and no state change will occur. A STATus message 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 shall initiate call clearing to the calling user with cause #97 "message type non-existent or not implemented".

6.1.4.4.2 Unexpected Message

Whenever an implemented message, except RELease or RELease COMplete, is received at either side of the interface, specifying a valid call reference relating to a call which is considered to be in (1) the ACTIVE state or (2) any of the states of call establishment, but for which a response is not prescribed by the procedures in 6.1.1, 6.1.2, or 6.1.3, the network will typically ignore the unexpected message and return a STATus message containing cause #101, "message not compatible with call state." Such messages will also be 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 will be cleared as described in 6.1.3, 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 message containing cause #101, "message not compatible with call state.".

If a RELease COMplete message is received, the receiver will stop any supervisory timers, release the B-channel (if any) and call reference and enter the Null state.

If a RELease message is received, then the receiver will stop any supervisory timers, release the B-channel (if any), send a RELease COMplete, release the call reference and enter the Null state.

The network will ignore any unsolicited STATus messages received from the user (ie. any STATus messages which are not in response to a STATus ENQuiry initiated by the network).

6.1.4.5 General Information Element Errors

If an information element is received which contains less information than is required to act on the information element, then this information element will be treated as having "invalid information element contents".

6.1.4.5.1 Duplicated Information Elements

When an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of the information element appearing first will be processed. All subsequent repetitions of the information element will be ignored.

When a message is received containing an information element repeated more times than the specified allowable maximum, the message will be acted upon, ignoring the contents of occurrences of the information element beyond the maximum.

6.1.4.5.2 Extension Errors

If the extension bit is '0' when '1' is expected or vice versa, then the information element will be ignored. When an information element is received with unrecognized extended octet(s), the information element will be ignored. If the ignored information element is mandatory, the error handling procedures for invalid mandatory information elements as described in 6.1.4.6 will be followed. If the ignored information element is non-mandatory, the receiver will continue to process the message.

6.1.4.6 Mandatory Information Element Errors

6.1.4.6.1 Out-Of-Sequence Mandatory Information Elements

The network will discard any information element that is out-of-sequence. (An information element is considered out-of-sequence if the value of its information element 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 the element to be missing and takes action as described in section 6.1.4.6.2

6.1.4.6.2 Mandatory information element missing

When a SETUP or RELease message is received, which has one or more mandatory information elements missing, a RELease COMplete message with cause value #96 "mandatory information element is missing" will be returned. After sending the RELease COMplete message, the sender shall release the B-channel (if any), release the call reference and return to the Null state.

When a DISConnect message is received with the Cause information element missing, then the actions taken will be the same as if a DISConnect message with cause value #31 "normal, unspecified" was received. The procedures in 6.1.3 for normal clearing will be followed. The RELease message returned may optionally contain cause value #96 "mandatory information element missing".

When a RELease COMplete message is received with a Cause information element missing, then it will be assumed that a RELease COMplete message was received with cause value #31 "normal, unspecified".

If a message other than SETUP, RELease, DISConnect, or RELease COMplete is received, which has one or more mandatory information elements missing, then a RELease message is returned with the cause value #96 "mandatory information element missing" and diagnostic field specifying the identifier of the first missing information element.

6.1.4.6.3 Mandatory Information Element Content Error

When a SETUP or RELease message is received, which has one or more mandatory information elements with invalid contents, a RELease COMplete message with cause value #100 "invalid information element contents" will be returned. After sending the RELease COMplete message, the sender shall release the B-channel (if any), release the call reference and return to the Null state.

When a DISConnect message is received with the Cause information element having invalid contents, then the actions taken shall be the same as if a DISConnect message with cause value #31 "normal, unspecified" was received. The procedures in 6.1.3 for normal clearing shall be followed. The RELease message returned may optionally contain cause value #100 "invalid information element contents".

When a RELease COMplete, HOLD REJect, or RETRieve REJect message is received with the Cause information element having invalid contents, then it will be assumed that the RELease COMplete, HOLD REJect, or RETRieve REJect message (respectively) was received with cause value #31 "normal, unspecified".

If a message, other than SETUP, RELease, DISConnect, RELease COMplete, HOLD REJect, or RETRieve REJect is received, which has one or more mandatory information elements having invalid contents, then a RELease message will be returned with cause value #100 "invalid information element contents".

6.1.4.7 Non-mandatory Information Element Errors

When the network or user receives a message containing optional information elements that it does not know how to act upon or having invalid contents, it will/shall process the message and those information elements that it can recognize and have valid contents. The information not acted upon should be discarded. Optionally, a STATus message will, in some instances be 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 information element identifier.

If the network receives a DISConnect or RELease containing an information element it cannot act on, it will discard the unrecognizable element, process any remaining elements, and continue 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 (ie. the subsequent RELease or RELease COMplete, respectively). If the network receives a RELease COMplete containing an unrecognizable information element, it will discard the element and clear the call as defined in section 6.1.3.

6.1.4.7.1 Out-Of-Sequence Non-Mandatory Information Elements

When the network receives a message containing a non-mandatory information element that is out-of-sequence, 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.

6.1.4.8 Data Link Reset

If the network side layer 3 entity is notified by its data link layer entity via the primitive DL-Establish-Indication that the data link has been reset, the following procedures apply:

a. For all calls in the Active state, the network will send a STATus ENQuiry message to the user. Timer T322 will be started and if any other timer is running, it will be cancelled. The procedures in 6.1.4.10 and 6.1.4.11 will then be applied.

b. For calls in the Call Initiated state (N1), the network will initiate clearing by sending a RELease COMplete message with cause value #41 "temporary failure". For calls in the other establishment states, the network will initiate clearing by sending a DISConnect message, with cause value #41 "temporary failure", and following the procedures in 6.1.3.

   For calls which are in the Call Present state (N6) and for which no response has been received from the user, the network will continue call offering until events lead to answer of the call or call clearing.

c. For calls in the Null state, no action will be taken.

d. For calls in the Clearing phase, (N12 or N19) the network will retransmit 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, no action shall be taken.

6.1.4.9 Data Link Failure

If the network side layer 3 is notified by its data link layer entity via the primitive DL-Release-Indication that there is a data link layer malfunction (other than as a result of TEI removal), the following procedures will apply:

a. Start timer T309 for all calls. Stop all other timers except for the call clearing timers (T305, T308).

   For calls in the establishment phase and for which a response has been received from a remote user, the network will clear the call to the remote user with a RELease message with cause value #41 "temporary failure".

   Note: If timer T309 is already running, it will not be restarted.

b. Request layer 2 re-establishment by sending primitive DL-Establish-Request. When informed via the DL-Establish-Confirmation that the data link layer is re-established, the network will stop timer T309 and follow the procedures defined in the case of Data Link Reset (6.1.4.8). If the remote user clears while timer T309 is still running, upon receiving the DL-Establish-Confirmation before T309 expires, the network will clear the call to the local user using the normal clearing procedures as described in 6.1.3.

If timer T309 expires prior to data link re-establishment, the network will clear the network connection and call to the remote user with cause value #41 "temporary failure". The network will also clear the connection and call to the local user by disconnecting and releasing the B-channel and the call reference and entering the Null state.

If the user side layer 3 entity is notified by its data link entity via the DL-Release-Indication primitive that there is a data link layer malfunction, it shall clear all calls. If the user side entity is able to distinguish calls in the Active state (ie. state 10), it may optionally maintain all active calls and start timer T309. If T309 expires (1) before layer 2 is reestablished and (2) before the user side entity receives a STATus ENQuiry message from the network, the entity should clear the call references associated with the active calls and disconnect all B channel connections. If the user side entity receives a STATus ENQuiry, it should follow the procedures outlined in sections 6.1.4.10 and 6.1.4.11 .

6.1.4.10 Status Enquiry Procedure

Whenever the network wishes to check the correctness of a call state at the user side, a STATus ENQuiry message will be sent requesting the call state. Timer T322 is started and if any other timer is running, it will be cancelled.

Upon receipt of a STATus ENQuiry message from the network, the user shall respond with a STATus message, if the call is in the Active state. The STATus message shall contain cause value #30 "responding to STATus ENQuiry".

If a STATus ENQuiry message is received in the Null state, then the user shall send a RELease COMplete message, using the call reference in the STATus ENQuiry message, with cause #81 "invalid call reference value".

If a STATus ENQuiry message is received in any state other than the Null or Active state, then the user shall either:

a. ignore the STATus ENQuiry message; or,

b. respond with a STATus message, reporting the current call state and cause #30 "responding to STATus ENQuiry".

Receipt of the STATus ENQuiry message does not result in a state change.

If clearing is initiated by either the user or network while T322 is running, the network will cancel timer T322 and proceed with call clearing as described in 6.1.3.

While T322 is running, the network will ignore all messages from the user except for clearing messages, and STATus messages with 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 message has been received, the network will clear the call by sending a DISConnect message, with cause #41 "temporary failure", as outlined in section 6.1.3. The call will be cleared to the remote user with cause #41 "temporary failure".

6.1.4.11 Receiving a STATus Message

On receipt of a STATus message from the local user containing (1) cause #30 "response to STATus ENQuiry"and (2) a call state, the network cancels timer T322 and takes action on the local user as follows, based on the call state reported.

REPORTED CALL STATE	NETWORK ACTION
Active (10)	Maintain end-to-end connection and continue call processing
Null (0)	Release B-channel and CR, and move call to null state
Disconnect Request (11) or Disconnect Indication (12)	Clear call with RELease message as described in section 6.1.3
Release Request (19)	Release B-channel and CR, and clear call with RELease COMplete message
Any Other State	Clear call with DISConnect message containing cause #101, "message not compatible with call state (location: public ntwk serving local user)" or other appropriate cause

Note: The CPE requires either the support of all call states or a minimum of two call states.

Unless the reported call state is Active (ie. 10), the network will also clear the call to the remote user with cause #41, "temporary failure (location: user)," or other appropriate cause.

If a STATus message is received from the user which contains a cause other than #30 "response to STATus ENQuiry" the message will be ignored and timer T322 will continue to run.

The network will ignore autonomous STATus messages from the user, that is, those not in response to a STATus ENQuiry message.

6.1.5 Call Collision

Call collision may occur when the user and network simultaneously send a SETUP message, allocating the last available call reference associated with the service profile. In the case of such conflicts, priority should be given to the incoming call over the call request from the user. The network will clear the outgoing call by sending a RELease COMplete message, with cause value #44 "requested circuit/channel not available".

6.1.6 Interworking with Existing Networks

6.1.6.1 Notification of interworking at the originating interface

During call establishment, the call may leave an ISDN environment, due to interworking with a non-ISDN network, or with non-ISDN equipment.

6.1.6.2 Outgoing call not end-to-end ISDN

When the network has received an indication that the outgoing call has left the ISDN after CALL PROCeeding has been sent, but before reaching the exchange serving the destination user, the network will send a PROGress message to the user, with Progress indicator information element specifying the value #1, "call not end-to-end ISDN".

This indicates that the user shall connect to the B-channel, if not connected already, and then monitor the B-channel for further in-band information. No state change will occur, but any supervisory timers will be stopped.

6.1.6.3 Answer Supervision

The network will monitor the out-going non-ISDN trunking facilities for answer and disconnect supervision. These conditions, upon detection, will be translated into CONNect or DISConnect messages, respectively, for the ISDN side of the call; and vice-versa.

7.0 PROTOCOL TIMER VALUES

7.1 TIMERS IN THE NETWORK SIDE

Timeout Number	Timeout Value	Started	Normally Terminated	Action to be Taken When Timer Expires
T301	3–7 min in steps of 1 minute (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 CR for incoming call and enter the Null state.
T305	30 s	On Sending DISC	On Receiving RELease or DISC.	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 call reference and B–channel and return to Null state

Timers in the Network Side

Timeout Number	Timeout Value	Started	Normally Terminated	Action to be Taken When Timer Expires
T309	30 s	DL Disc Calls in active state are not lost	On DL Reconnect	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 resent	timeout	If in Call Abort state, the CR is released. Otherwise, no action is taken.
T322	4 s	On Sending STATus ENQuiry	On Receipt of STATus	Initiate Call Clearing

Timers in the Network side cont'd.

Timeout Number	Timeout Value	Started	Normally Terminated	Action to be Taken When Timer Expires
T400	20 sec (default)	Message received that provides address information, but address information not yet complete	INFOrmation is received from calling user Note 4	Network provides partial dial treatment
T401	4–10 sec	Message received that potentially completes address information	INFOrmation is received from calling user Note 4	Network provides partial dial treatment or routes the call as appropriate.

Timers in the Network side (cont.)

Note 1: This timer is settable by the network in the range from 0 – 320 seconds.

Note 2: Timer T301 is supported for both ISDN calls and non-ISDN calls.

Note 3: Timer T303 is terminated on receipt of RELease COMplete if the network knows there is only one user on the interface.

Note 4: Timer T400 is started after the network sends the SETUP ACKnowledge message to the user. It is terminated when an INFOrmation message is received from the user or the timer period expires. If T400 expires, the call is given call treatment using an inband tone or announcement, at which time the user should disconnect their call. Timer T401 is used for interdigit timing and is started on receipt of each INFOrmation message until end of dialing is determined.

7.2 TIMERS IN THE USER SIDE

Timeout Number	Timeout 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 sec.	On Expiry of T308	On receiving REL COMp or RELease	Release Call Reference
T309	30 sec.	On DL-Release	On reestab-lishment of Layer 2 to network	Clear all CRs of active calls and B-channel connections
T313	4 sec.	On Sending CONNect	On Receiving CONNect ACK, DISC or REL	Send RELease

8.0 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 the 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 Section E of this specification.

For terminals which make use of these procedures, it is recommended that the data link connection should be kept up and running all the time when layer 1 is up.

8.1 CALL-INDEPENDENT CONNECTION USING REGISTER

8.1.1 Connection Establishment

The side which initiates a call-independent connection must first establish a reliable data link connection between the network and the user. All layer 3 messages shall be sent to the data link layer using a DL-DATA-REQ primitive. The data link services described in Section C of this interface specification are assumed.

A call-independent connection using REGister is one which is established with a REGister message. The REGister message establishes a call reference for the connection and includes a Facility information element.

8.1.2 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, identifies the service.

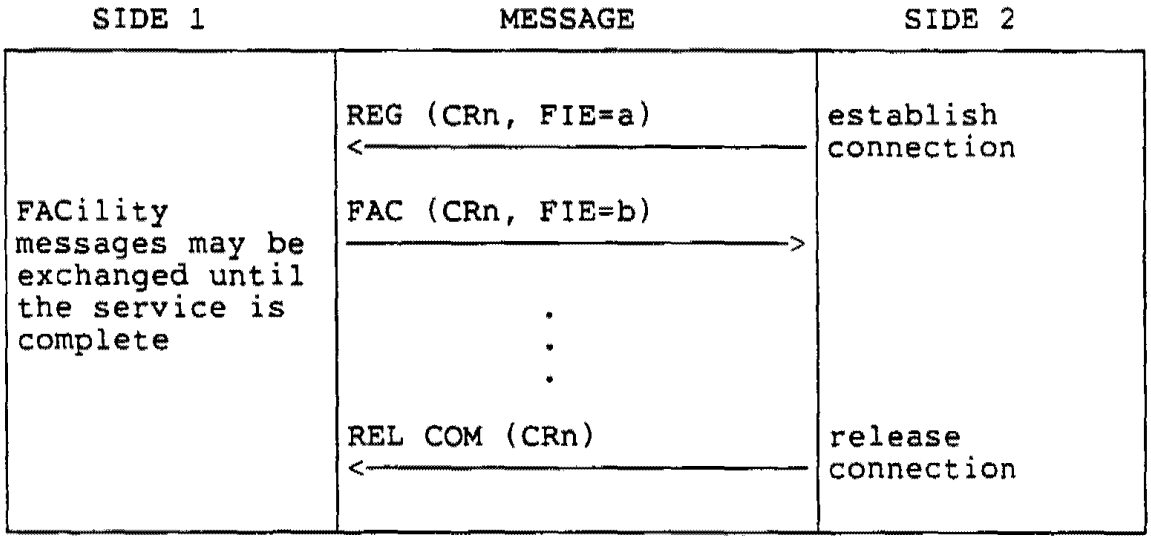
An exchange of FACility messages on the established call reference may follow, each of which contains a Facility information element containing a Remote Operations component for the service. The RELease COMplete message which clears the connection may include a Facility information element containing the final component of the service operation.

The components contained in the Facility information elements are specific to each service.

8.1.3 Connection Clearing

A RELease COMplete message clears the call-independent connection and releases the call reference.

Depending on the service, connection establishment and completion can be performed by the network or by the user.



Example Call-Independent Connection Using REGister

8.1.4 Handling of Error Conditions

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 message which clears a call-independent connection can optionally include a Cause information element. Service and RO errors are normally reported in a Reject or Return error component.

8.1.4.1 Protocol Discriminator Errors

When a message is received with a protocol discriminator not in accordance with section 5.2, that message shall be ignored.

8.1.4.2 Message Too Short

When 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), then that message shall be ignored.

8.1.4.3 Call Reference Errors

8.1.4.3.1 Invalid call reference format

If the call reference information element octet 1, bits 5 through 8, do not equal 0000, then the message shall be ignored.

If the call reference information element octet 1, bits 1 through 4, indicate a length greater than the maximum length supported by the receiving equipment, then the message shall be ignored.

8.1.4.3.2 Call reference procedure errors

a. Whenever the network or user receives any message except REGister or RELease COMplete, specifying a call reference which it does not recognize as relating to an active connection, it sends a RELease COMplete message using the call reference in the received message, with cause value #81 "invalid call reference value".

b. If a RELease COMplete message is received, specifying a call reference which is not recognized as relating to an active connection, no action should be taken.

c. When a REGister message is received with the call reference flag value incorrectly set to 1, then the REGister message shall be ignored.

d. If a REGister message is received indicating a call reference which is already in use, the user and the network shall abort any services active on the connection. The receiver may send a FACility message, containing a Facility information element with a Return error component, for each active service. The connection is then cleared with a RELease COMplete message and the call reference is released.

e. When any message is received specifying the global call reference, the message shall be ignored.

8.1.4.4 Message Type Errors

8.1.4.4.1 Unrecognized Message Type

If a message is received containing a message type which is either not implemented or not understood, then no action shall be taken on that message and no state change shall occur.

8.1.4.4.2 Unexpected Message

If a message other than REGister, FACility, or RELease COMplete is received with a call reference of a call-independent connection, the connection is cleared by sending a RELease COMplete message with cause value #101 "message not compatible with state" and releasing the call reference. The user and the network shall abort all services which are active on the connection.

If the user or network begins clearing of the connection and there are active services using the connection, clearing can continue. If the call reference is released before a service can complete, the user and the network shall abort the service.

8.1.4.5 General Information Element Errors

The following procedures only apply to Q.931 information elements and the Q.931 portion of the Facility information element, for call-independent connections. The error handling procedures for the Remote Operations component of the Facility information element are covered in the specifications of the services which use call-independent connections.

8.1.4.5.1 Duplicated Information Elements

When an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of the information element appearing first shall be processed. All subsequent repetitions of the information element shall be ignored.

When a message is received containing an 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.

8.1.4.5.2 Extension Errors

If the extension bit is '0' when '1' is expected or vice versa, then the information element shall be ignored. When an information element is received with unrecognized extended octet(s), the information element shall be ignored. If the ignored information element is mandatory, the error handling procedures for invalid mandatory information elements as described in 8.1.4.6 shall be followed. If the ignored information element is non-mandatory, the receiver should continue to process the message.

8.1.4.6 Mandatory Information Element Errors

8.1.4.6.1 Mandatory information element missing

When a REGister message is received, which has one or more mandatory information elements missing, a RELease COMplete message with cause value #96 "mandatory information element is missing" shall be returned. After sending the RELease COMplete message, the sender shall release the call reference.

If a FACility message is received, which has one or more mandatory information elements missing, then a RELease COMplete message is returned with the cause value #96 "mandatory information element missing" and diagnostic field specifying the identifier of the first missing information element.

8.1.4.6.2 Mandatory information element content error

When a REGister message is received, which has one or more mandatory information elements with invalid contents, a RELease COMplete message with cause value #100 "invalid information element contents" shall be returned. After sending the RELease COMplete message, the sender shall release the call reference.

When a RELease COMplete message is received with the Cause information element having invalid contents, then it will be assumed that a RELease COMplete message was received with cause value #31 "normal, unspecified".

If a FACility message is received, which has one or more mandatory information elements having invalid contents, then a RELease COMplete message shall be returned with cause value #100 "invalid information element contents".

8.1.4.7 Non-Mandatory Information Element Errors

When the user or network receives a message containing optional information elements that it does not know how to act upon or having invalid contents, it shall process the message and those information elements that it can recognize and have valid contents. The information not acted upon should be discarded.

8.1.4.8 Data Link Reset or Failure

If layer 3 is notified by its data link layer via the primitive DL-Establish-Indication that the data link has been reset, or layer 3 is notified by its data link layer via the primitive DL-Release-Indication that there is a data link layer malfunction, layer 3 will note the problem but not take any additional action. Services active on the call-independent connection are responsible for deciding whether to abort.

APPENDIX A. 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.

- 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 states are associated with a call-independent connection.

- Null (State U0)

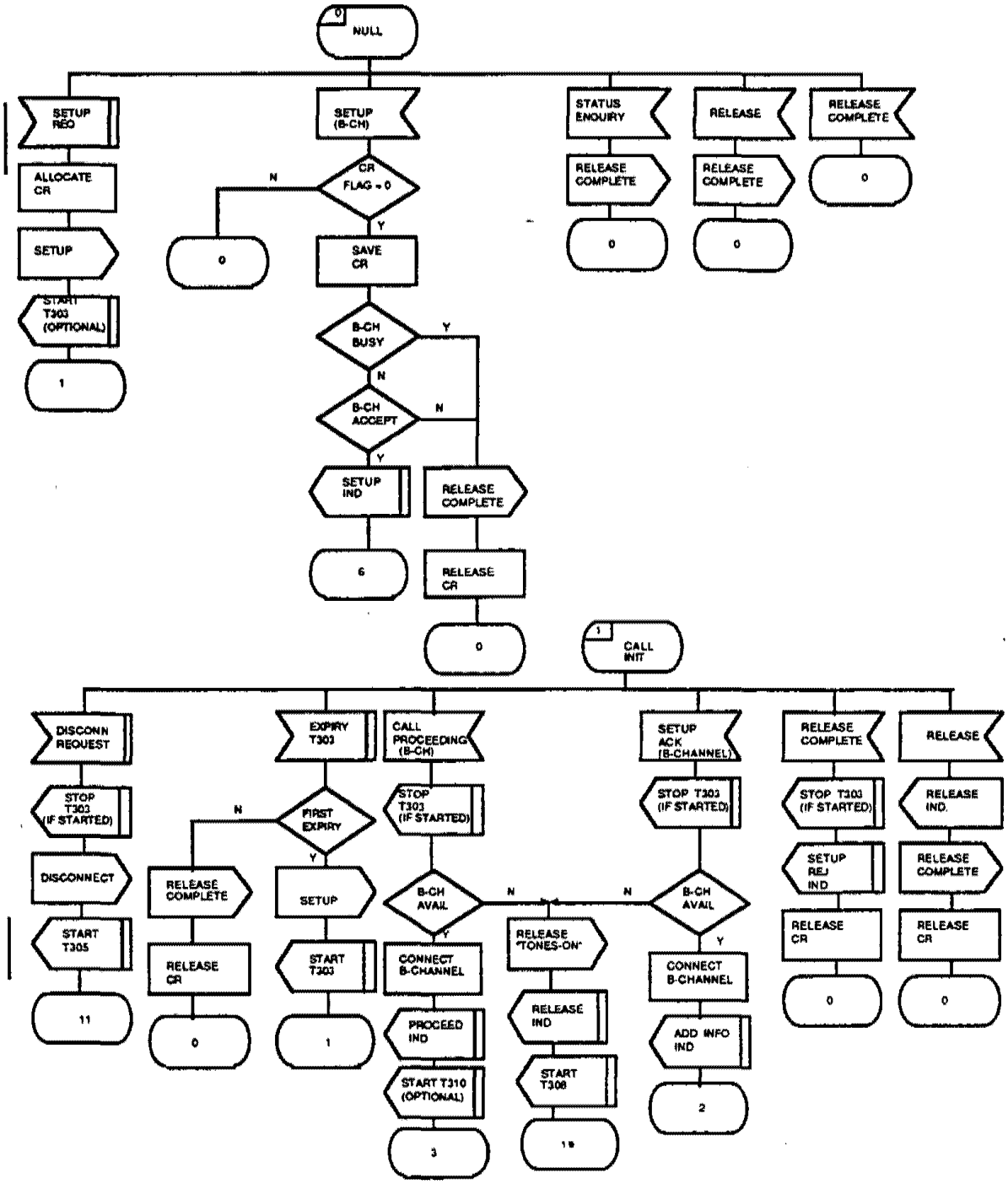
  No connection exists.

- Call Independent Service (State U31)

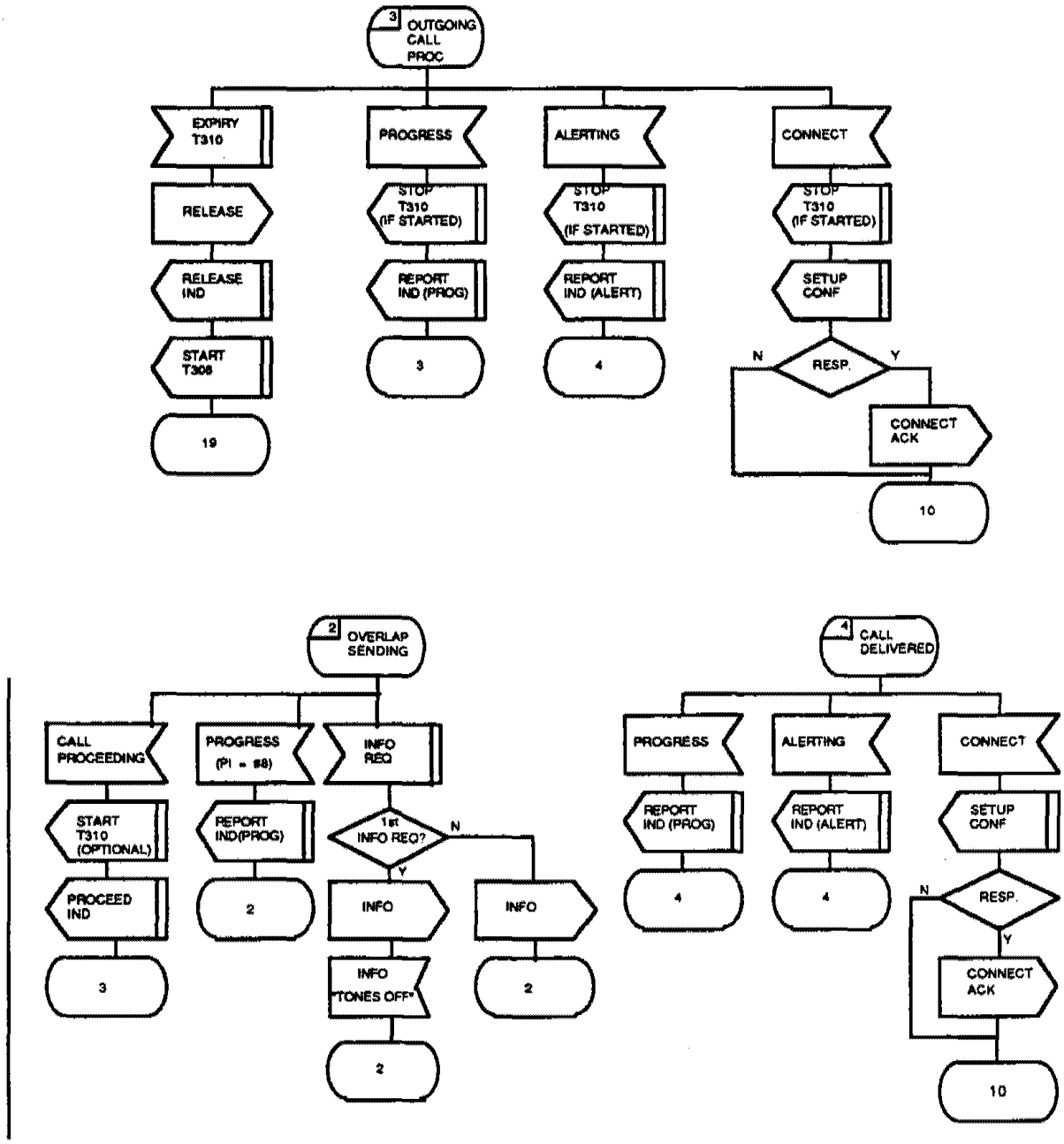
  This state exists for a call-independent connection after the user accepts a network-initiated connection requested or after the user reserves a call reference for a user-initiated connection request.

APPENDIX B. SDL DIAGRAMS

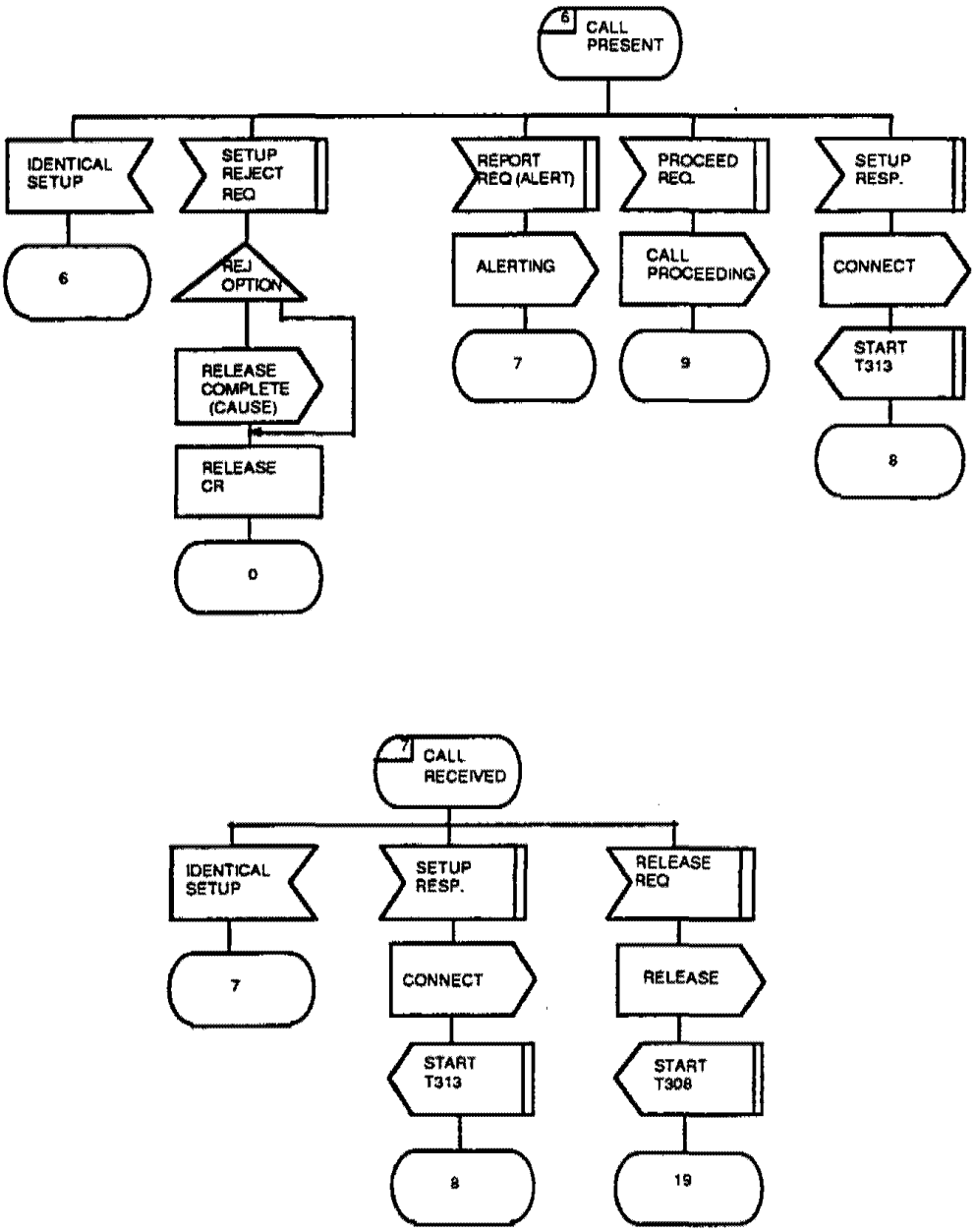
B.1 CALL CONTROL PROCEDURES



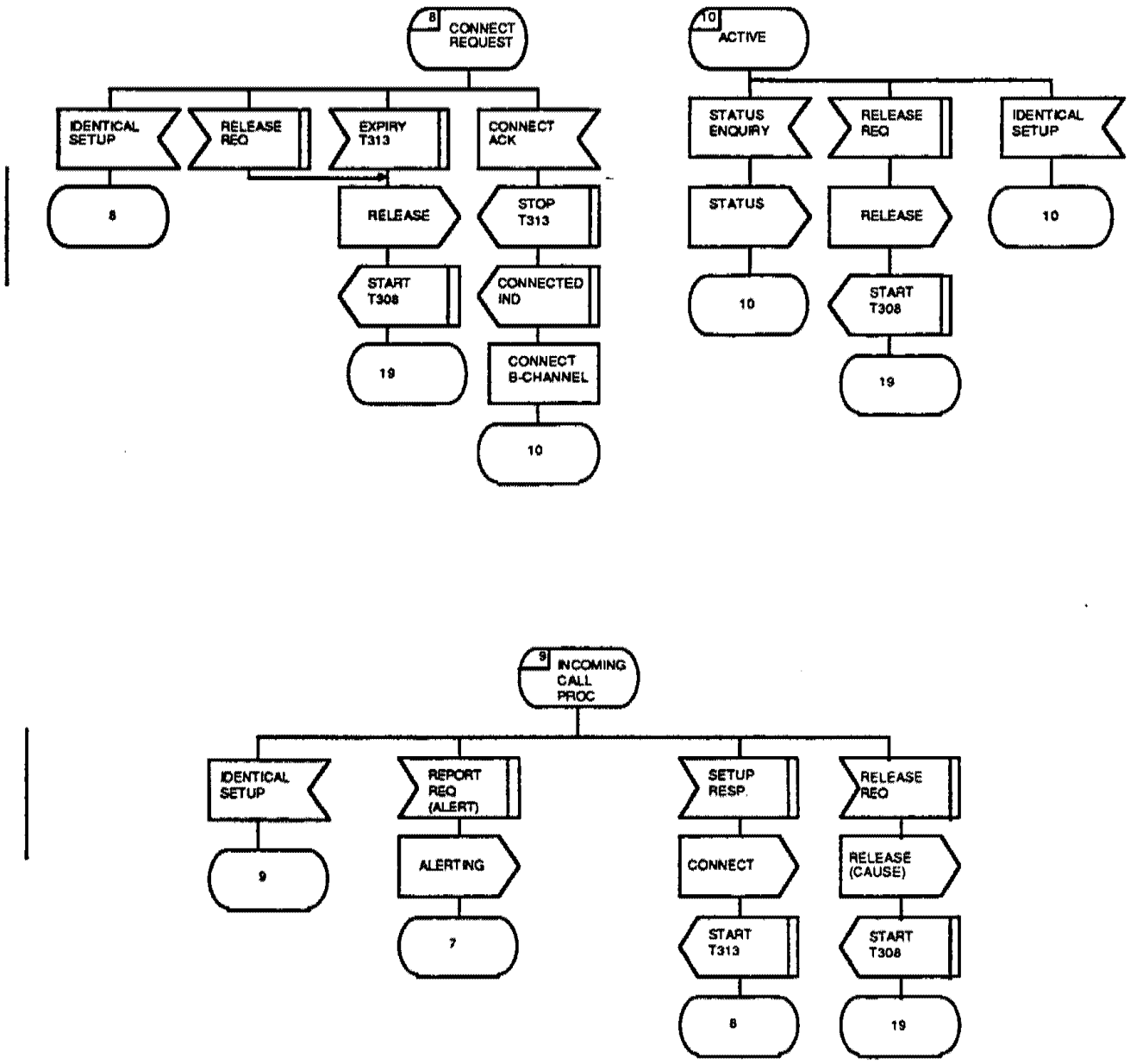
Call Control SDL Diagrams - USER SIDE (1 of 8)



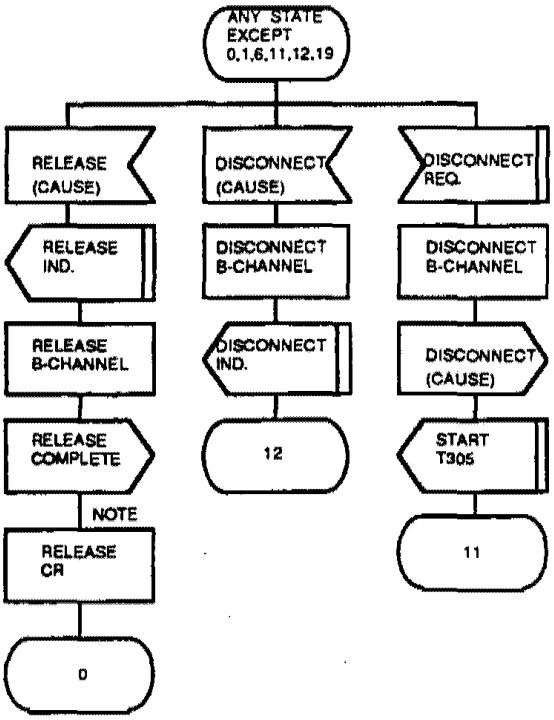
Call Control SDL Diagrams - USER SIDE (2 of 8)



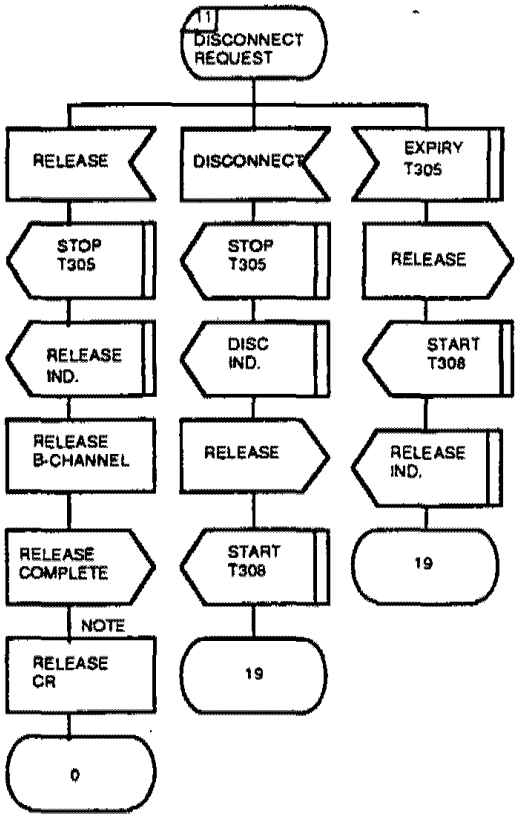
Call Control SDL Diagrams - USER SIDE (3 of 8)



Call Control SDL Diagrams - USER SIDE (4 of 8)

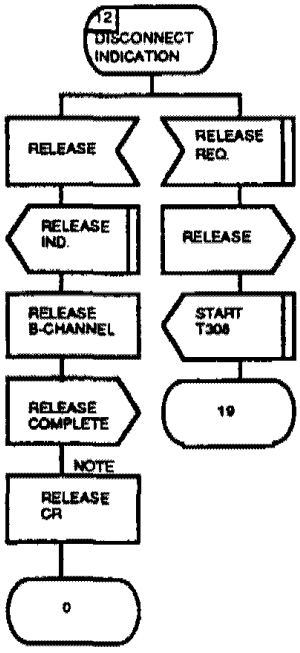


NOTE: THE CR SHOULD NOT BE REUSED UNTIL INTERNAL CLEARING ACTIONS HAVE BEEN COMPLETED.

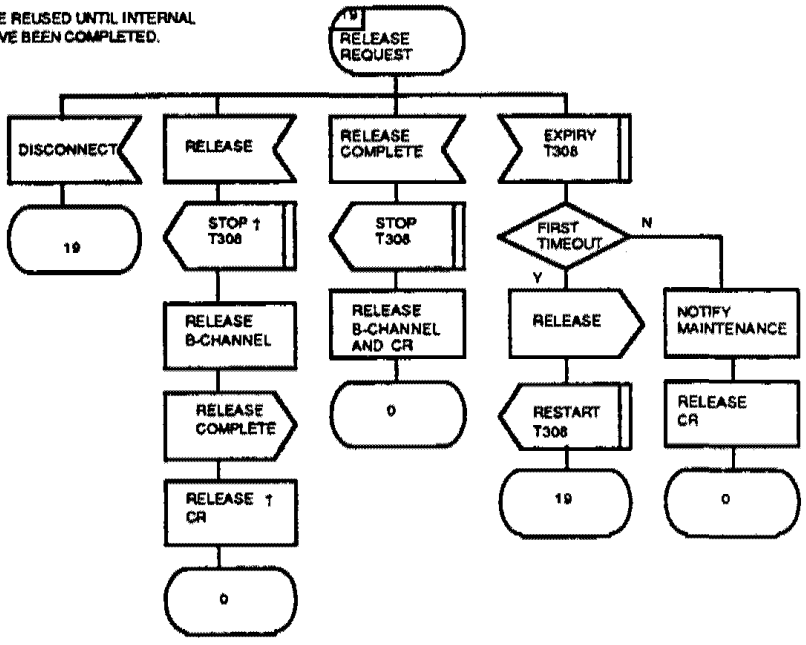


NOTE: THE CR SHOULD NOT BE REUSED UNTIL INTERNAL CLEARING ACTIONS HAVE BEEN COMPLETED.

Call Control SDL Diagrams - USER SIDE (5 of 8)

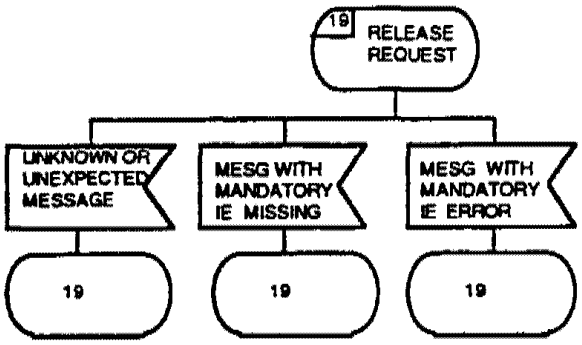


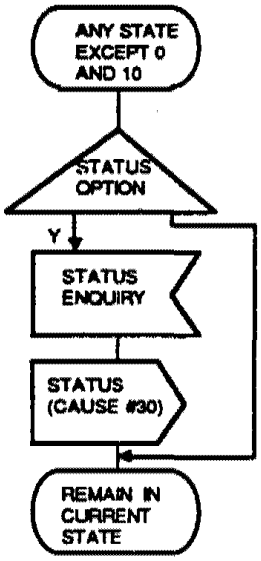
NOTE: THE CR SHOULD NOT BE REUSED UNTIL INTERNAL CLEARING ACTIONS HAVE BEEN COMPLETED.

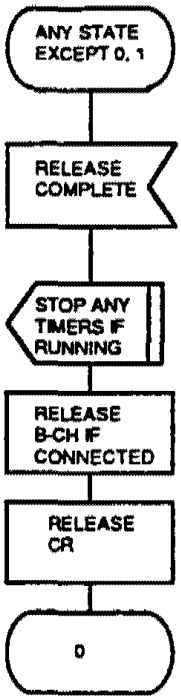


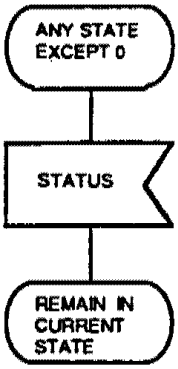
NOTE: THE CR SHOULD NOT BE REUSED RIGHT AWAY FOR MAKING A NEW CALL. OTHERWISE, THE RELEASE COMPLETE FROM THE NETWORK WOULD BE MISTAKEN AS A REJECTION FOR THE NEW CALL.

Call Control SDL Diagrams - USER SIDE (6 of 8)

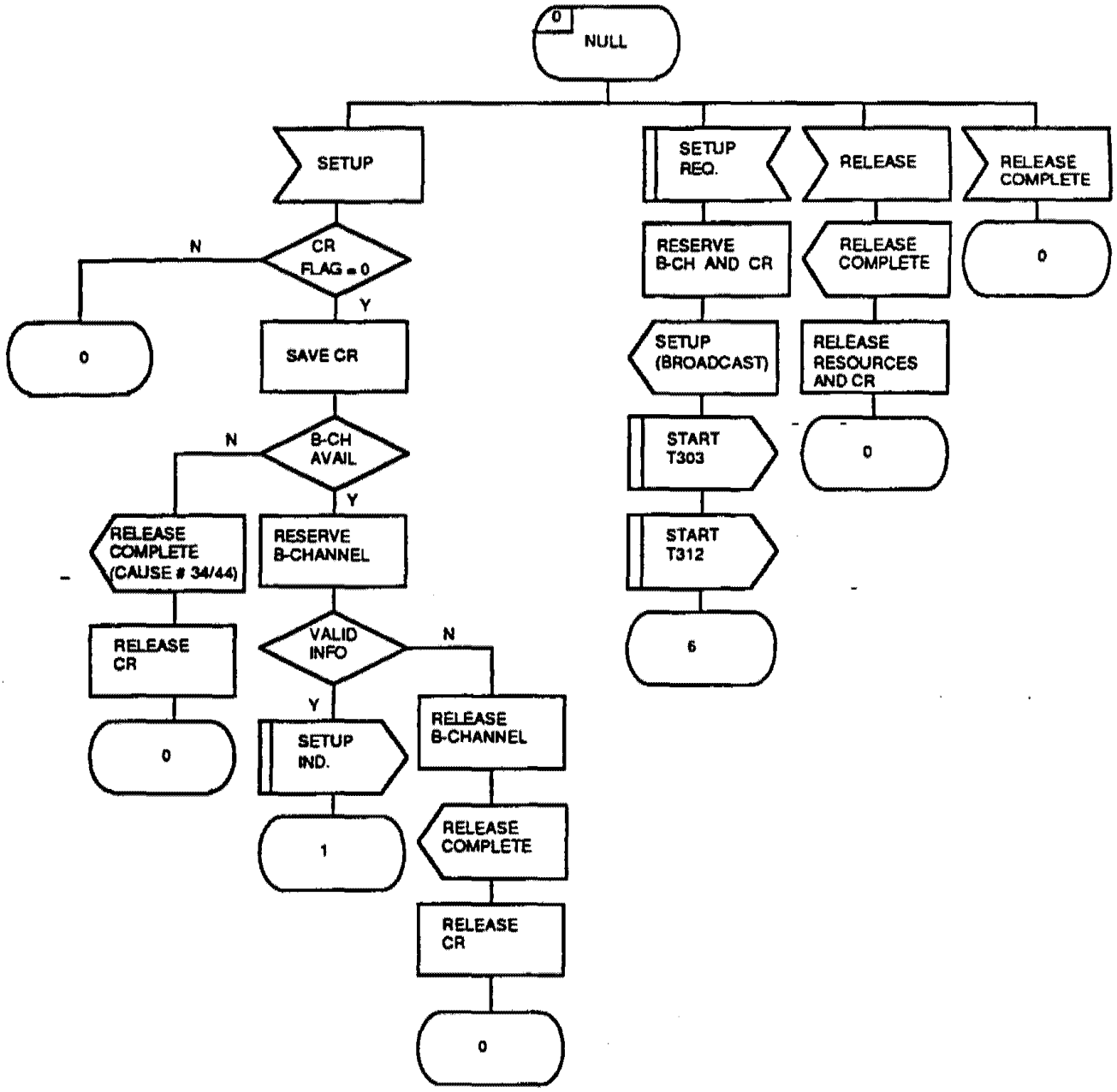




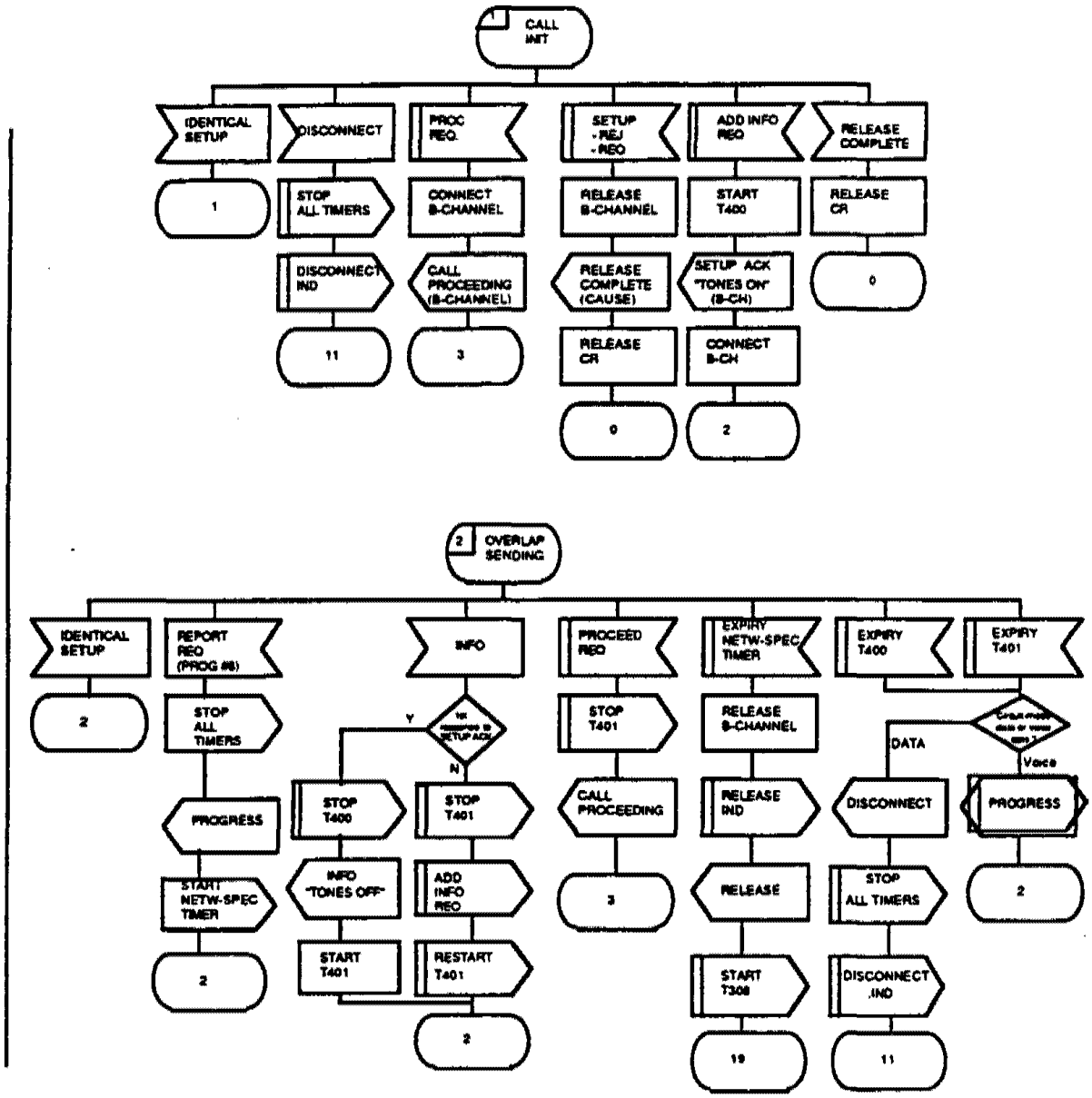




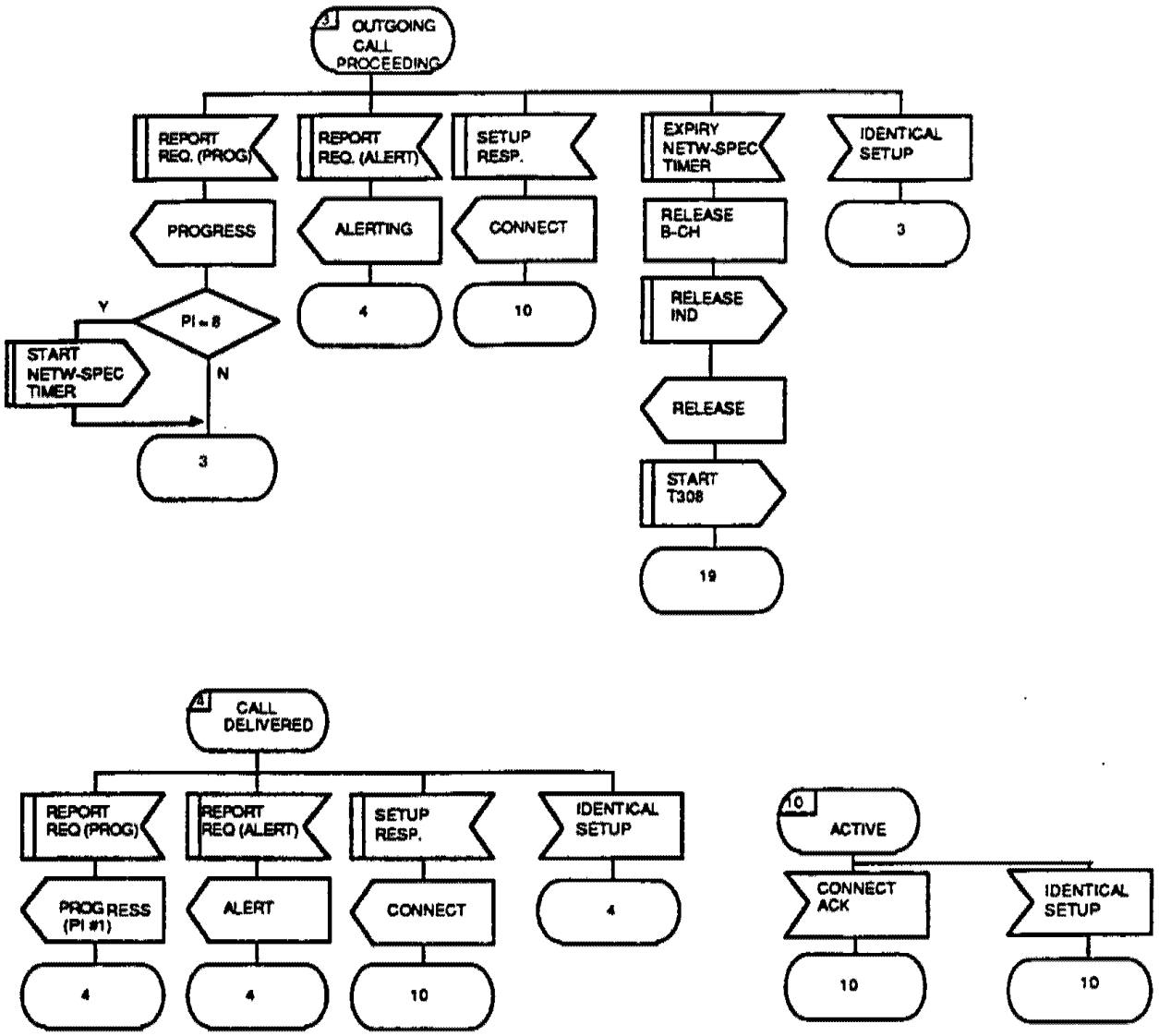
Call Control SDL Diagrams - USER SIDE (8 of 8)



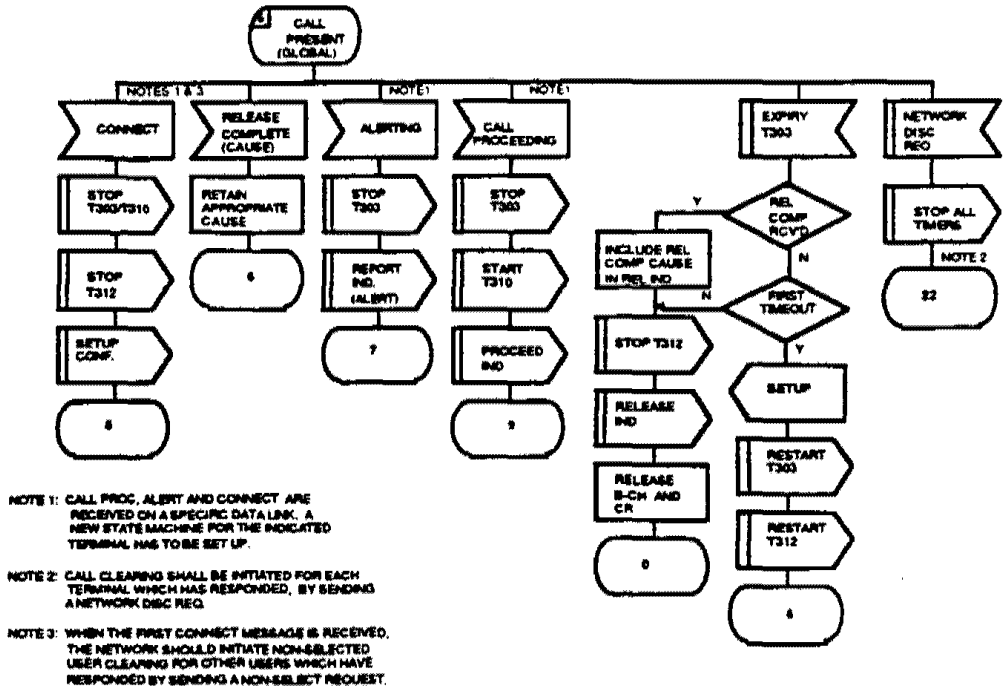
Call Control SDL Diagrams - NETWORK SIDE (1 of 9)

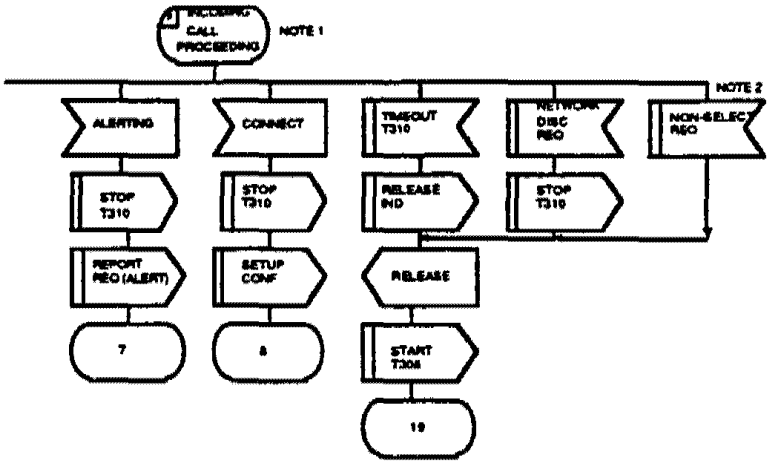


Call Control SDL Diagrams - NETWORK SIDE (2 of 9)

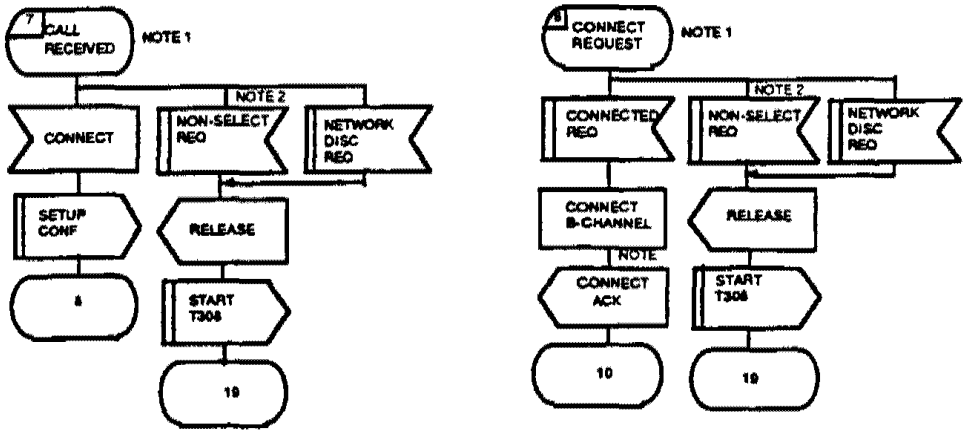


Call Control SDL Diagrams - NETWORK SIDE (3 of 9)



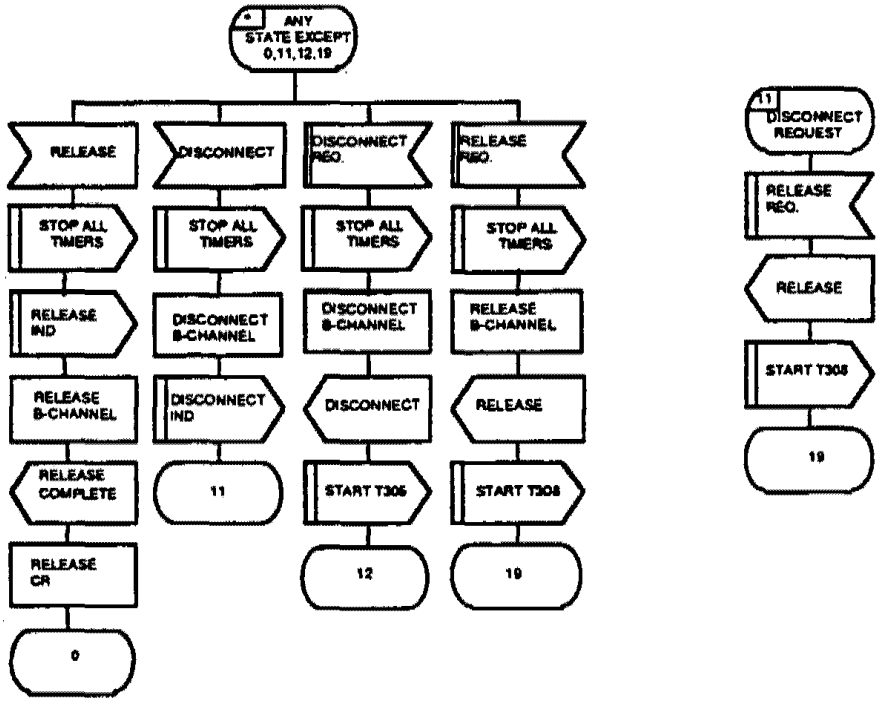


Call Control SDL Diagrams - NETWORK SIDE (4 of 9)

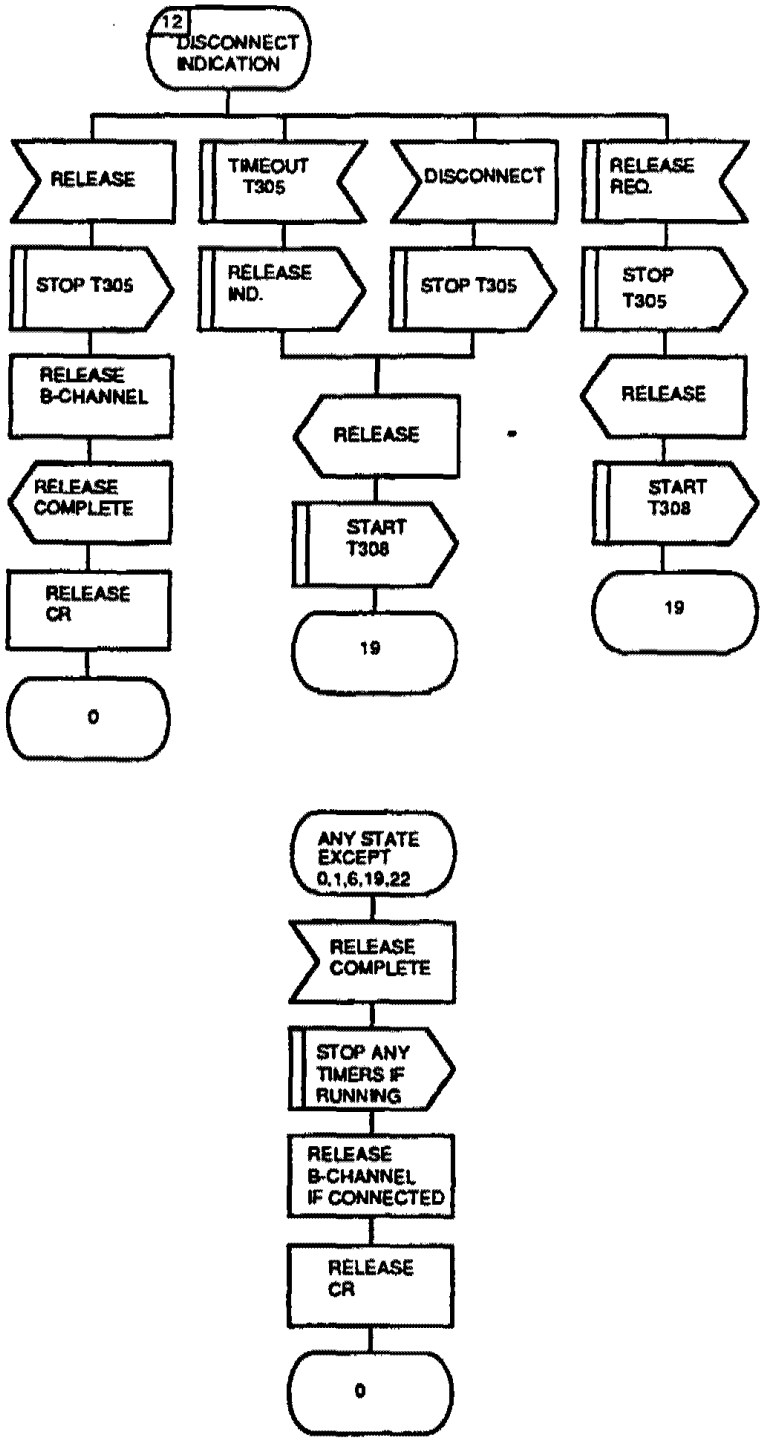


NOTE 1: A SEPARATE STATE MACHINE EXISTS FOR EACH USER ON A PT-TO-MULTIPT. INTERFACE.

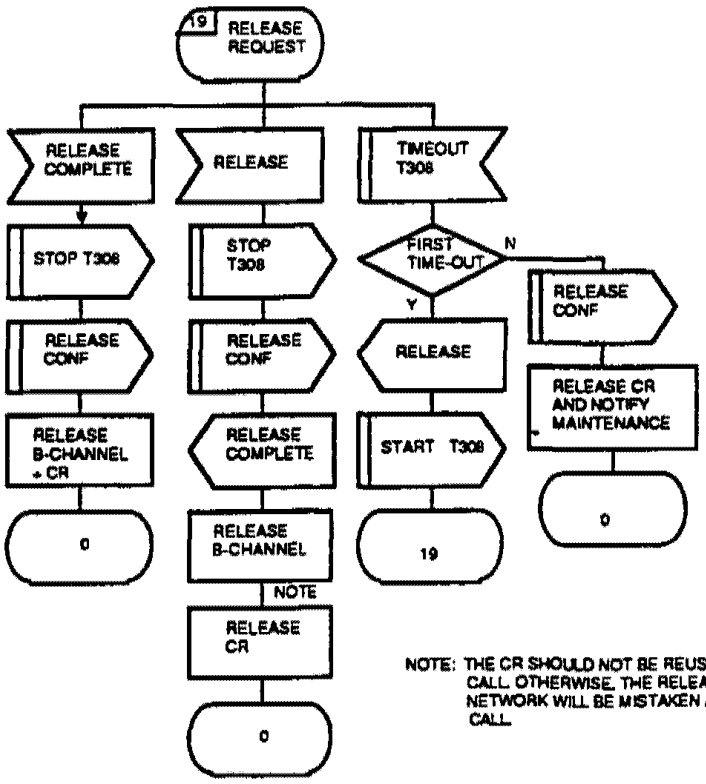
NOTE 2: NETWORK WILL INITIATE NON-SELECTED USER CLEARING IF ANOTHER USER HAS SENT A FIRST CONNECT MESSAGE TO THE NETWORK.



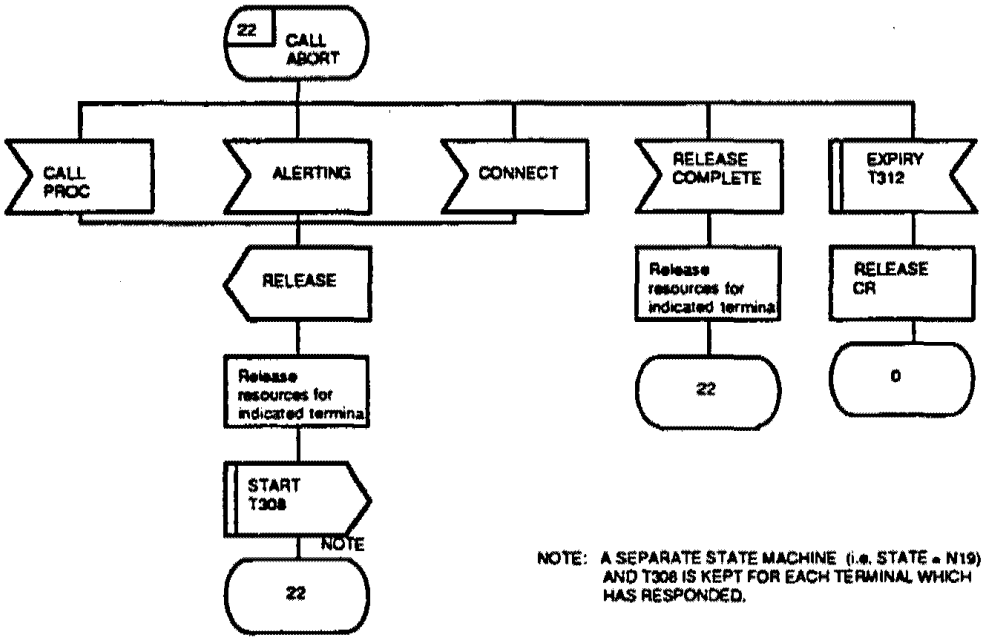
Call Control SDL Diagrams - NETWORK SIDE (5 of 9)



Call Control SDL Diagrams - NETWORK SIDE (6 of 9)

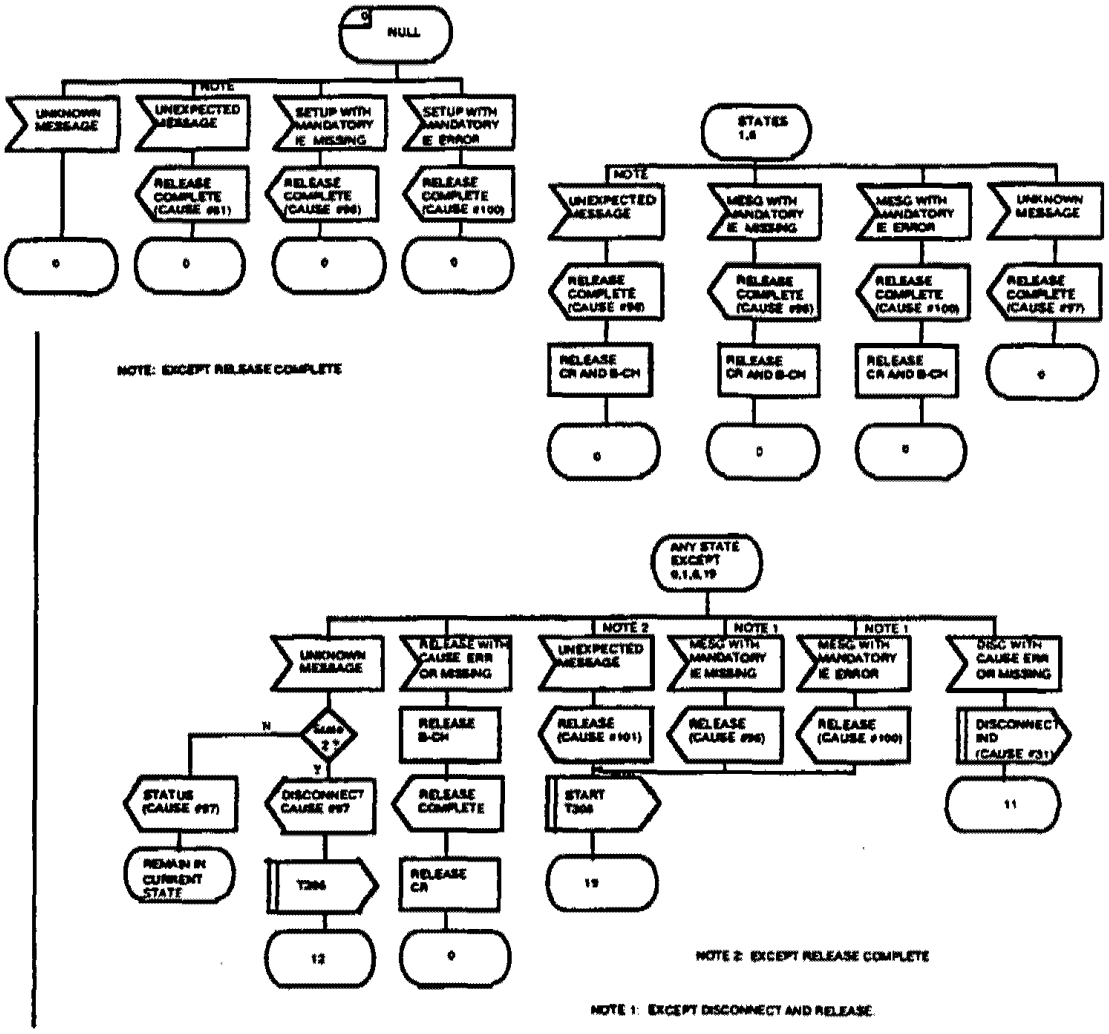


NOTE: THE CR SHOULD NOT BE REUSED RIGHT AWAY FOR A NEW CALL. OTHERWISE, THE RELEASE COMPLETE FROM THE NETWORK WILL BE MISTAKEN AS A REJECT TO THE NEW CALL.

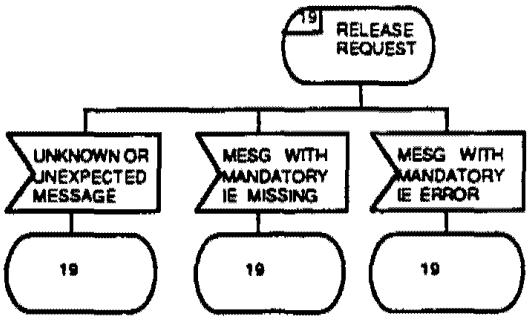


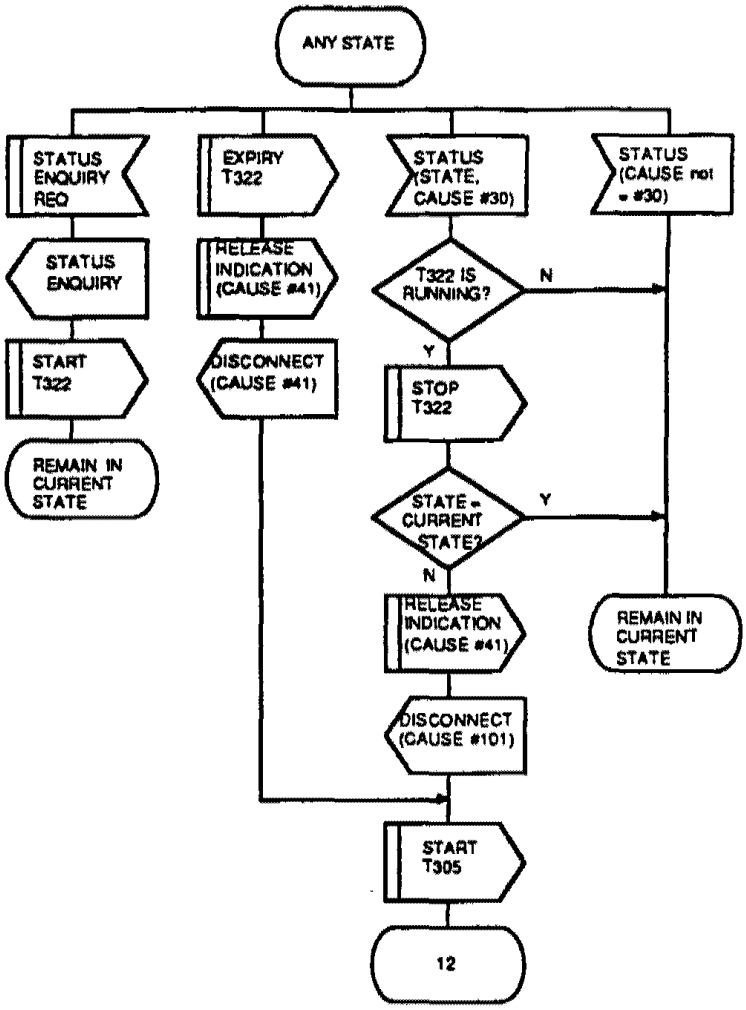
NOTE: A SEPARATE STATE MACHINE (i.e. STATE = N19) AND T308 IS KEPT FOR EACH TERMINAL WHICH HAS RESPONDED.

Call Control SDL Diagrams - NETWORK SIDE (7 of 9)

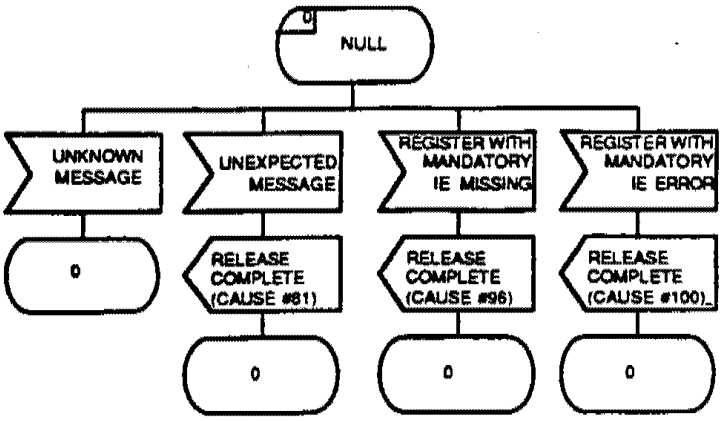


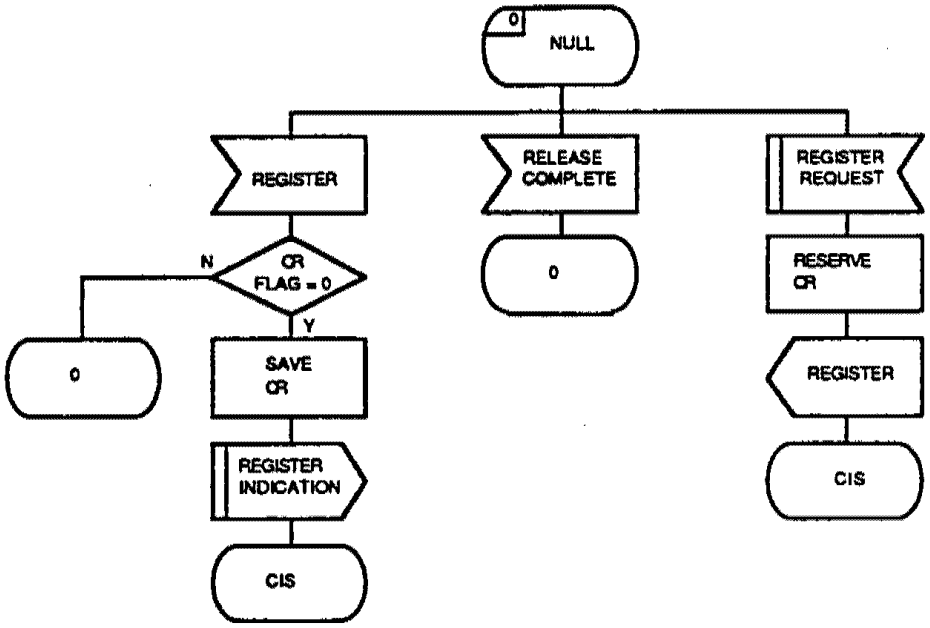
Call Control SDL Diagrams - NETWORK SIDE (8 of 9)



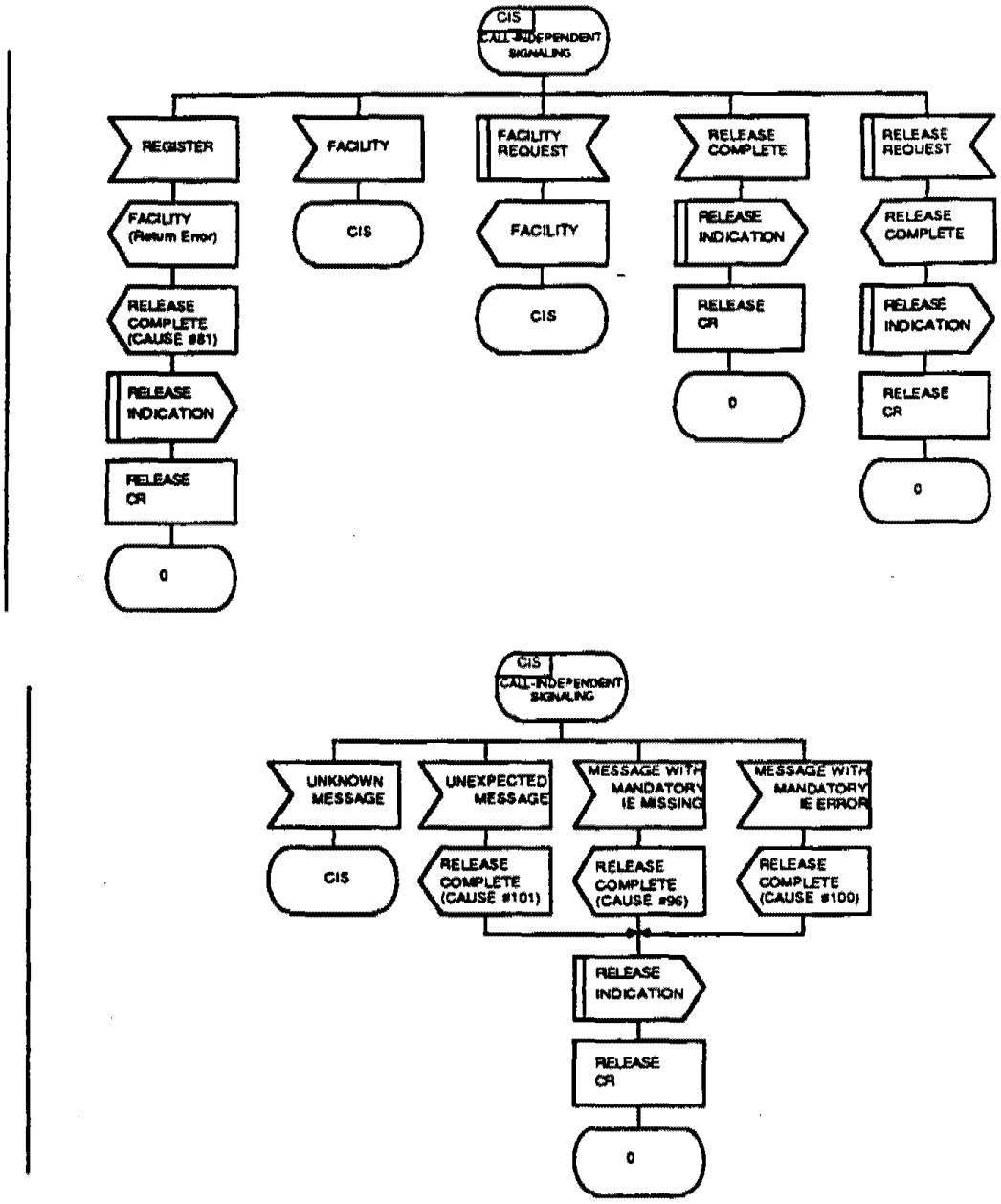


Call Control SDL Diagrams - NETWORK SIDE (9 of 9)

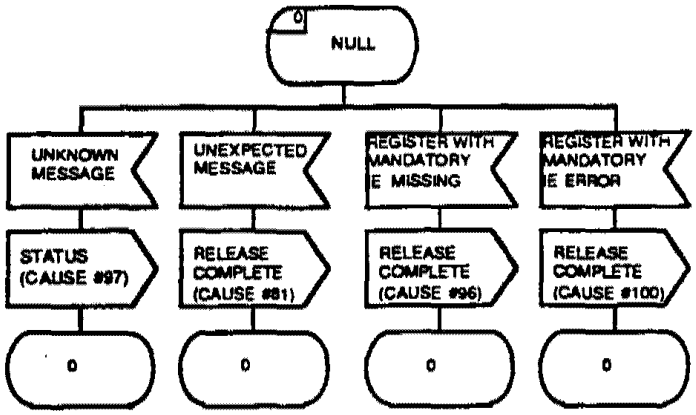


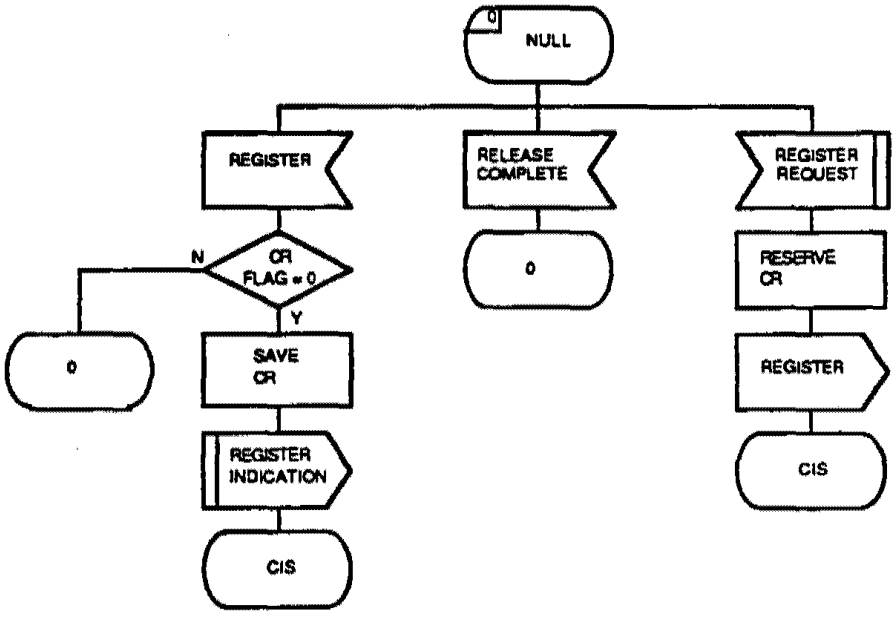


Call - Independent Connection SDL Diagrams - NETWORK SIDE (1 of 2)

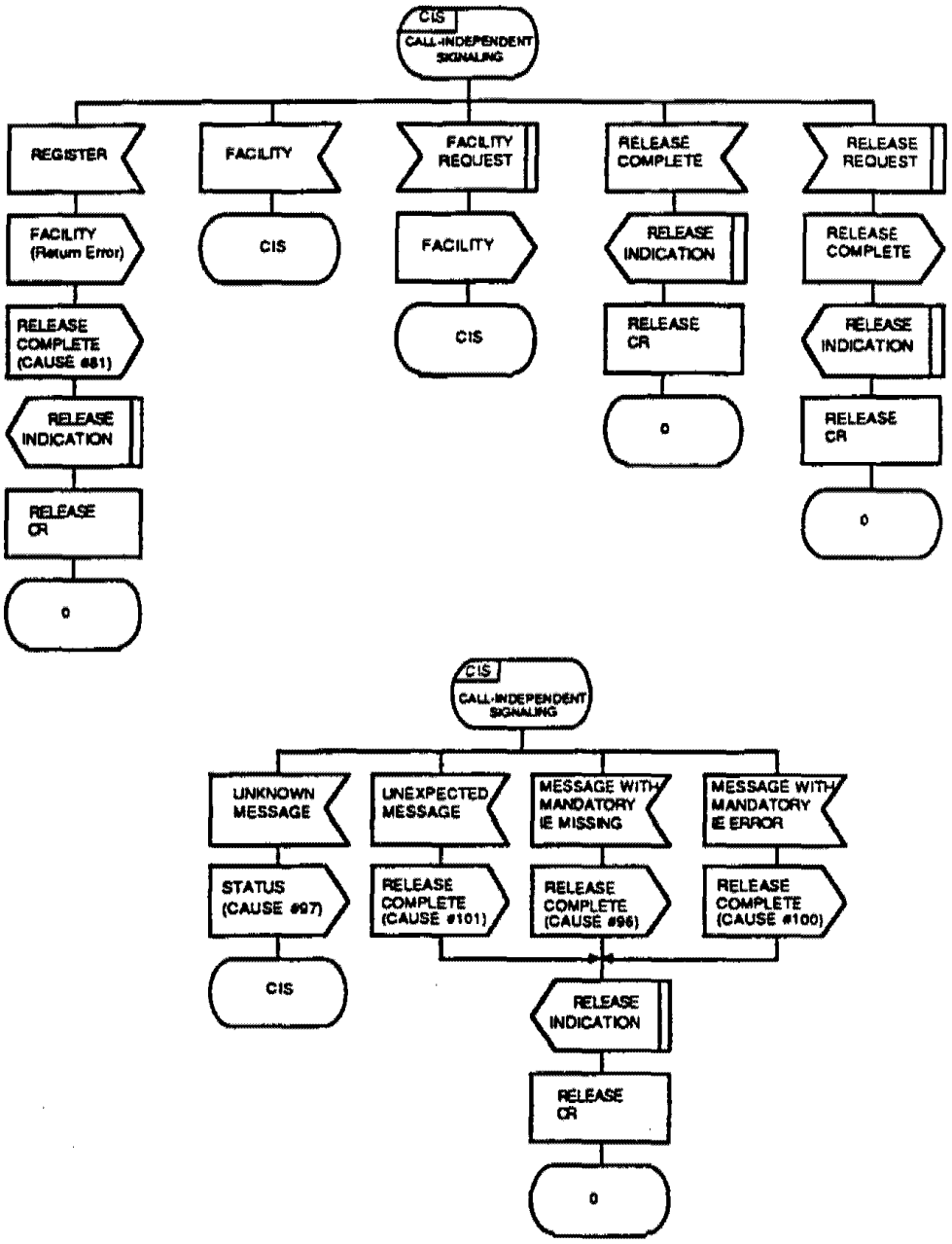


Call - Independent Connection SDL Diagrams - NETWORK SIDE (2 of 2)





Call - Independent Connection SDL Diagrams - USER SIDE (1 of 2)



Call - Independent Connection SDL Diagrams - USER SIDE (2 of 2)

APPENDIX C. REMOTE OPERATIONS SERVICE

This appendix provides background on Remote Operations (RO), which is new with Issue 1.1 of this specification, and is 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 Sections D, E, and H) contains all the information needed to implement services provided with Remote Operations, the reader should refer to the above CCITT recommendations for further background information on this topic.

C.1 REMOTE OPERATIONS SERVICE ELEMENT (ROSE)

C.1.1 General

This section provides an overview of the Remote Operations service, and notation and protocol defined in X.219/X.229 that is supported by this specification.

C.1.2 The Remote Operation Model

The Remote Operation (RO) service supports an interactive communication between two Application Processes, and can be modelled 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 Operation Service Element (ROSE) represents that part of the functionality which provides the open com-

munication for a request/reply interaction (see Figure 2 on page D-249).

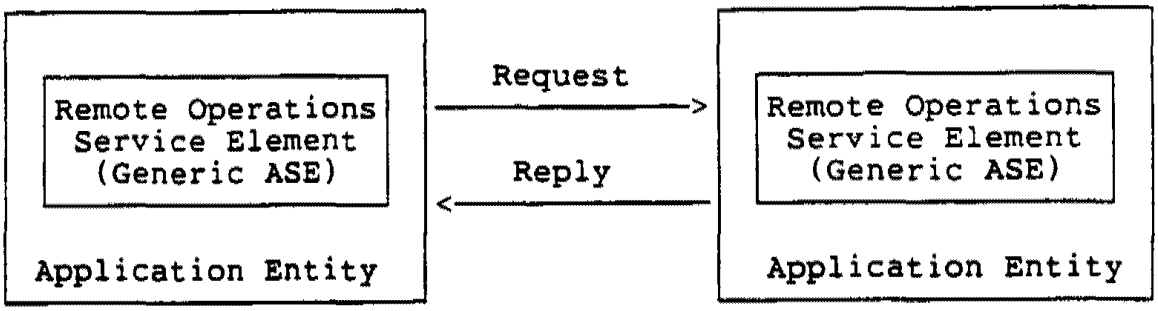


Figure 2. ROSE Request/Reply Interaction

Operations invoked by one AE (Application Entity), 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, an error reply is returned if the operation is unsuccessful);
- in case of failure only (no reply is returned if the operation is successful, an error reply is returned if the operation is unsuccessful);
- in case of success only (a result reply is returned if the operation is successful, no reply is returned if the operation is unsuccessful); or
- 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: synchronous, in which the invoker requires a reply from the performer before invoking another operation; and 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; and
- Operation Class 5: Asynchronous, outcome not reported.

In some cases it is useful to group operations into a set of linked-operations which are performed by one parent-operation and one or more child-operations. 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 (Figure 3 on page D-251). An example of a service which uses linked-operations is Service Profile Management (see Section H).

Remote Operations (RO) service defines a set of components which are used to communicate between entities. These are:

- Invoke
- Return result
- Return error
- Reject

Invoke components are use to start both parent-operations and child-operations. Return result is used to report successful outcomes and Return error is used to report failures. Reject is used to report errors which are not operation specific, such as unknown operation.

C.2 REMOTE OPERATIONS MACROS

This specification uses the macro format, as described in X.219, to define service operations which use RO procedures. To relate these macro descriptions to actual component encodings, the reader should refer to the remainder of this appendix, which provides the notation (ASN.1) and the encoding rules (transfer syntax) for each data type. "Facility" on page D-106 describes the structure of each type of RO component. Services which are defined using RO macros include Service Profile Management (Section H).

C.2.1 Macro Notation

The 5 classes of Remote Operations (see "The Remote Operation Model" on page D-248) are defined using the following operation

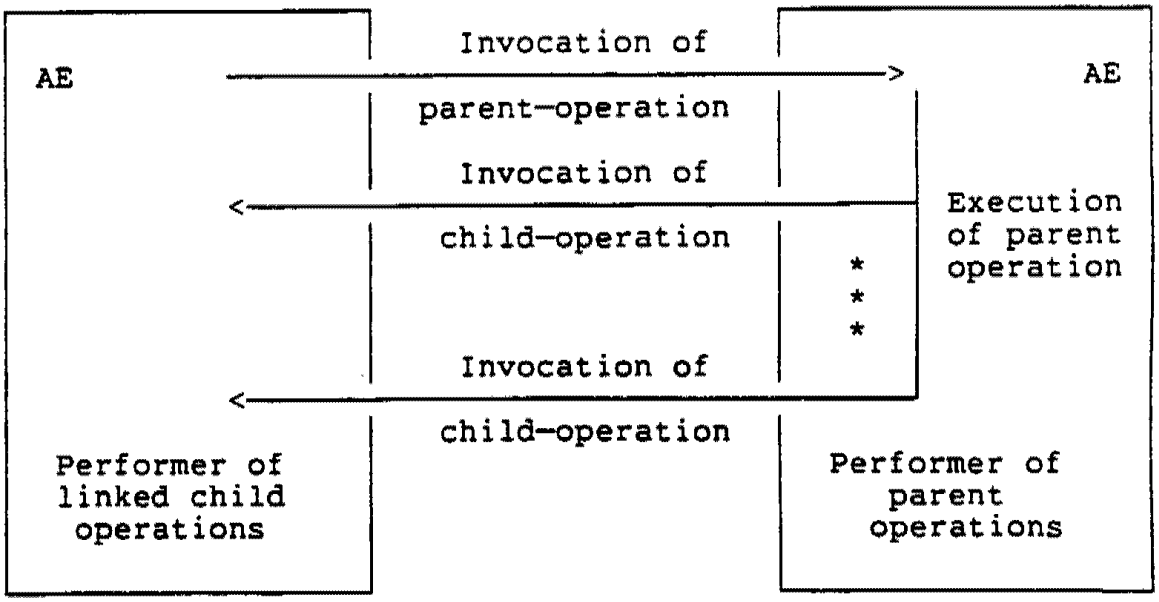


Figure 3. ROSE Linked Operation

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 with the keyword OPTIONAL after the type. A mandatory type which has a default value is indicated with the keyword DEFAULT followed by a value, after the type.

C.2.1.1 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. The "operationname" is the label of the operation macro, which is to be identified in the Invoke component using the "operationvalue". The "ArgumentType" is the label of the argument data type, which may be used in the Invoke component and is operation specific. It is defined, when required, on a per operation basis using ASN.1. The "ResultType" is the label of the result data type which may be used in the Return result component and is operation specific. It is defined, when

required, on a per operation basis using ASN.1. The "ErrorList" is a list of "errorname" labels, each of which is defined using the error macro notation and labelled with an "errorname" (see below). The "LinkedOpList" is a list of "operationname" labels, each of which is defined using this operation macro notation.

C.2.1.2 Error Macro Notation

```
errorname       ERROR
                PARAMETER  ParameterType | empty
                ::= errorvalue
```

ERROR and PARAMETER are keywords used to structure error macros. The "errorname" is the label of the error macro, which is identified in the error component using the "errorvalue". The "ParameterType" is the label of the parameter data type, which may be used in the Return error component and is error specific. It is defined, when required, on a per error basis using ASN.1.

C.2.2 Class 1 and 2 Operations

Class 1 and 2 operations are those which always require a response, whether the operation succeeded or failed. There is an optional argument. Class 1 operations are synchronous and Class 2 operations are asynchronous.

```
operationExample12  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" and 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, which is defined in this example by the type "ResultType12".

In this example, there are 2 possible error responses if the operation fails. The first, "error1", has value 1 and has one parameter, "ParameterType1". The second error, "error2", has value 2 and has no parameter. The error result is returned in a Return error component.

C.2.3 Class 3 Operation

Class 3 operations are those which only require a response when the operation fails. Class 3 operations are not currently used in this specification, so the following example is presented here for informational purposes only.

```
operationExample3  OPERATION
                   ARGUMENT    ArgType3
                   ERRORS      {error1,error2}
                   ::= 10
```

C.2.4 Class 4 Operation

Class 4 operations are those which only require a response when the operation succeeds. Class 4 operations are not currently used in this specification, so the following example is presented here for informational purposes only.

```
operationExample4  OPERATION
                   ARGUMENT    ArgType4
                   RESULT      ResultType4
                   ::= 11
```

C.2.5 Class 5 Operation

Class 5 operations are those which do not require any response. There is a mandatory argument, ArgumentType5.

```
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, which is further defined by the type "ArgumentType5".

C.2.6 Linked Operation

The example below shows how linked operations are defined in the macro notation. The parent-operation, "parentop12", has one child-operation, "operationExample51".

```
parentop12   OPERATION
             ARGUMENT    ArgumentType12
             RESULT      ResultType12
             ERRORS      {error1,error2}
             LINKED      {operationExample51}
             ::= 12
```

C.3 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 entirety of the ASN.1 specification is not repeated here, but only those parts that are relevant to understanding the service definitions given in this specification which have been described with ASN.1.

C.3.1 Data Types

Data Types which are defined in the operation macros (for example, ArgumentType5 and ResultType12 in the operation examples) are defined following the main operation definition, using the following general format.

```
DataTypeLabel  ::=  PredefinedValue | TaggedValue
```

The left-hand side of the definition symbol "::=" is the label of the Data Type being defined. The right-hand side is the Data Type definition, which may be either a pre-defined value or a tagged value. Pre-defined values belong to the Universal class

and use the tags defined in X.208. Figure 4 on page D-255 lists the pre-defined values which are 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, which are enclosed in brackets "[]" (for example, [PRIVATE 1]). The classes which 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, which are shown in the left-hand column of Figure 4.

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
IA5String	UNIVERSAL 22	0 0 0 1 0 1 1 0

Figure 4. Universal Tagged Types in this Specification: All are in the universal class (bits 8,7 = 00). The sequence and set tags are constructors (bit 6 = 1), and the rest are primitives.

If the term IMPLICIT is used between the tag and the value in the type definition, the type tag will be 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 will be a constructor and the full base encoding of the value will be used (tag, length, contents).

To illustrate the coding rules, for translating between ASN.1 and data element octets, examples are shown in Figure 5 on page D-256. The coding for the IA5String "Jones" is shown for each type. 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.

```
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

Figure 5. Coding of Example ASN.1 Types: The ultimate contents of each type is the string "Jones", but the structure of the data elements differs, as shown. The octet contents are displayed in base-16 (hexadecimal).

3. The tag for Type3 is Context class, code 2. Since the 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.

C.3.1.1 INTEGER

An INTEGER type is a primitive which has 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 of the contents. The bits in the first octet of the contents and bit 8 of the second octet shall not all be 1's and shall not all be 0's. This ensures that the integer is encoded in the smallest possible number of octets.

C.3.1.2 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.

C.3.1.3 ENUMERATED

An ENUMERATED type is a primitive which has as its contents an integer value which is associated with one of the defined range of allowed values. The following is an example of an ENUMERATED type in ASN.1:

```
WeekDays  ::=  {monday (0), tuesday (1), wednesday (2),
                thursday (3), friday (4)}
```

When the defined type, WeekDays, is present in a component it will contain 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 "()".

C.3.1.4 SEQUENCE

A SEQUENCE type is a constructor which has 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. The following is an example of a SEQUENCE type in ASN.1:

```
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 where it is or defined elsewhere. In the above example, the type "age" is optional. The following is the

coding of an Stype1 with the name "Jones" and age 30. All values are in base-16 (hexadecimal).

	TAG	LENGTH	CONTENTS
SType1	30	0A	
name	16	05	4A6F6E6573
age	02	01	1E

C.3.1.5 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. The following is an example of a SEQUENCE OF type in ASN.1:

```
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.

C.3.1.6 SET

A SET type is a constructor which has 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. The following is an example of a SET type in ASN.1:

```
Stype3  ::=  SET {name IA5String,
                  age  INTEGER     OPTIONAL}
```

The following 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.

	TAG	LENGTH	CONTENTS
SType1	30	0A	
age	02	01	1E
name	16	05	4A6F6E6573

C.3.1.7 SET OF

A SET OF structure is a constructor which has 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. The following is an example of a SET OF type in ASN.1:

```
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.

C.3.1.8 IA5String

An IA5String type is a primitive which has 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.

C.3.2 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 the example below, car and bicycle types are distinguished by their different tags.

```
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.

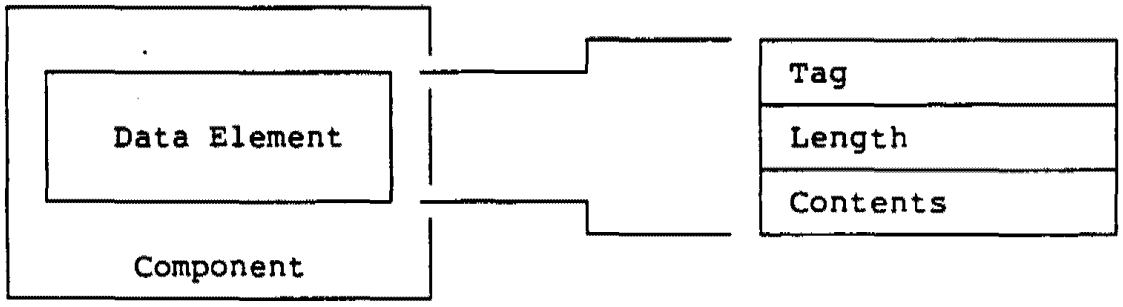
C.4 TRANSFER SYNTAX

C.4.1 General Description of Component Encoding Rules

The following description of general component encoding rules is based on Q.932, Appendix III.

C.4.1.1 General Component Structure

Each component consists of data elements, each of which has the same structure. A data element consists of three fields, which always appear 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 6 shows an overview of a component and a data element.



a) Component b) Data Element

Figure 6. Structure of a Component and Data Element

Each field is coded using one or more octets. Octets are labelled as shown in Figure 7 on page D-261. The first octet is the first transmitted. Bits in an octet are labelled as shown in Figure 8 on page D-261, with bit 1 the least significant and the first transmitted.

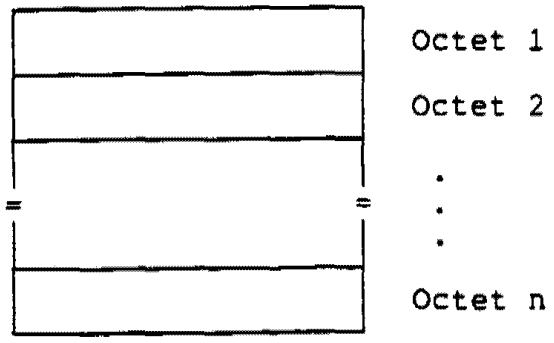


Figure 7. Octet Labelling Scheme

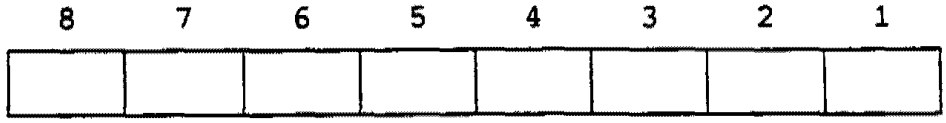
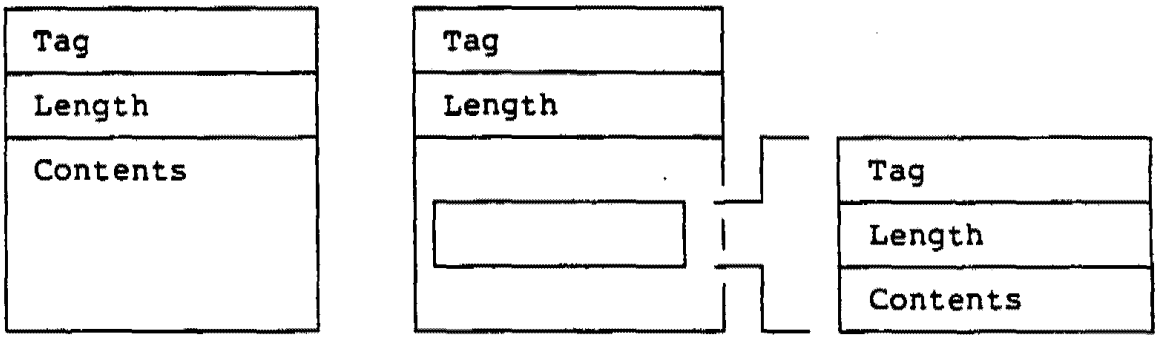


Figure 8. Bit Labelling Scheme

The contents of each data element is either one value (primitive) or one or more data elements (constructor), as shown in Figure 9.

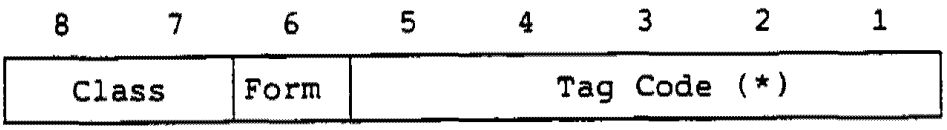


a) Primitive b) Constructor

Figure 9. Types of Contents

C.4.1.2 Tag

A data element is first interpreted according to its position within the syntax of the messages. The tag distinguishes one data element from another and governs the interpretation of the contents. It is one or more octets in length. The tag is composed of "class", "form" and "tag code", as shown in Figure 10 on page D-262.



(*): The tag code may be extended to the following octets as discussed in "Tag Code" on page D-263

Figure 10. Format of Tag

C.4.1.2.1 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 Figure 11.

Class	Coding (bits 8 and 7)
Universal	0 0
Application-wide	0 1
Context-specific	1 0
Private	1 1

Figure 11. Coding of Tag Class

The Universal class is used for tags that are 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 Information Elements, CCITT Signaling System No 7 ASEs (Application Service Elements), X.400 MHS (Message Handling System), X.500 Directory Services, etc.

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 that are 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, a network, or a private user, and apply across all applications.

C.4.1.2.2 Form of the Data Element

Bit 6 is used to indicate whether the data element is "primitive" or a "constructor", as shown in Figure 12. A primitive element is one whose structure is atomic (i.e., one value only). A constructor element is one whose content is one or more data elements which may themselves be constructor elements.

Both forms of elements are shown in Figure 9 on page D-261.

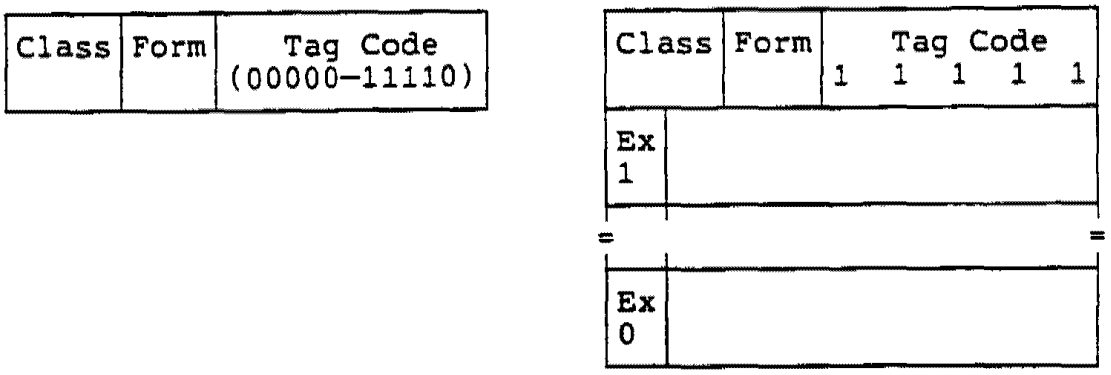
Element Form	Coding (bit 6)
Primitive	0
Constructor	1

Figure 12. Coding of Element Form

C.4.1.2.3 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 to 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, then no further octets for this tag are used. If bit 8 is set to 1, the following octet is also used for extension of the tag code. The resultant tag consists of bits 1 to 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 is encoded as 0011111 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.



a) One Octet Format b) Extended Format

Figure 13. Format of the Tag Code

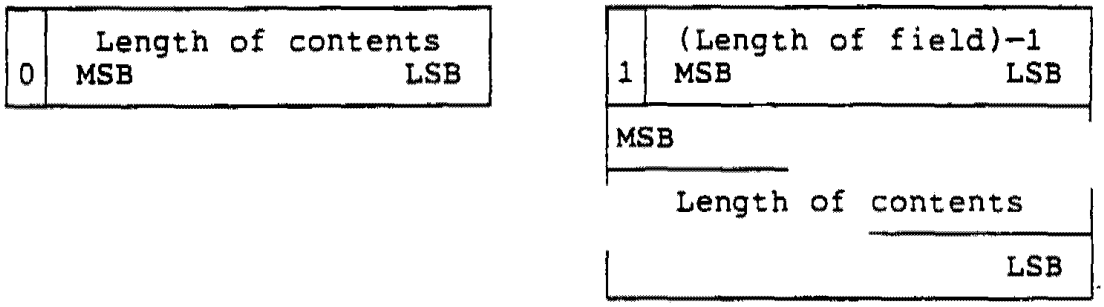
C.4.1.3 Length of the Contents

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, then the long form of the length of the contents is used. The long form length is from 2 to 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 (Most Significant Bit) is bit 8 of the second octet, and whose LSB (Least Significant Bit) 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.

Figure 14 on page D-265 shows the formats of the length field described above. The maximum value that may be encoded is constrained by Q.931 message size limitations.



a) Short Form b) Long Form

Figure 14. Format of Length Field

C.4.1.4 Contents

The contents is the substance of the data element and contains the information the data element is intended to convey. Its length is variable, but always an integral number of octets. The contents is interpreted in a type-dependent manner, that is, according to the tag value.

SECTION E: ISDN BASIC RATE INTERFACE - SUPPLEMENTARY SERVICES ASSOCIATED WITH FUNCTIONAL BASIC CALL

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1.0 INTRODUCTION

This section describes an extensive range of supplementary services including services described for National ISDN 1. Services not described by National ISDN 1 follow the National ISDN 1 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.

This section is provided primarily to assist terminal designers. Since not all the terminals are expected to implement all of the features described in this section, terminals are required to comply with only the procedures for the features they support.

This section 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.[1] The messages and information elements are specified in section D of this interface specification.

All descriptions of feature activation/deactivation and procedures are based on the Abstract Terminal defined in section 2.

A TEI on a basic rate interface can only have access to one B-channel at a time. If the user requires two B-channels, then two service profiles must be defined for the interface. A service profile is a datafillable instance of the Abstract Terminal, which is described in section 2.

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[1] See NIS S208-2 for supplementary services associated with a stimulus basic call.

1.1 REFERENCES

1. Meridian Digital Centrex Features, 50006.08/06-88, Issue 1.

1.2 TERMINOLOGY AND NOTATION

The abbreviations used in this section are:

AC	Attendant Console
ACO	Additional Call Offering
ASN.1	Abstract Syntax Notation One
AUD	Automatic Dial
AUL	Automatic Line
BC	Bearer capability information element
CAP	Call appearance information element
CAR	Call Request
CBQ	Call Back Queuing
CDN	Called party number information element
CFB	Call Forward Busy
CFC	Call Forward Cancel
CFD	Call Forward Don't Answer
CFI	Call Forward Intragroup
CFP	Call Forward Programming
CFU	Call Forward Universal
CFWVAL	Call Forward Validation
CGN	Calling party number information element
CID	Channel identification information element
CLLI	Common Language Location Identifier
CN	Connected number information element
CPU	Call Pickup
CR	Call Reference
CRm	Call Reference #m
CRn	Call Reference #n
CRd	Call Reference null or dummy
CSE	Cause information element
DCBI	Directed Call pickup with Barge-In
DCBX	Directed Call Pickup with Barge-in Exempt
DCPU	Directed Call Pickup Non Barge-In
DCPK	Directed Call Park
DCPX	Directed Call Pickup Exempt
DDD	Direct Distance Dialing
DID	Direct Inward Dialing
DIN	Denied Incoming
DISA	Direct Inward System Access
DLH	Distributed Line Hunting
DN	Directory Number
DND	Do not disturb
DNH	Directory Number Hunting
DOD	Direct Outward Dialing
EBO	Executive Busy Override
EBX	Executive Busy Override - Exempt
EID	Endpoint identifier information element
EKTS	Electronic Key Telephone Service
ERWT	Expensive Route Warning Tone
ESB	Emergency Service Bureau

ESN	Electronic Switched Network
FA	Feature activation information element
FC	Flexible Calling
FCM	Functional Call Management
FFM	Functional Feature Management
FI	Feature indication information element
FIE	Facility information element
FKM	Feature Key Management
GIC	Group Intercom
ICM	Intercom
IRQ	Information request information element
KP	Keypad information element
LNR	Last Number Redial
LNRA	Last Number Redial Associated with Set
MADN	Multiple Appearance Directory Number
MAP	Maintenance and Administration Position
MBS	Meridian Business Set
MCH	Malicious Call hold
MLH	Multiline Hunting
MRFM	MADN Ring Forward Manual
MSB	Make Set Busy
MWT	Message Waiting
NCOS	Network Class of Service
NDC	No Double Connect
NI	Notification indicator information element
PBL	Individual Private Business Lines
PI	Progress indicator information element
PRK	Call Park
PRL	Privacy Release
PSTN	Public Switched Telephone Network
RAG	Ring Again
RGN	Redirecting number information element
RLS	Release
RMB	Random Make Busy
RNN	Redirection number information element
RO	Remote Operation
SCL	Speed Call – Long list
SCS	Speed Call – Short list
SCU	Speed Call User
SIG	Signal information element
SLU	Subscriber Line Usage
SMDR	Station Message Detail Recording
SPID	Service profile identifier information element
TEI	Terminal Endpoint Identifier
TID	Terminal Identifier
USID	User Service Identifier
3WC	Three Way Calling

The notation "FI=x,y" represents a Feature indication information element with feature identification number=x and status indicator pattern y, where x=1 to 64 and y is as described in section D of

the interface specification. The status indicator codepoints and associated meaning are summarized in section 2.

The notation "FA=z" represents a Feature activation information element with feature identification number=z, where z=1 to 64, as described in section D of the interface specification.

The notation "SIG=alert patn x" represents a Signal information element with alerting pattern x, as described in section D of the interface specification.

1.3 CALL REFERENCE RULES

The phrase "call associated services" is defined as services which 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 message, the following rules apply:

a. If the service is call associated, then the active call reference must be used if the service is associated with a functional call.

b. If no active call reference exists, (e.g. when programming the Call Forward number) then the dummy call reference will be used.

If an INFOrmation message with a Feature indication information element is received, specifying a non-dummy call reference which is not related to any existing functional call, then the terminal shall discard the INFOrmation message received from the network.

2.0 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 via 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 via the messaging defined in this specification. 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, the Abstract Terminal is part of the user–network interface. The Abstract Terminal is the primary vehicle through which a terminal and the DMS–100 interact.

2.1 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), and Functional Terminal Management (FTM). Terminal shall all implement at least Functional Call Management in order to support basic call.

FCM handles all basic functional signaling call control requirements. It includes Abstract Terminal logical resources such as Directory Numbers (DNs), B-channels, call references and bearer capabilities, and uses both the display and keypad on the Abstract Terminal. FCM is CCITT, T1, and TR-TSY-000268 Issue 2 compatible and is a crucial component of NT's ISDN BRI implementation to facilitate terminal portability among switch interfaces which are built to these standards.

FFM handles supplementary service signaling features, which modify the basic call control process, such as Hold/Retrieve, Additional Call Offering (ACO) and Electronic Key Telephone Service.

FKM handles all supplementary services using activators and indicators which transfer information between the switch and terminal, but which do not directly change the basic call control process, such as Speed Calling, Call Pickup etc.

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 Feature Activator key of the FKM component.

The following subsections define the logical components in the Abstract Terminal. Refer to Figure 1 on page E-9 below for a pictorial view of the Abstract Terminal concept.

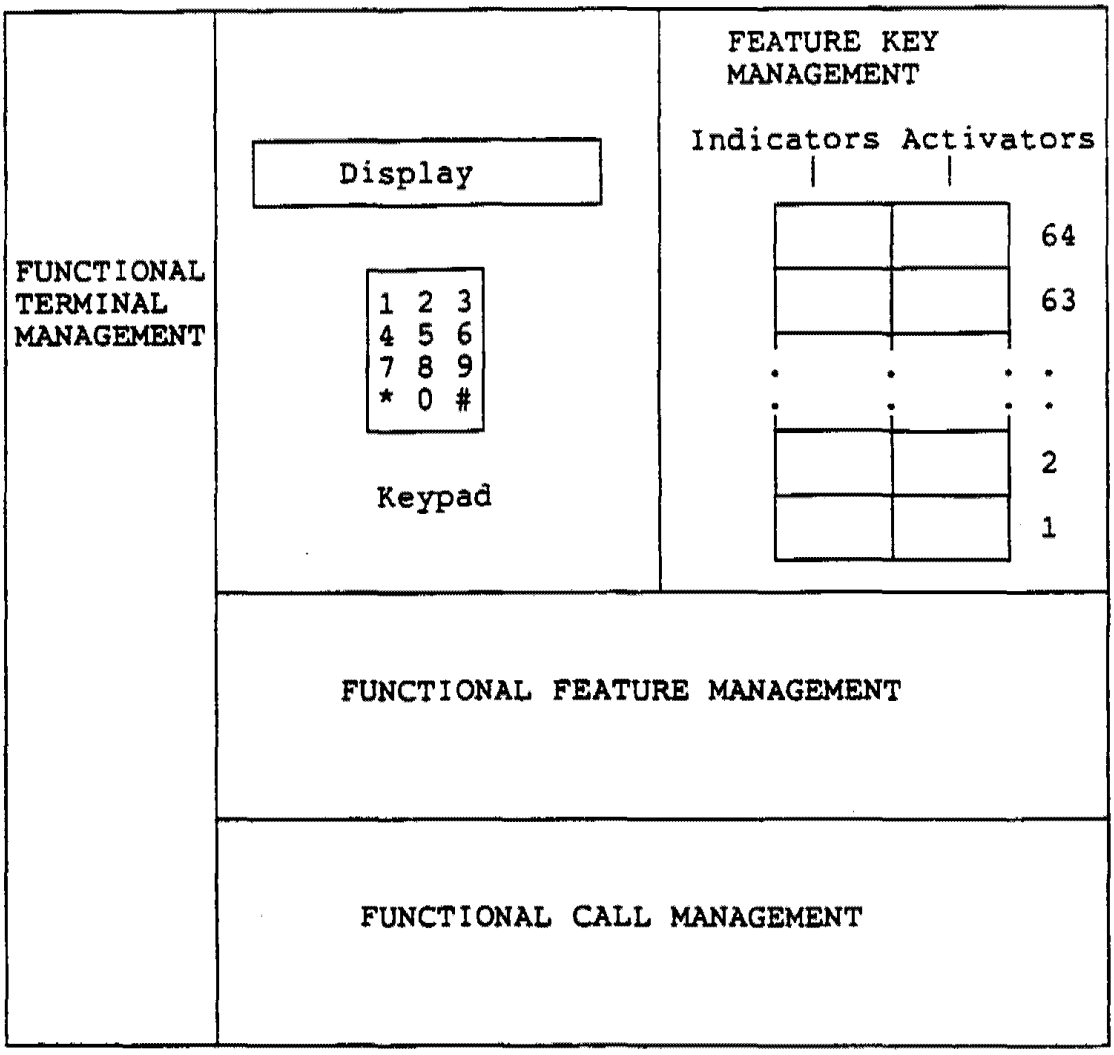


Figure 1. Logical Representation of the Abstract Terminal

2.2 FUNCTIONAL CALL MANAGEMENT COMPONENT

The following logical components are required for basic functional signaling control.

2.2.1 Directory Numbers

The Abstract Terminal has directory numbers (DNs) which it may use when terminating or originating a call. A terminal is only associated with a DN when the terminal originates an outgoing call or when the terminal is awarded an incoming call by answering it.

2.2.2 Call References

The Abstract Terminal has a number of call references which it may use when establishing a call or activating a feature. A terminal is associated with a call reference when the terminal originates an outgoing call, or when the terminal responds to an incoming call. A null call reference is used for invocation of supplementary services only. Refer to section D for more information.

2.2.3 Bearer Capabilities

The Abstract Terminal is capable of supporting a number of bearer capabilities. For a particular call instance, a terminal shall only be associated with one of these same bearer capabilities. Refer to section D for more information.

2.2.4 Address Information Elements

The Abstract Terminal supports address information elements, which may be delivered in call control messages. Section D defines the procedures and coding of these information elements.

There are six address related information elements of interest:

Called Party Number (CDN) – The purpose of the Called party number information element is to identify the destination of the call to the calling party. Examples of encoding of called party number are shown in section D.

Calling Party Number (CGN) – The purpose of the Calling party number information element is to identify the origin of a call to the called party. The terminal user would normally use this information to recognize the caller.

Connected Number (CN) – The purpose of the Connected number information element is to indicate which number is connected to a call. This is sent from the network to both the calling and called terminals to indicate the address of the actual connected party. The connected number may be different from the calling or called party number(s) because of changes (e.g. call redirection) during the lifetime of the call.

Redirecting Number (RGN) – The purpose of the Redirecting number information element is to identify the number from which call redirection/ diversion was invoked. An example of this is Call Forward where the redirecting number would be the terminal which activated this feature.

Redirection Number (RNN) – The purpose of the Redirection number information element is to identify the number to which call redirection/ diversion will be or has been invoked. In the case of Call Forwarding the redirection number would be the terminal address which the calls were forwarded to.

2.2.5 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 which represent bidirectional communication channels between the terminal and the network. The Abstract Terminal makes no restriction on what input/output devices the physical terminal shall implement. The maximum number of B–channels supported by the Abstract is limited to one at this time.

B–channels are dynamically assigned to terminals on an interface. A terminal is only allocated a B–channel when the terminal originates an outgoing call or when the terminal is awarded an incoming call by answering it. When the terminal is idle, it is not associated with any B–channel.

2.2.6 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 via the B–channel.

2.2.6.1 Digit Sending

The procedures for digit sending are described in section 5, Generic Procedures for Supplementary Service Access.

2.3 FUNCTIONAL FEATURE MANAGEMENT COMPONENT

FFM handles supplementary service signaling features, which modify the basic call control process, such as Hold/Retrieve, Additional Call Offering (ACO) and Electronic Key Telephone Service (EKTS).

2.4 FEATURE KEY MANAGEMENT COMPONENT

FKM handles all supplementary services using activators and indicators which transfer information between the switch and terminal, but which do not directly change the basic call control process.

2.4.1 Activators and Indicators

2.4.1.1 Activators

FKM features are activated using feature activators. A feature activator is mapped into a Feature activation information element, containing a feature identification number (i.e. feature key number). This Feature activation information element may be carried in an INFOrmation message 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.

2.4.1.2 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 exists 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 (i.e. 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 Feature indication information elements contain a feature identification number and a status indicator, as described in section D.

2.4.1.3 Indicator States

There are four feature indicator states defined for the Abstract Terminal. They are shown in the following figure:

States	Feature Indicator Corresponding to a Feature Appearance
0	Deactive or idle
1	Active
2	Prompt
3	Pending

Figure 2. Abstract Terminal Indicator States

It is not the intention of this definition to constrain the terminal vendors to a specified man-machine interface. The customer premise equipment (CPE) may choose to indicate the states in whatever manner is most consistent with other man-machine considerations on the terminal.

The meanings of the feature indicator states will vary depending on the particular feature.

2.4.1.4 Directory Number (DN) Appearances

For each Directory number assigned to a particular logical terminal, a number of feature activators/indicators are reserved (i.e. they cannot be used for Feature Key Management-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.

It is suggested that 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 will reserve 10 activators, (e.g. FA=1 to 10). The terminal in this case could represent the appearance of calls using key/lamp pairs 1 to 10, while pairs 11-64 (corresponding to activator/indicator pairs 11 to 64) can be used for supplementary services.

It is noted that while this is a convenient approach, terminals are by no means constrained to this man-machine interface.

2.4.2 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, and Redirection number. This information will be delivered as information elements in the call control messages. The Abstract Terminal also provides display of NAME/Reason, using the Display Text infomation element, as described in Section E-6.34. NAME/Reason display includes the use of generic procedure G11, described in Section 5.13. Section D defines the procedures and coding of these information elements.

2.4.2.1 Usage of Display and Address Elements

While it is desirable to support basic terminals with the widest possible variety of features, it is realized that many of the CPE vendors will want to build more sophisticated terminals. One of the most visible ways of increasing the visible sophistication (in the user's eyes) of the terminal is through the use of displays and/or graphics to show information about the call(s). This information could include the Called party number, Calling party number, 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).

2.4.3 Keypad

The Feature Key Management component also makes use of the keypad for sending additional information pertaining to feature activation.

For sending additional information (authorization codes, call forwarding address, etc.) the terminal shall send this information to the network by en-bloc or overlap sending. Section 5.0, Generic Procedures for Supplementary Service Access, describes enbloc and overlap sending procedures.

2.5 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 Feature Activator key of the Feature Key Management component.

Currently, the only function provided by this component is to ensure the alignment of the Abstract Terminal definition between the terminal and the switch. For further information, refer to the description of the Service Profile Management capability in Section H of this specification.

3.0 DEFINITION OF BUSY

In general, an ISDN endpoint is considered busy whenever the resources associated with that endpoint (and 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.

In addition, the operation of certain supplementary services are affected when certain of these resources are busy.

3.1 BUSY CONDITIONS

- Subscriber busy
  This condition is indicated by the subscriber's terminal equipment, e.g. by having all compatible terminals which could respond to the call request indicate "user busy" when offered the call.

- Channel or interface busy
  This condition occurs when there is no appropriate B-channel available for the call.

- Call reference busy
  This occurs when all of the call references (in either direction) that are allowed to be active concurrently for a given directory number on an ISDN interface are currently active (i.e. the maximum number of calls subscribed to has been reached). In the absence of other features (e.g. Additional Call Offering), a given directory number is considered by the switch to be busy if it is call reference busy. The call reference busy limit is in addition to the interface busy limit.

- Notification busy
  This occurs when all of the call references that may be used concurrently for user notification of waiting calls (as provided by Additional Call Offering) for a given directory number on an interface are currently in use. When this occurs, the given directory number is considered by the switch to be busy.

3.2 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:

1. Assume that a call is about to be offered.

2. If all of the appropriate user-network interface B channels are busy (i.e. 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 will clear the call with cause value #17 "user busy" back towards the calling subscriber.

3. Similarly, if the maximum number of calls supported at the given subscriber's interface(s) has been reached, the network will clear the call with cause value #17 "user busy" back towards the calling subscriber.

4. Otherwise, the network offers the call to the subscriber.

5. If any compatible terminal responds "positively" to the call offering, i.e. gives some indication that the call may progress toward successful completion, the normal call offering procedures will follow.

6. If no terminal responds "positively" but one or more terminals respond "User Busy", then when the response-to-call-offering timeout occurs, the network will clear the call with cause value #17 "user busy".

7. It can be noted that since every compatible terminal is required to respond in some way to an incoming call offering, if no terminal responds before the above timeout occurs, the network will clear the call with cause value #18 "no user responding".

4.0 TERMINAL IDENTIFICATION PROCEDURES

Terminal identification procedures enable the network to uniquely identify a terminal on a multi-terminal interface. These terminal identification procedures, also called terminal initialization procedures, provide a Layer 3 handshake between the network and the terminal, in order to associate the terminal with a specific Terminal Service Profile (TSP).

For terminals that use static (or fixed) TEIs, 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, for example, D-channel data-only terminals, therefore do not require any additional terminal identification procedures, and the procedures defined in this section are not applicable to such terminals.

Dynamic TEIs are either network assigned (i.e. TEI values in the range 64-126), or user-assigned (i.e. TEI values in the range 0-63). For terminals that use dynamic TEIs, the TEI value alone is insufficient for the network to associate a particular terminal with its TSP. Such terminals are required to initialize using the procedures described in this section. The network only supports association of one terminal with a TSP.

Once initialization is complete, the network can directly address a terminal by including a specific Layer 3, Endpoint Identifier (EID) information element in SETUP, KEY SETUP, or INFOrmation messages. Note, however, that not all SETUP messages contain EID information. Such information is only included if the SETUP message is sent to a terminal that is part of an EKTS group.

This Section Describes the procedures, based on 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", that are required in addition to the information elements in Section D, for initializing terminals.

4.1 DEFINITIONS

The following terminology is defined for this section:

- A terminal is defined as the piece of user equipment that terminates a layer 2 data link signaling connection on the D-channel.

- A Service Profile Identifier (SPID) is an identifier, which is used by a terminal in the initialization procedures defined below. A SPID is unique on a switch, and is a 10 digit primary directory number with an optional suffix. The maximum length of a SPID is 20 digits as defined in the Service Identification information element in section D. All but the least two significant digits of the SPID are provided by the network administration at subscription time. The two least significant digits of the SPID contain a "Terminal IDentifier (TID) portion" to be administered by the user. 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. Starting in BCS 34, a two digit TID must be entered as the last two digits of the SPID (e.g., 10 digit PDN + SPID + 2 digit TID). For example, a terminal with Primary DN = 613 555-1212, SPID = 21, and TID = 0-62, the following digits would be entered: 613555121221xx.

  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.

- An Endpoint Identifier is a Layer 3 information element included in either the SETUP, KEY SETUP, or INFOrmation messages to indicate the user service identifier (USID) and the terminal identifier (TID) for the purpose of identifying or selecting a specific terminal. Refer to section D of this interface specification for a description of the Endpoint Identifier Information element.

- A service profile is a set of service or feature parameters, subscribed to by a terminal, and associated with the terminal after successful SPID initialization.

- Timer TI-T1 is defined as the period of time within which the network expects a terminal to request initialization after a TEI has been assigned or after initialization has been requested by the network. The value of this timer is fixed at 20 seconds.

A service profile, SPID, and terminal may be used interchangeably in the sense that they have a one-to-one mapping. Note, however, that service profiles do not necessarily have to contain unique parameter values; that is, two service profiles may have exactly the same parameter values but associated with different terminals via different SPIDs.

4.2 PROCEDURES

The terminal identification procedures in this section consist of two parts, that is, SPID initialization and terminal selection.

SPID initialization may be requested by the terminal or in some cases by the network. SPID initialization results in the the network, based on the SPID value provided by a terminal, associating the terminal with the appropriate service profile. Subsequent to a successful initialization request, all service requests and responses from that terminal may be interpreted and coordinated in association with the service profile identified in the initialization.

Terminal selection occurs, in the provision of some features, when the switch is required to broadcast messages targeted at a specific terminal associated with a particular service profile.

4.2.1 SPID initialization

SPID (re)initialization must occur, in terms of layer 2 states (see section C), 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 for and been assigned a new TEI value, (for example, after removal of a previous TEI by the switch) must undergo SPID initialization so that service can be reinstated by the switch.

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.

4.2.1.1 Terminal Requested Initialization

Terminals request initialization, as shown in Figure 3 on page E-26, by sending an INFOrmation message with a Null (or dummy) Call Reference (CRd) and the Service Profile Identification information element containing the SPID value (as defined in section D).

If successful (i.e. the SPID is valid) the network will respond with an INFOrmation message containing the Null (or dummy) Call Reference (CRd) and the appropriate Endpoint Identifier (EID). The Endpoint IDentifier information element (EID) is defined in "Definitions" on page E-23 and in Section D of this interface specification.

Terminals, on receiving the Endpoint identifier information element shall store the identifier value.

On successful initialization, the network will associate the TEI with the appropriate service profile.

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.

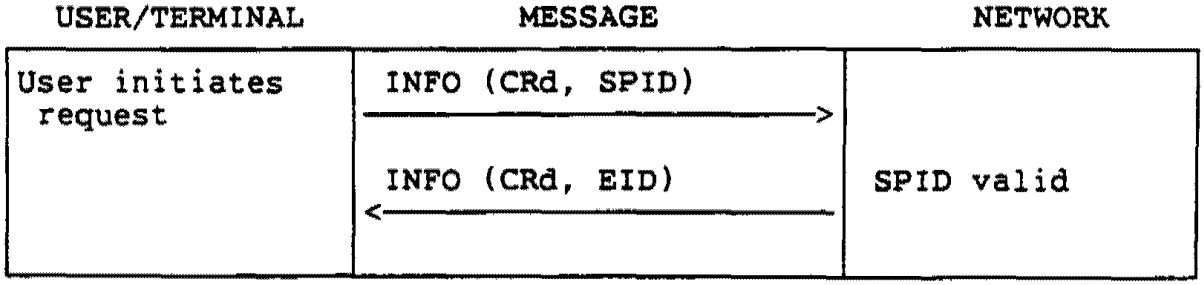


Figure 3. Terminal Requested Initialization

4.2.1.2 Network Requested Initialization

Under some circumstances, the network will request that a terminal initializes its SPID. This will happen if the terminal had not requested initialization within a time value specified by timer TI-T1, after assignment of a TEI, or after the first request for service from a terminal which has not previously undergone initialization.

The network will request that a terminal initialize, by sending to the terminal an INFOrmation message containing the Null Call Reference (CRd), and an Information Request information element specifying "prompt" for terminal identification with the type of information parameter coded to "terminal identification".

Terminals are expected to respond to this request by returning an INFOrmation message with a Null (or dummy) Call Reference (CRd) and their respective Service Profile IDentification information element (SPID) (as defined in Section D). This response must be received prior to the expiration of the time specified for TI-T1. See Figure 4 on page E-28.

If a terminal does not respond correctly within timer TI-T1, the network returns an INFOrmation message containing a Null (or dummy) Call Reference (CRd) and an Information Request 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 will return an INFOrmation message containing the Null (or dummy) call reference (CRd), the Endpoint IDentifier information element (EID) and the Information Request (IRQ) information element indicating that initialization is complete (IRQ=complete). See Figure 4 on page E-28. The Endpoint identifier information element is defined in section D.

Terminals, on receiving the Endpoint identifier information element shall store the identifier value.

On successful initialization, the switch will associate the dynamic TEI with the appropriate service profile.

Scenario: Terminal is idle. Layer 2 has been established and a TEI has been assigned. The network requests initialization.

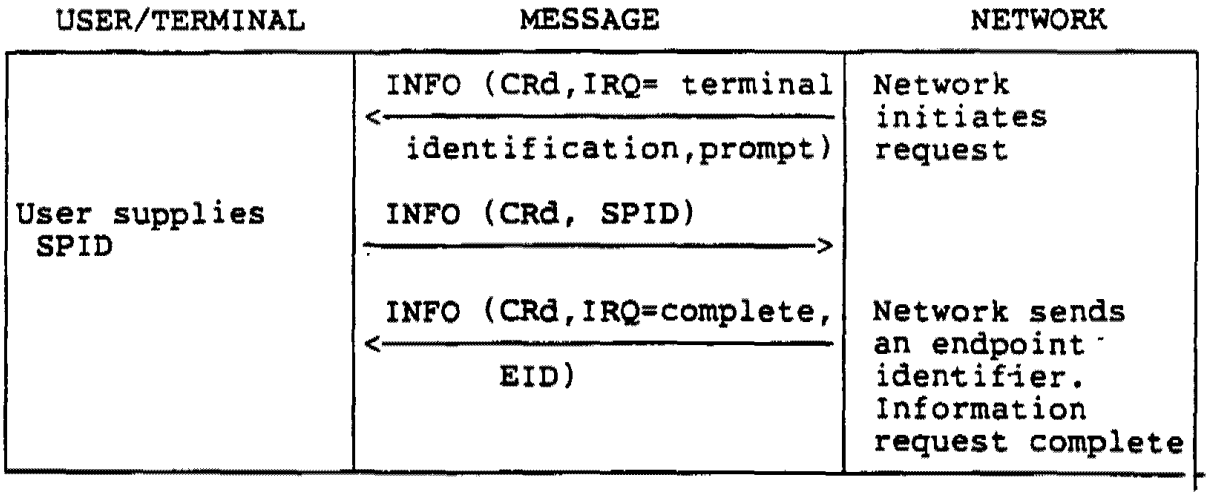


Figure 4. Network Requested Initialization

4.3 EXCEPTIONS AND ERROR CONDITIONS

4.3.1 Unsuccessful Initialization

If the SPID value received by the network in an initialization attempt is invalid, that is, not assigned to that interface, the network will indicate an unsuccessful initialization attempt by sending an INFOrmation message containing the Null Call Reference (CRd) and a Cause information element with cause value #100 "invalid information element contents" (CSE=100). See Figure 5. In the event of an unsuccessful initialization attempt, no ongoing association is made by the network between the terminal and a service profile.

A terminal may implement a timer, set to 15 seconds, on first transmission of the INFOrmation message containing the SPID value. If no response is received from the network upon the first expiry of this timer, the terminal shall retransmit the initialization request. If the initialization attempt is rejected by the network, or if there is no response from the network after the second expiry of the above timer, the terminal will repeat the request for initialization until the correct ACK message comes from the switch.

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.

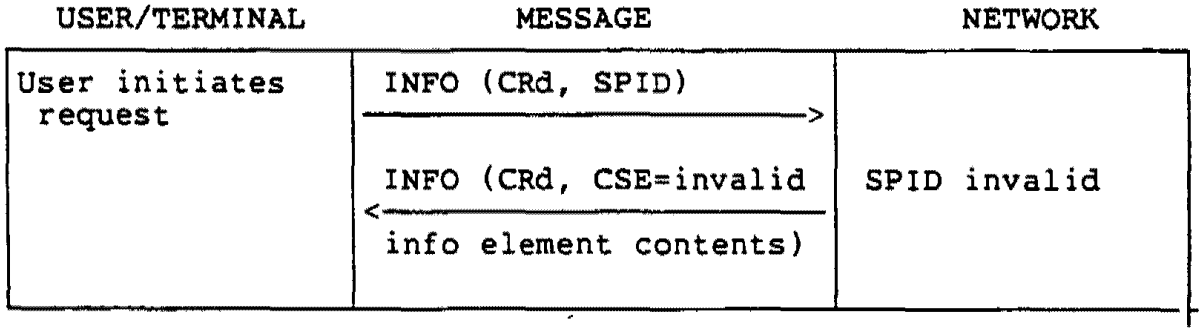


Figure 5. Unsuccessful Initialization Request

4.3.2 Clearing of Association between TEI and Service Profile

If for any reason the network decides to remove a TEI value that has been assigned to a terminal (see section C), the network will also remove the association between the TEI and the service profile.

The terminal is expected to do the same, that is, whenever it enters the TEI-unassigned state (see section C), it shall remove its EID if it has not already done so. The terminal may re-initialize once it has been assigned another dynamic TEI and established the data link connection.

4.3.3 Messaging Prior To Service Profile Association

If a SETUP message is received from a terminal, prior to initialization, it will be ignored by the network after returning a RELease COMplete message with Cause value #50 "requested facility not subscribed" (CSE=50).

If an INFOrmation message (other than the initialization request message) is received from a terminal with a Null (or dummy) Call Reference (CRd) for which service profile association has not been carried out or is no longer valid, it will be ignored by the network after returning an INFOrmation message with Cause value #50 "requested facility not subscribed" (CSE=50).

Other messages received from the terminal before service profile association will be treated as defined in Section D as call reference errors.

The network will then request the terminal to initialize its SPID, as described above.

4.3.4 Invalid SPID Initialization/Terminal Re-Initialization

A terminal-requested initialization using a static (i.e. datafilled) TEI shall be rejected by the network by sending an INFOrmation message with cause value #99 "information element nonexistent or not implemented."

The network handles a terminal's request for re-initialization differently according to the (1) the SPID sent, (2) the TEI used, and (3) the status of any call on the terminal. The following table

specifies all potential re-initialization conditions and the appropriate network responses.

SPID SENT	TEI USED	CALL STATUS	NETWORK ACTION	CAUSE VALUE
Same SPID	Same TEI	No Active Call	Acknowledge successfull initialization	N/A
Same SPID	Same TEI	Active Call	Acknowledge successfull initialization	N/A
Different SPID	Same TEI	No Active Call	De-initialize old TSP and initialize on new TSP	N/A
Different SPID	Same TEI	Active Call	Reject initialization request	#53
Same SPID	Different TEI	No Active Call	Initiate TEI audit to check if current TEI is still active; If so, reject initialization request If not, accept initialization request	 #100 N/A
Same SPID	Different TEI	Active Call	Initiate TEI audit to check if current TEI is still active; If so, reject initialization request If not, accept initialization request	 #100 N/A

Figure 6. Re-Initialization and Network Responses

4.3.5 Invalid Initialization Threshold

The network will keep 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.

4.4 ERROR CONDITION SUMMARY TABLE

The following table summarizes all error conditions, network responses, and cause values associated with terminal initialization procedures.

ERROR CONDITION	NETWORK ACTION	CAUSE VALUE
Terminal attempts to initialize using an invalid SPID	Reject by sending an INFOrmation message	#100
SETUP message sent prior to terminal initialization	Return RELEASE COMPLETE message	#50
Network receives INFOrmation message with null call reference from terminal with uninitialized or invalid service profile	Ignore message and send an INFOrmation message	#50
Terminal attempts to initialize using static TEI	Reject by sending an INFOrmation message	#99
Terminal with active call attempts re-initialization using current TEI and different SPID	Reject request by sending an INFOrmation message	#53
Terminal without active call attempts re-initialization using current SPID and an inactive TEI	Reject request by sending an INFOrmation message	#100
Initialization Threshold Exceeded	May Disable Logical Link to TEI	N/A

Figure 7. Error Condition Summary Table

4.4.1 Terminal selection

The protocol specification of some features require the switch to target a broadcasted SETUP message at a specific terminal. To do this, the switch will send the SETUP message with the appropriate Endpoint identifier information element and other information elements as required.

Only the terminal that is addressed by the Endpoint identifier information element, and is compatible with any other existing compatibility checks, for example bearer capability, shall respond. Any terminal that responds, but does not satisfy the above conditions, will be ignored by the switch.

5.0 GENERIC PROCEDURES FOR SUPPLEMENTARY SERVICE ACCESS

This section specifies generic signaling procedures for the invocation of supplementary services through Feature Key Management and Code Access. Specific service descriptions, and procedures, are detailed in section 6.

5.1 INTRODUCTION

- 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 therefore should assist terminal vendors in structuring their feature access implementation.

- 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.

- Notes Concerning This Section

  1. The examples in this section only show the optional informational elements, related to Feature Key Management or Access Codes, required in each scenario. Mandatory information elements are not shown (e.g. Bearer Capability) in order to simplify the diagram.

  2. The network may send a Feature Indication (FI) information element in a call control message, or an INFOrmation message at any time, to provide feature indication status update. For example, the Feature Indication information element is sent by the network in response to a feature request using a Feature Activator (FA), however 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. In order to present a generic procedure and to reflect the requirement to include this value the line diagrams in this section simply refer to the value as "status".

3. When utilizing an En Bloc sequence the digits shall be sent together in one message. The terminal shall send the called number digits, En Bloc, in either Keypad (KP) or Called Party Number (CDN) information elements; or for a routing feature, the access code may be coded in the Transit Network Selection (TNS) information element with any supplemental address information coded in the CDN.

4. In the subsequent diagrams illustrating these generic procedures, CRn represents a non-dummy, or established call reference (call related). CRd represents the dummy or null call reference (non-call related).

5. The following are definitions for the logical call phases:

   a. Call Initiation/Establishment Phase

      This phase starts with a call initiation request (i.e. SETUP message) and ends when the network has received sufficient information to establish a basic outgoing call (i.e. CALL PROCeeding message sent to terminal).

   b. Call Progress/Active Phase

      This phase starts from the time the call initiation phase ends (i.e. after the CALL PROCeeding message is sent and before call clearing is initiated).

6. Tones and announcements are always provided (inband) by the network.

7. Feature invocation when there is an established call (i.e. Call Progress/Active phase) is only supported through Feature Key Management.

8. Feature invocation using the null call reference (i.e. non-call related) is only supported through Feature Key Management.

9. The following are definitions for the messaging sequences:

   a. Overlap Sending

      The "Overlap" sending sequences presented in this section 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 message.

In the case 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 messages.

b. En Bloc Sending

The "En Bloc" sending sequences presented in this section 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 Feature Activation request in the SETUP message. In the case where supplemental address information is being sent "En Bloc", this means that all of the supplementary address digits are sent in a single INFOrmation message.

- Supporting Activities for Feature Invocation

1. End of Dialing Determination – Call Related

a. End of dialing will be determined when the network recognizes a complete sequence.

b. 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 will apply critical interdigit timing to determine end of dialing.

c. 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 the Called Party Number information element. The '#' may only be included in the Called Party Number information element when the Type of Number is "unknown" and the Numbering Plan Identification is "unknown". Refer to Section D of this specification for description of the Called Party Number information element.

2. End of Dialing Determination – Non Call Related

a. As mentioned above, only Feature Key Management procedures are applicable to 'non call related' feature invocation. The user shall indicate the end of dialing sequence by resending the feature activator to the network at the end of the dialing sequence. See Generic Procedure G2.

3. Invalid Information Handling – Call Related

   If the user inputs a digit sequence that is not allowed in the dialing/numbering plan currently in use, the network will clear the call as described in section D of this interface specification, and where applicable include the following:

   a. If a feature indicator is associated with the requested feature, the Feature Indication information element will be included in the first call clearing message (or in a preceding INFOrmation message).

   b. If information request procedures (see generic procedure G4 or G8 for examples) were used, the Information Request information element coded to indicate that the request for information has been completed will be included in the first call clearing message or in a preceding INFOrmation message.

4. Invalid Information Handling – Non Call Related

   If the user inputs a digit sequence that is not allowed in the dialing/numbering plan currently in use, the network will send an INFOrmation message containing the Null Call Reference, the Information Request information element coded to indicate that the request for information has been completed, and the Feature Indication information element coded as specified for the particular feature involved to indicate that the request was not accepted.

5. Feature Programming Abandon – Non Call Related

   In order to allow the user to abandon feature programming/invocation during the non call related feature key access procedure (G2), terminals are required to support the release feature as described in section 6.33.

5.2 GENERIC FEATURE ACCESS PROCEDURE SUMMARY

Depending on the specific feature to be accessed, a terminal should use either Feature Key Management or Dial Code Access procedures. The set of generic procedures for supplementary service access are:

1. Procedure G1 – Feature Key Access Non–Call–Related.
2. Procedure G2 – Interactive Feature Key Access Non–Call–Related.
3. Procedure G3 – Feature Key Access Call Initiation Phase.
4. Procedure G4 – Interactive Feature Key Access Call Initiation Phase.
5. Procedure G5 – Feature Key Access Call Progress/Active Phase.
6. Procedure G6 – Interactive Feature Key Access Call Progress / Active Phase.
7. Procedure G7 – Dial Access Call Initiation Phase.
8. Procedure G8 – Interactive Dial Access Call Initiation Phase.
9. Procedure G9 – Network Notification Of Feature Information.
10. Procedure G10 – Network Notification of Event.
11. Procedure G11 – Call Related Notification of Feature Information

5.3 G1 – FEATURE KEY ACCESS (NON-CALL-RELATED)

This procedure applies when a user invokes a feature, not related to a call in progress, using feature key access.

The terminal shall request a feature be activated by sending an INFOrmation message with a Feature activation information element specifying the feature identification number. If the network accepts the request, the terminal will receive an INFOrmation message with Feature indication information element specifying status "active". If the feature cannot be activated, the network will ignore the message sent by the terminal or return an INFOrmation message with an appropriate cause value.

When the feature indicator contains status "active", the terminal shall request the feature be deactivated by sending an INFOrmation message with a Feature activation information element specifying the feature identification number. If the network accepts the request, the terminal will receive an INFOrmation message with Feature indication information element specifying status "idle". If the feature cannot be deactivated, the network will ignore the message sent by the terminal or send an INFOrmation message with an appropriate cause value.

An example of a feature using this procedure is Make Set Busy.

Scenario: A user attempts to activate a feature, using activator #x, while there is no currently active call. The user then deactivates the feature, again using activator #x.

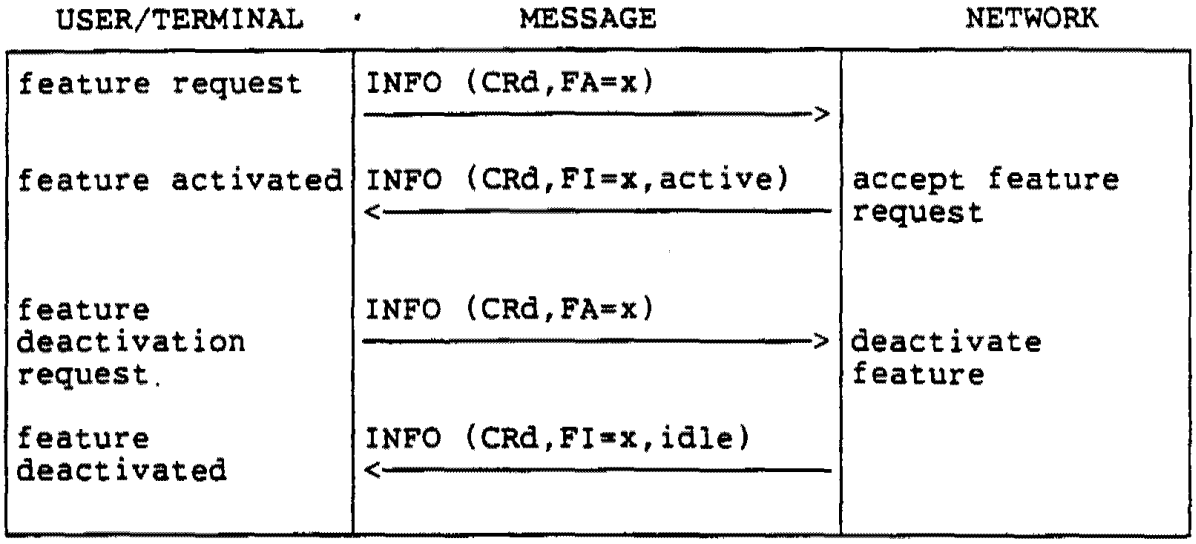


Figure 8. Feature Key Access: Non-call Related.

5.4 G2 - INTERACTIVE FEATURE KEY ACCESS (NON-CALL-RELATED)

This procedure applies when a user requests a feature, not related to a call in progress, using feature key access, and supplemental (address) information is required to be entered by the user.

The procedure is initiated when an INFOrmation message is sent to the network containing the dummy (i.e. null) Call Reference (CRd) and either:

1. a Feature Activator (FA=x) specifying the feature identification number;

2. [2]a Feature Activator and partial supplemental (address) information in the Keypad information element; or

3. [2]a Feature Activator and complete information in either the Keypad or the Called Party Number information element.

In cases (1) and (2) above, where no information or partial information is sent along with the Feature Activator, the network will prompt the user for additional information with an INFOrmation message containing the dummy Call Reference (CRd), the Feature Indication information element corresponding to the specified feature identification number with status prompt (FI=x,prompt). Also included is the Information Request information element, coded to prompt for address digits (IRQ=prompt,address). See Figure 9 on page E-44, case 1 and 2.

Address sending from the terminal then begins by sending one or more INFOrmation messages (i.e. En Bloc or Overlap) to the network. In case (2) where partial information is sent with the Feature Activator, the remaining information shall be sent in the Keypad (KP) information element in one or more INFOrmation message(s) including the dummy Call Reference (CRd). In case (1) where no supplemental information is sent with the Feature activator, the supplemental information shall either be sent enbloc in the Called Party Number (CDN) or Keypad information element, or overlap in the Keypad information element contained in multiple INFOrmation messages.

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[2] At this time the network will not support the receipt of a feature activator together with either a Keypad information element or Called Party Number information element in an INFOrmation message containing the dummy Call Reference. Consequently, cases (2) and (3) described above are not currently supported.

In all cases, See Figure 9 on page E-44, the user shall indicate the end of the dialing sequence by again sending the INFOrmation message containing the dummy Call Reference (CRd) and the Feature Activator (FA=x) information element.

The network will complete the sequence by returning an INFOrmation message containing the dummy Call Reference (CRd) and a Feature Indicator corresponding to the specific feature identification number with the appropriate status for the given feature (FI=x, "status"). In cases (1) and (2) where additional information have been requested by the network, the Information Request information element coded to complete (IRQ=complete) will also be included in the INFOrmation message.

Depending on the specific feature, the network will use status "idle" to indicate rejection of the digits entered.

Examples of features using this procedure are Call Forward All Calls programming and Speed Calling programming.

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.

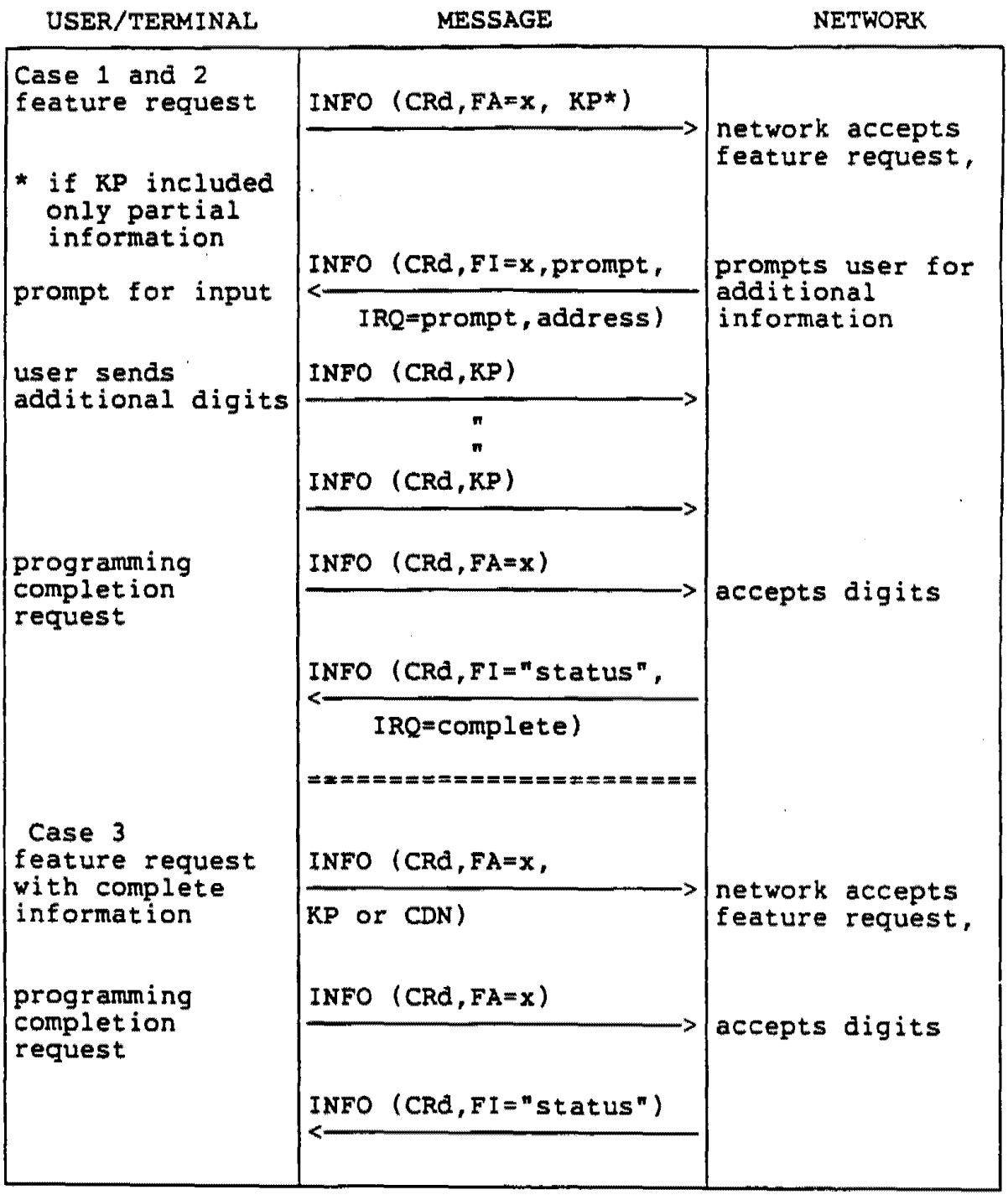


Figure 9. Interactive Feature Key Access – Non-Call Related

5.5 G3 - FEATURE KEY ACCESS (CALL INITIATION PHASE)

This procedures applies when a user invokes a feature, using feature key access during call establishment, and no supplemental (address) information is required.

The feature activation request shall be sent to the network either enbloc in the SETUP message, or overlap in an INFOrmation message after receipt of the SETUP ACKnowledge message.

In the enbloc case, the Feature Activator shall be included in the SETUP message sent to the network. Depending on the specific feature, the call will either proceed or be cleared as described in the procedure "Common Call Clearing/Establishment Procedures" on page E-75.

In the overlap case, the user shall send a SETUP message to the network and with no Feature Activator information element included in the message. The network will respond with a SETUP ACK message containing the established Call Reference (CRn), a B-channel assignment (CID=B-ch), the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Signal Information element coded to "dial tone on" (Signal). The network will provide dial tone at this time. See Figure 10 on page E-46.

After receipt of the SETUP ACKnowledge message, the user shall send an INFOrmation message to the network containing the established Call Reference (CRn) and the Feature Activator (FA=x) specifying the feature identification number. Depending on the specific feature, the call will then proceed or be cleared as described in the procedure "Common Call Clearing/Establishment Procedures" on page E-75.

If the feature request is rejected, the network will clear the call in accordance with the procedures in section D.

Examples of features using this procedure are Automatic Dial and Call Pickup.

Scenario: A user attempts to activate a feature, using activator #x, during call initiation.

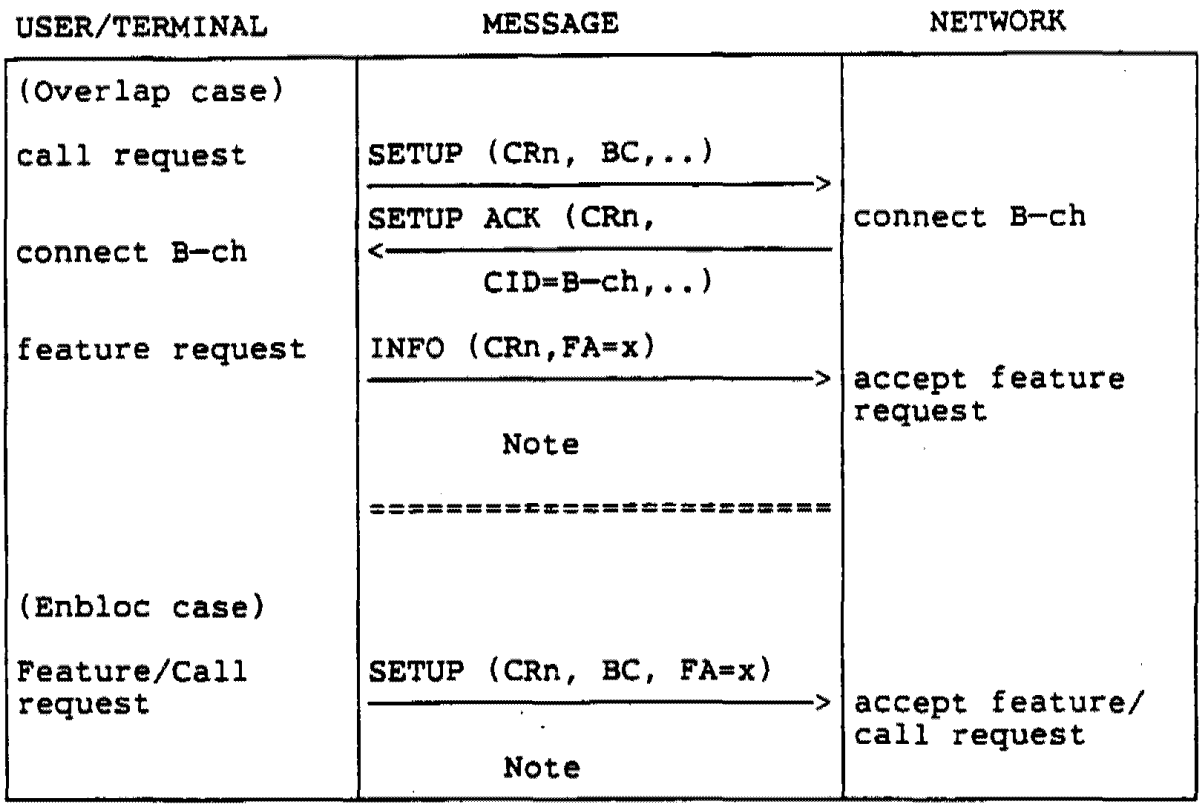


Figure 10. Feature Key Access – Call Initiation Phase

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

5.6 G4 - INTERACTIVE FEATURE KEY ACCESS (CALL INITIATION PHASE)

This procedure applies when a user invokes a feature using feature key access, during call initiation, and supplemental (address) information is required to be entered by the user.

This procedure includes a number of alternative sequences dependening on how the supplemental information is sent to the network, and on whether the feature activation request is included in the SETUP message, or a subsequent INFOrmation message. The following sequences are supported:

1. Single Enbloc;

2. Enbloc followed by supplemental information sent enbloc or overlap;

3. Single Overlap;

4. Overlap followed by supplemental information sent enbloc 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 section D of this interface specification.

If the feature request or digits entered are rejected, the network will clear the call in accordance with the procedures in section D.

An example of a feature using this procedure is Speed Calling User.

In case (1), the user shall send a SETUP message to the network including the Feature Activator (FA=x) and the complete supplemental information encoded in either the Keypad or Called Party Number information element. See Figure 11 on page E-50. Depending on the feature invoked, the call will either proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

In case (2), the user shall send a SETUP message to the network including the Feature activator (FA=x) and no supplemental information. The network will return a SETUP ACKnowledge message containing the established Call Reference (CRn), the B-channel assignment (CID=B-ch), the Feature Indicator corresponding to the specified feature identification number with status prompt (FI=x,prompt), and the Information Request element coded to prompt for address digits (IRQ=prompt,address). The network will also include the Signal Information element (Signal) coded to "recall dial

tone" and the Progress Indicator (PI) coded to "inband information or appropriate pattern now available." The network provides recall dial tone at this time. See Figure 12 on page E-51.

Address sending from the terminal shall begin by sending one or more INFOrmation messages either Enbloc or Overlap. If the Enbloc sequence is used, all of the supplemental address digits shall be contained in the Keypad information element (KP) or Called Party Number information element (CDN).

If the Overlap sequence is used, the terminal shall send multiple INFOrmation messages to the network containing the established Call Reference (CRn) and the supplemental address digits in the Keypad information element (KP). After receipt of the first message the network will send an INFOrmation message containing the established Call Reference (CRn) and the Signal Information element (Signal) coded to "tones off". At this time the network will remove dial tone. The user shall send 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 will then proceed or be cleared using the procedure as described in "Common Call Clearing/Establishment Procedures" on page E-75.

The single overlap case (3) occurs when the user initiates a call which includes a Feature Activator (FA) and partial but not complete supplemental (address/digit) information contained in the Keypad information element. The network will return a SETUP ACKnowledge message containing the established Call Reference (CRn), the B-channel assignment (CID=B-ch), and the Feature Indicator corresponding to the specified feature identification number with status prompt (FI=x,prompt). The user shall send the remaining supplemental address information coded in the Keypad information element contained in one or more INFOrmation messages. See Figure 13 on page E-52. Depending on the specific feature the call will proceed or be cleared using the procedure as described in "Common Call Clearing/Establishment Procedures" on page E-75.

In case (4), Overlap followed by Overlap/Enbloc, the user sends a SETUP message to the network and no Feature Activator or supplemental information is included. The network will respond with a SETUP ACKnowledge message containing the established Call Reference (CRn), a B-channel assignment (CID=B-ch), the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Signal Information element coded to "dial tone on". The network will return inband dial tone at this time. See Figure 14 on page E-53.

After receipt of the SETUP ACKnowledge message, the user shall send an INFOrmation message to the network containing the established Call Reference (CRn) and the Feature Activator (FA=x) specifying the feature identification number. The network will return an INFOrmation message containing the Signal information element coded

to "tones off" (signal) and remove inband dial tone. If the feature request is accepted the network will prompt the user for additional information with an INFOrmation message containing the established Call Reference (CRn), the Feature Indicator corresponding to the specified feature identification number with status prompt (FI=x,prompt), the Signal Information element coded to "recall dial tone" (Signal), the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Information Request element coded to prompt for address digits (IRQ=prompt,address). At this time the network will provide inband recall dial tone. See Figure 14 on page E-53.

Digit transmission from the terminal shall begin by sending one or more INFOrmation messages (i.e. Enbloc or Overlap). In either case after receipt of the first message the network will return an INFOrmation message containing the established Call Reference (CRn) and the Signal Information element coded to "tones off" (Signal). At this time the network will remove recall dial tone.

If the Enbloc sequence is used, all of the supplemental address digits shall be contained in the Keypad information element (KP) or Called Party Number information element (CDN).

If the Overlap sequence is used, the terminal shall send multiple INFOrmation messages containing digit information coded in the Keypad information element.

The user/terminal then continues digit transmission by sending multiple INFOrmation messages coded in the same fashion as the first.

Depending on the specific feature the call may then proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user requests feature activation with complete supplemental information included in the SETUP message.

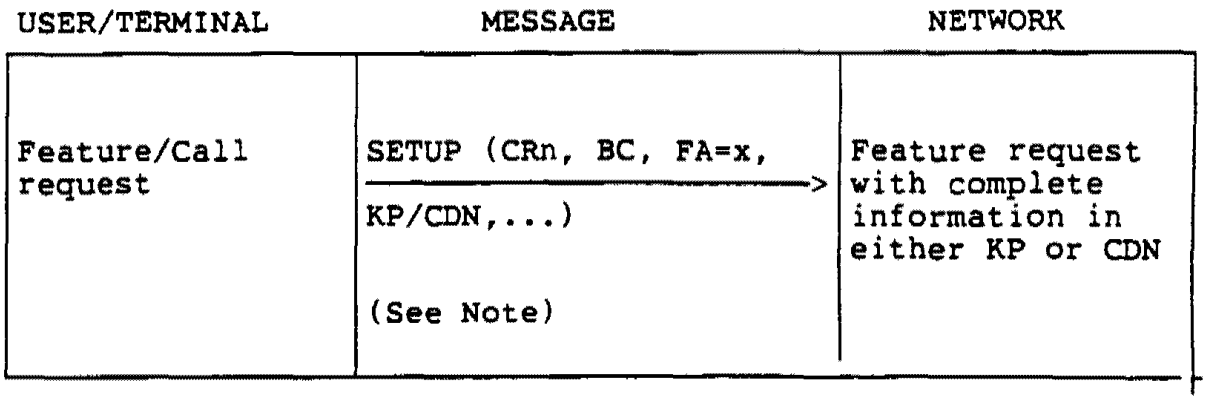


Figure 11. Single Enbloc Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user is prompted by the network to provide additional information.

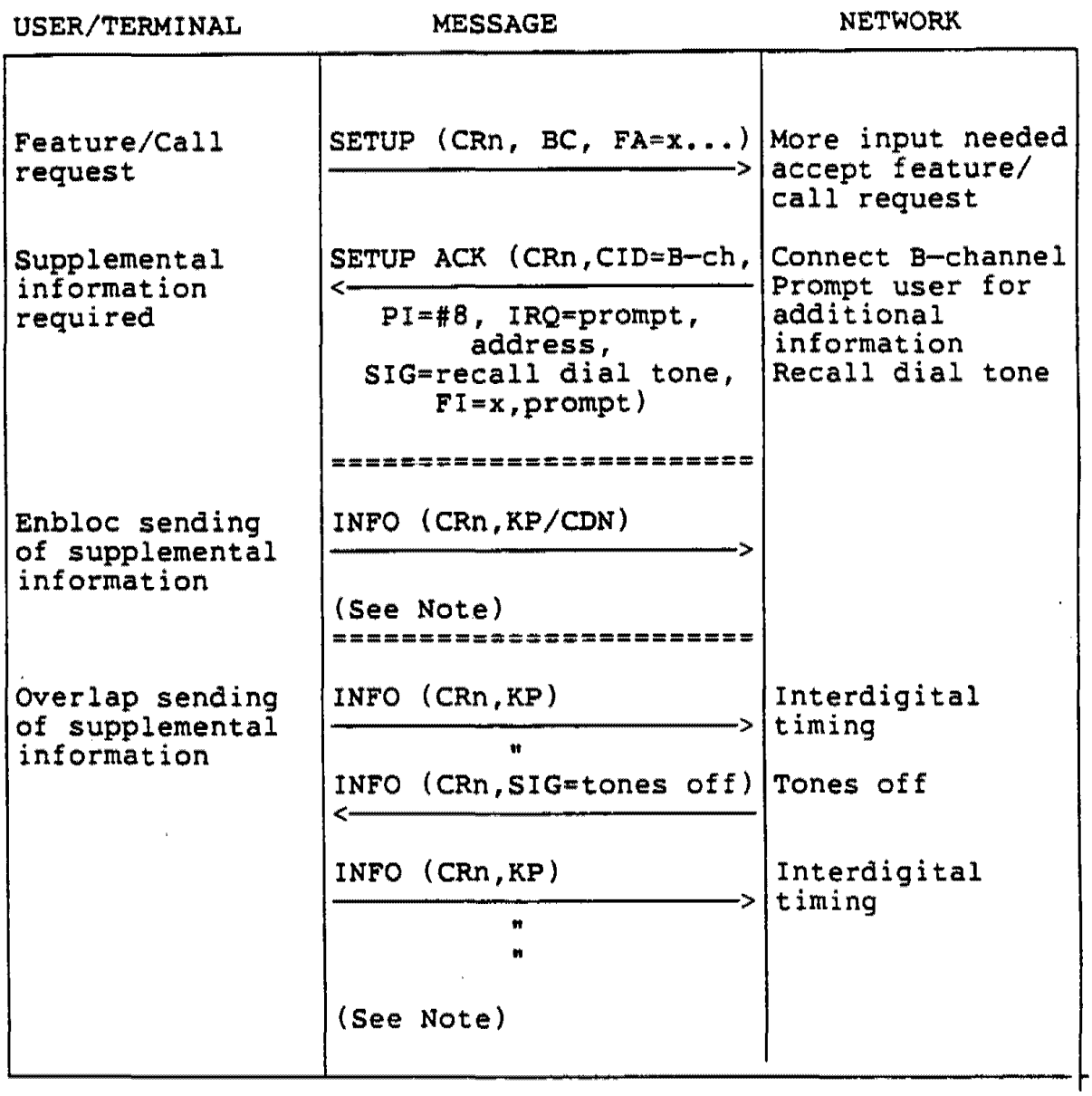


Figure 12. Enbloc followed by Enbloc/Overlap Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user requests feature activation with partial supplemental information included in the SETUP message.

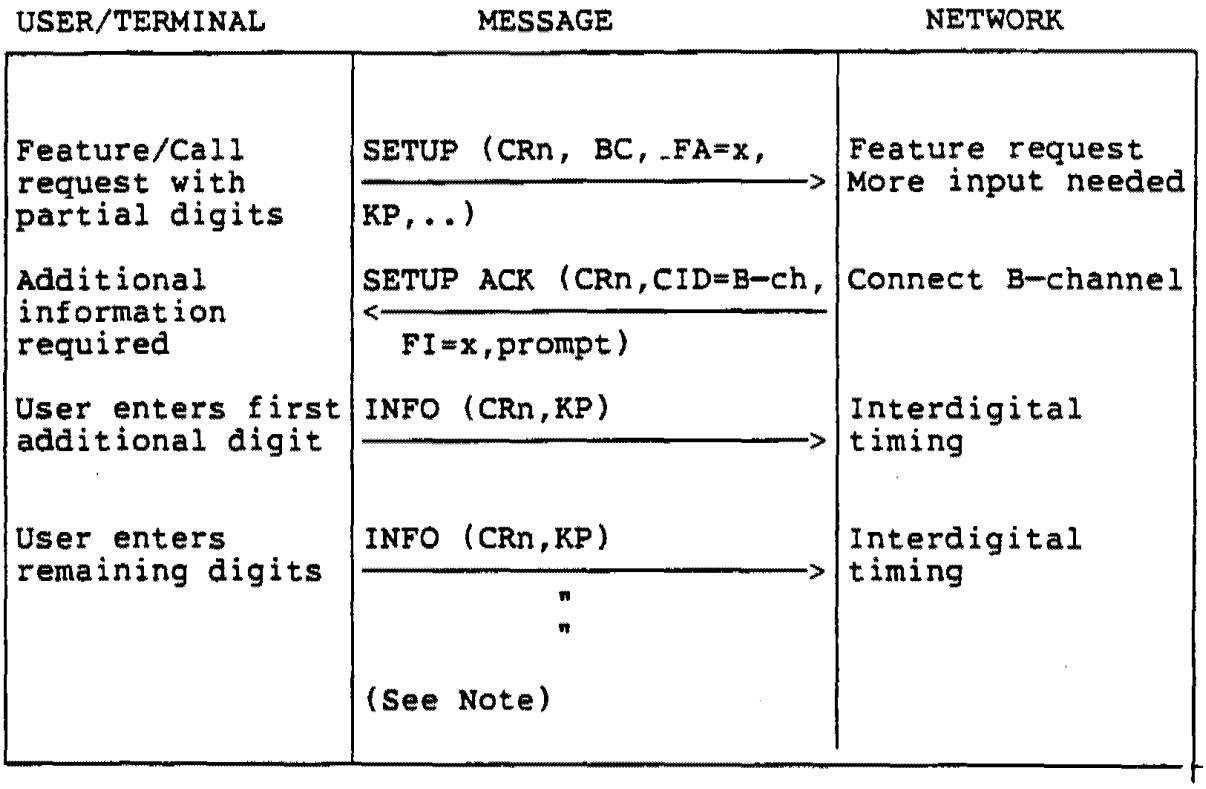


Figure 13. Single Overlap Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user is prompted by the network to provide additional information.

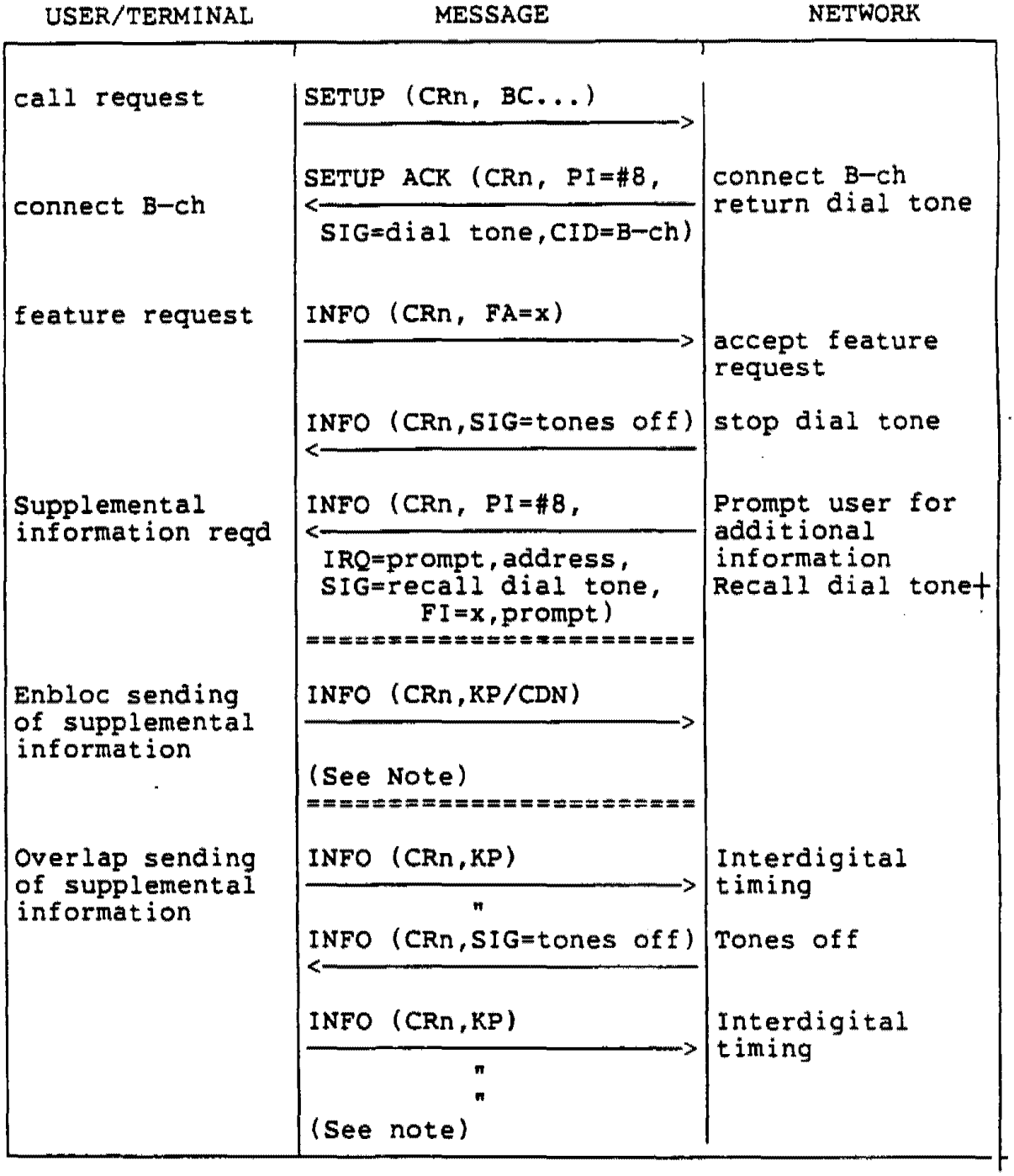


Figure 14. Overlap Followed by Enbloc/Overlap Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

5.7 G5 – FEATURE KEY ACCESS (CALL PROGRESS/ACTIVE PHASE)

This procedure applies when a user requests feature invocation using feature key access during the call progress or active phase of a call, and no supplemental information is required.

The procedures apply for example, when the terminal has received a busy or call active indication.

The user sends an INFOrmation message containing the established Call Reference (CRn) and a Feature Activation information element (FA=x) corresponding to the feature identification number.

If the feature request is accepted, the network will return an INFOrmation message containing the established Call Reference (CRn) and a Feature Indicator corresponding to the feature identification number with the appropriate status (FI=x, "status"). See Figure 15 on page E–56.

An example of a feature using this procedure is Call Park Store.

Scenario: A user attempts to activate a feature, using feature activator #x, during the call progress/active phase.

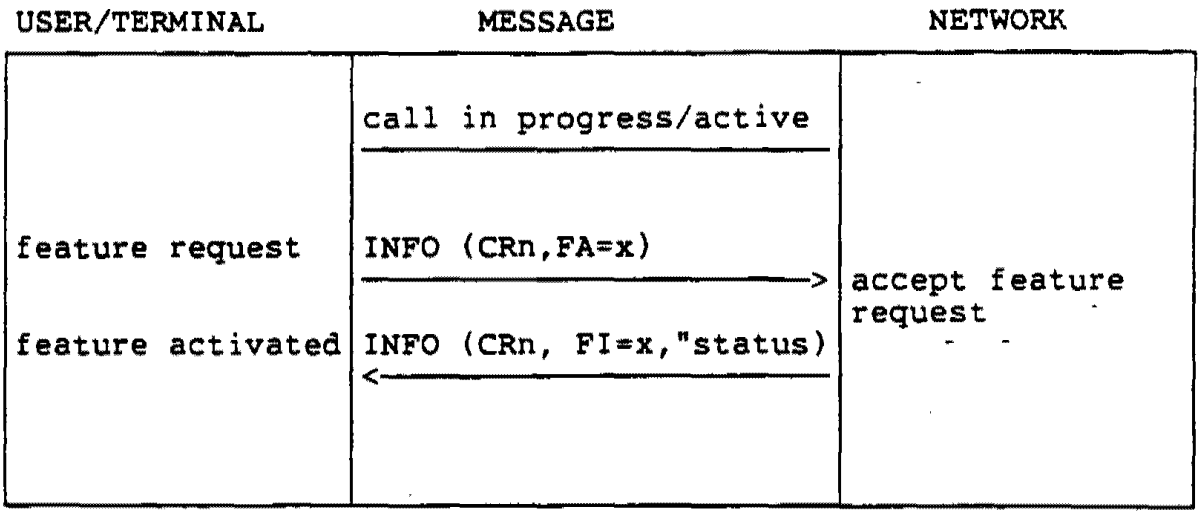


Figure 15. Feature Key Access – Call Progress/Active Phase

5.8 G6 – INTERACTIVE FEATURE KEY ACCESS (CALL PROGRESS/ACTIVE PHASE)

This procedure applies when a user requests feature invocation using feature key access during the progress or active phase of a call, and additional supplemental (address/digits) information is required.

The procedures apply for example, when the terminal has received a busy or call active indication.

The procedure is initiated when a user sends an INFOrmation message to the network containing the established Call Reference (CRn) and either:

1. a Feature Activator (FA=x) specifying the feature identification number;

2. a Feature Activator and partial supplemental (address) information in the Keypad information element; or

3. a Feature Activator and complete information in either the Keypad or the Called Party Number information element.

In cases (1) and (2) above, where no information or partial information is sent along with the Feature Activator, the network will prompt the user for additional information with an INFOrmation message containing the established Call Reference (CRn), the Feature Indicator corresponding to the specific feature identification number with status prompt (FI=x,prompt). The Information Request element will also be included to prompt for address digits (IRQ=prompt,address). See Figure 16 on page E-59, case 1 and 2.

The user shall then send the supplemental information in one or more INFOrmation messages (i.e. En Bloc or Overlap) to the network. In case (2) where partial information was sent with the Feature Activator, the remaining information shall be sent in the Keypad (KP) information element in one or more INFOrmation message(s) including the established Call Reference (CRn). In case (1) where no supplemental information was sent with the Feature activator, the supplemental information shall either be sent enbloc in the Called Party Number (CDN) or Keypad information element, or overlap in the Keypad information element contained in multiple INFOrmation messages.

In each case, the network will complete the sequence by returning an INFOrmation message containing the established Call Reference (CRn) and a Feature Indicator corresponding to the specific feature identification number with the appropriate status (FI=x, "status"). In cases (1) and (2), where supplemental address information has been requested by the network, the Information Request

information element coded to complete (IRQ=complete) will also be included in the INFOrmation message.

Scenario:A user attempts to activate a feature, using feature key access, during the call progress/active phase.

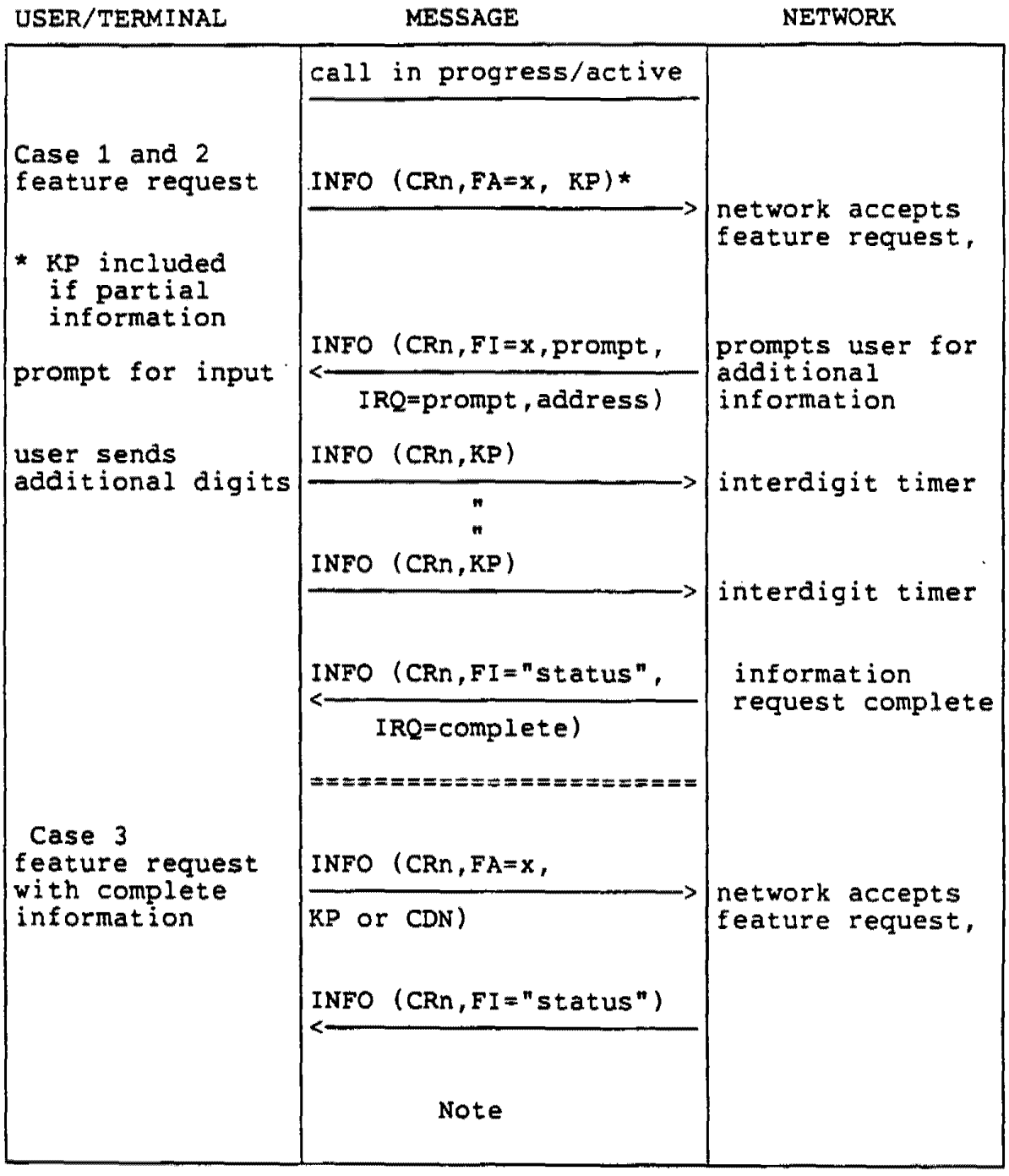


Figure 16. Interactive Feature Key Access – Call Progress/ Active Phase

Note

1. 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.

5.9 G7 – DIAL ACCESS (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 Enbloc or Overlap.

In the Enbloc case, the user shall send all of the access code digits encoded in either the Keypad (KP) or Called Party Number (CDN) information element in the SETUP message. See Figure 17 on page E-62. Depending on the specific feature, the call will either proceed or be cleared using the procedures as specified in section D of this specification.

In the Overlap case, the user shall send the SETUP message to the network containing the established Call Reference (CRn) and either does or does not included the Keypad information element. The network will respond by sending a SETUP ACK message containing the established Call Reference (CRn) and a B-channel assignment (CID=B-ch).

In the case where the Keypad information element was not included in the SETUP message, the Progress Indicator (PI), coded to "inband information or appropriate pattern now available", and the Signal Information element (Signal), coded to "dial tone on", will also be included in the SETUP ACK message. The network will provide inband dial tone at this time. See Figure 18 on page E-63.

Address sending from the terminal shall then begin by sending one or more INFOrmation messages to the network containing the established Call Reference (CRn) and the Keypad (KP) information element containing one or more Feature Access code digits. If the Signal information element (Signal) was included in the SETUP ACK, an INFOrmation message will also be sent to the terminal containing the established Call Reference (CRn) and the Signal information element (Signal) coded to "tones off". The user/terminal shall send 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 will then proceed or be cleared using the procedure as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: A user invokes a feature during call initiation by entering the Feature Access Code using Enbloc sending.

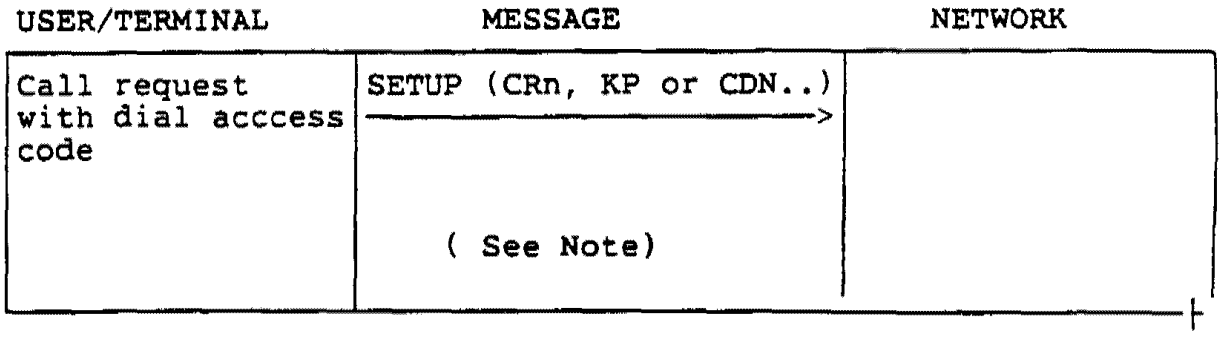


Figure 17. Feature Activation Request – Enbloc Sending of access code

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E–75.

Scenario: A user invokes a feature during call initiation by entering the Feature Access code using Overlap sending.

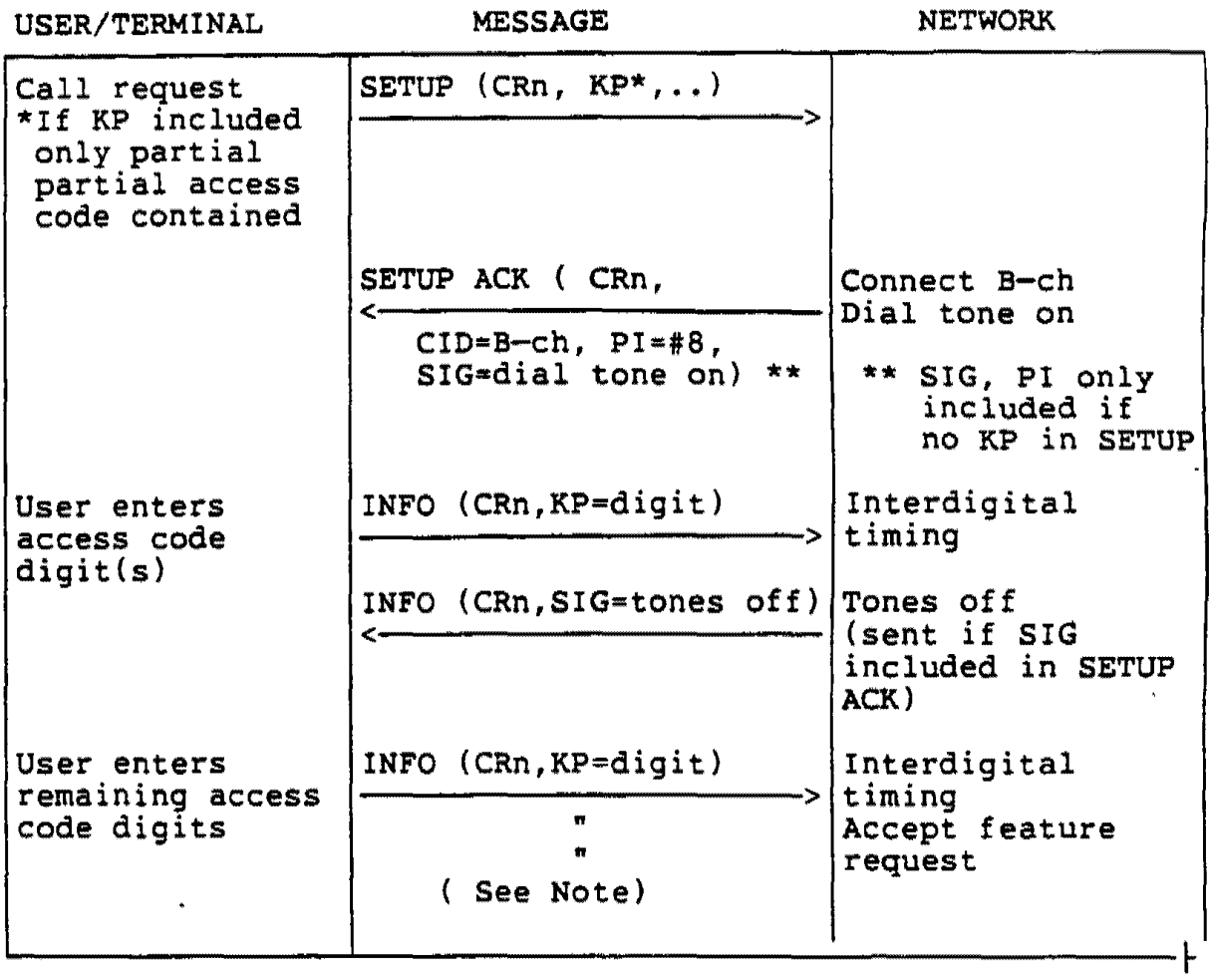


Figure 18. Feature Activation Request – Code Access (Overlap sending)

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

5.10 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 (Enbloc or Overlap) and on whether the feature access code is sent Enbloc or Overlap. The following sequences are supported:

1. Single Enbloc;

2. Enbloc Followed by supplemental information sent enbloc or overlap;

3. Single Overlap;

4. Overlap followed by supplemental information sent enbloc or overlap.

These sequences are designated here as case (1), case (2), case (3), and case (4), respectively.

In all cases, the user shall establish a call using the normal call establishment procedures as described in section D of this interface specification.

If the feature request or digits entered are rejected, the network will clear the call in accordance with the procedures in "Common Call Clearing/Establishment Procedures" on page E-75.

In case (1), the user shall send a SETUP message to the network including the feature access code and the complete supplemental information encoded in the Keypad (KP); or the access code for a routing feature may be coded in the Transit Network Selection (TNS) information element, with supplemental informtion in the Called Party Number information element; or for operator access, the Operator System Access information element with supplemental information in the Called Party Number information element. See Figure 19 on page E-67. Depending on the feature invoked, the call will either proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

In case (2), the user shall send a SETUP message to the network including the complete access code encoded in the Keypad information element. The network will return a SETUP ACKnowledge message containing the established Call Reference (CRn), the B-channel assignment (CID=B-ch), and the Information Request information element to prompt for supplemental address information (IRQ=prompt,address). The network will also include is the Signal Information element (Signal) coded to "recall dial tone" and the

Progress Indicator (PI) coded to "inband information or appropriate pattern now available." The network will provide inband recall dial tone at this time. See Figure 20 on page E-68.

On receipt of the network prompt, the user/terminal shall send supplemental (address/digit) information to the network in one or more INFOrmation messages (i.e. Enbloc or Overlap). After receipt of the first message, the network will return an INFOrmation message containing the established Call Reference (CRn) and the Signal Information element coded to "tones off" (Signal), and simultaneously remove recall dial tone.

If the Enbloc sequence is used all of the supplemental address information shall be contained in the Keypad information element (KP).

If the Overlap sequence is used the terminal shall send multiple INFOrmation messages containing digit information in the Keypad information element.

Depending on the specific feature the call will then proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

For the single overlap case (3), the user shall send a SETUP message 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 will return a SETUP ACKnowledge message containing the established Call Reference (CRn) and the B-channel assignment (CID=B-ch). The user shall then send the remaining supplemental information coded in the Keypad information element contained in one or more INFOrmation messages. See Figure 21 on page E-69. Depending on the specific feature the call will then proceed or be cleared using the procedure as described in "Common Call Clearing/Establishment Procedures" on page E-75.

In case (4), Overlap followed by Overlap/Enbloc, the user shall send a SETUP message to the network which may or may not contain the Keypad information element. If the Keypad information element is included, then part, but not all of the feature access code is included. The network will respond with a SETUP ACKnowledge message containing the established Call Reference (CRn), and a B-channel assignment (CID=B-ch). If the the Keypad information element was not included in the SETUP message, the network will return inband dial tone, and also include the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Signal Information element coded to "dial tone on" (Signal) in the SETUP ACKnowledge message. See Figure 22 on page E-70.

After receipt of the SETUP ACKnowledge message, the user shall send the access code or the remaining digits of the access code in the

Keypad information element contained in one or more INFOrmation messages. If the Signal information element was included in the SETUP ACKnowledge message, then after receipt of the first message the network will remove inband dial tone and return an INFOrmation message containing the established Call Reference (CRn) and the Signal Information element (Signal) coded to "tones off". If the feature request is accepted, the network will pompt the user for additional information with an INFOrmation message containing the established Call Reference (CRn), the Signal Information element coded to "recall dial tone" (Signal), the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Information Request information element to prompt for supplemental address information (IRQ=prompt,address). At this time the network will provide inband recall dial tone. See Figure 22 on page E-70.

On receipt of the network prompt, the user/terminal shall send supplemental (address/digit) information to the network in one or more INFOrmation messages (i.e. Enbloc or Overlap). After receipt of the first message, the network will return an INFOrmation message containing the established Call Reference (CRn), the Signal Information element coded to "tones off" (Signal), and simultaneously remove recall dial tone.

If the Enbloc sequence is used all of the supplemental address information shall be contained in the Keypad information element (KP).

If the Overlap sequence is used the terminal sends multiple INFOrmation messages 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 "Common Call Clearing/Establishment Procedures" on page E-75.

An example of a feature using this generic procedure is Speed Calling User.

Scenario: The user requests feature activation using dial access with complete supplemental information included in the SETUP message.

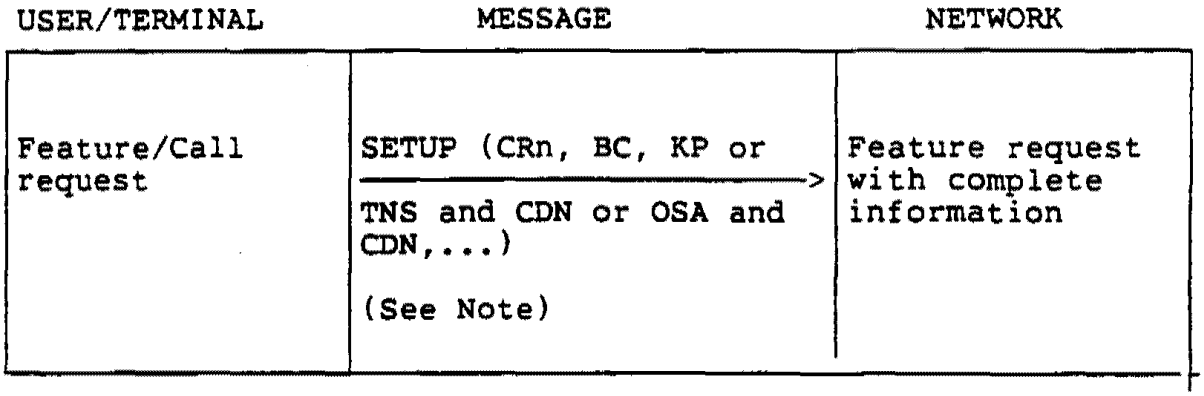


Figure 19. Single Enbloc Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user requests feature activation enbloc using dial access and is prompted by the network for supplemental information.

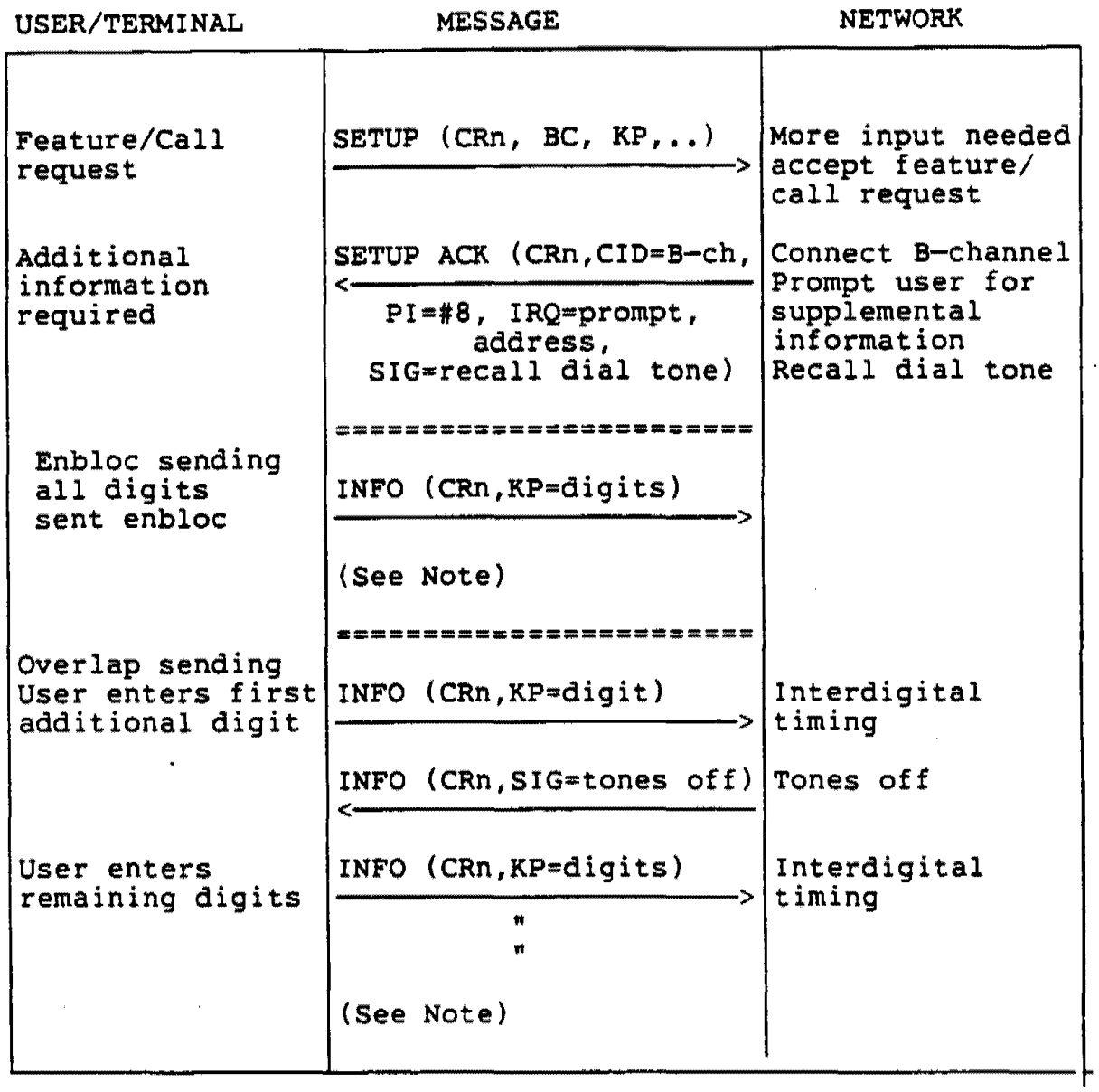


Figure 20. Enbloc followed by Enbloc/Overlap Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user requests feature activation using dial access with partial supplemental information included in the SETUP message.

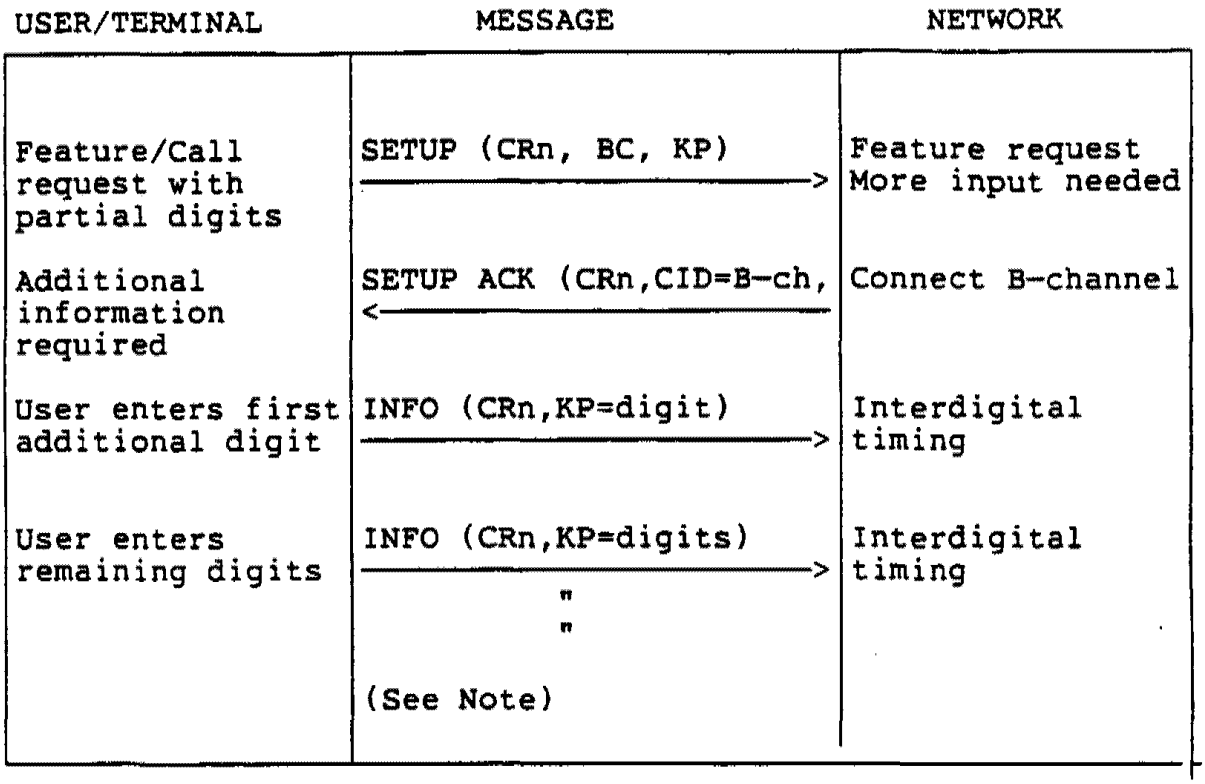


Figure 21. Single Overlap Sequence

Note

1. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

Scenario: The user requests feature activation using overlap dial access and is prompted by the network for supplemental information.

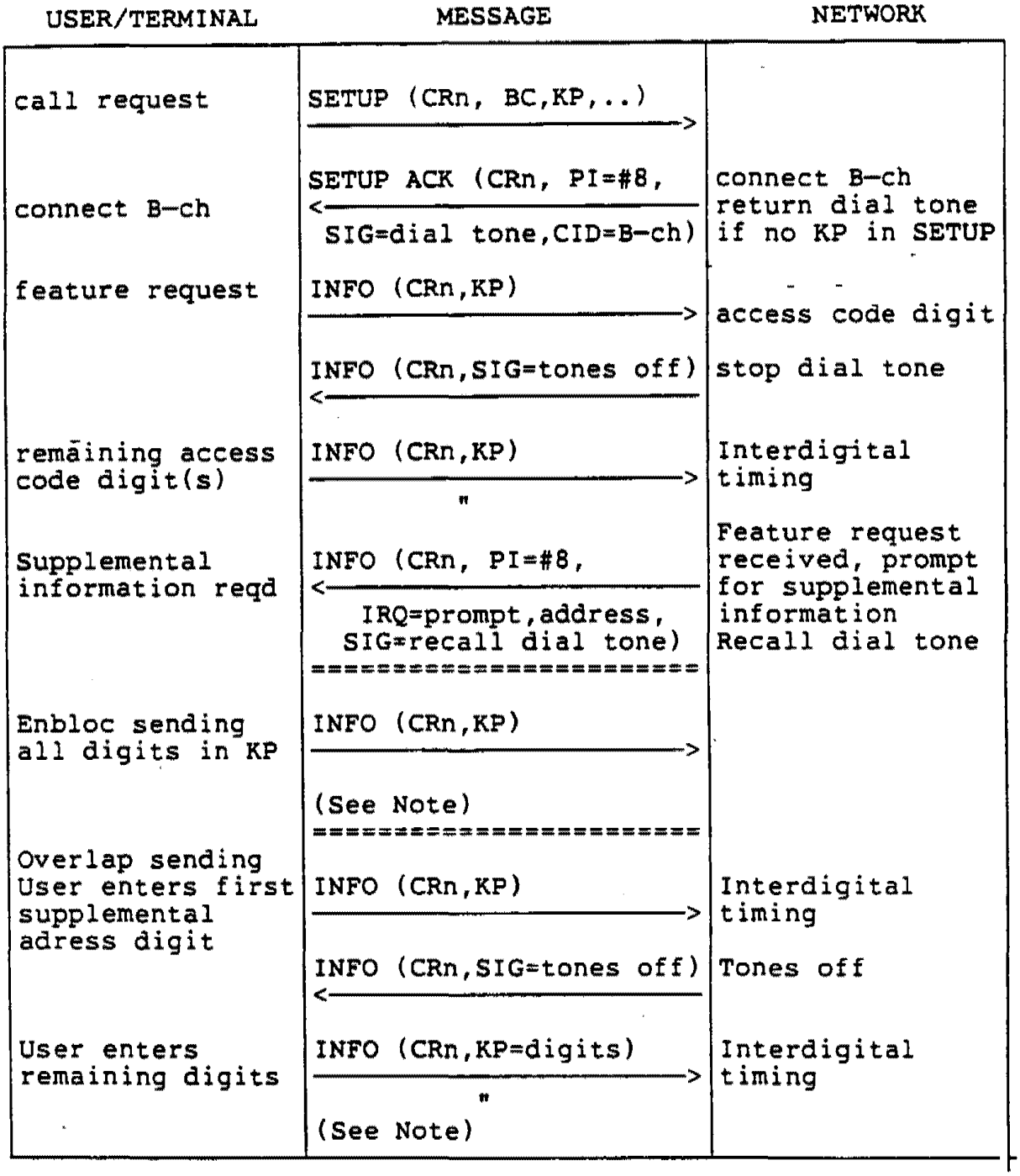


Figure 22. Overlap Followed by Enbloc/Overlap Sequence

Note

1. If KP is included then only part of the access code is included.

2. Depending on the specific feature activated, the call will proceed or be cleared as described in "Common Call Clearing/Establishment Procedures" on page E-75.

5.11 G9 – NETWORK NOTIFICATION OF FEATURE INFORMATION

The network will send INFOrmation message(s) with Feature indication and other information elements to convey feature information not related to any calls which are currently in the initiation, call progress or active phase. The terminal shall not acknowledge the receipt of this message.

A Feature indication information element will also be included in certain call control messages.

An example of a feature using this procedure is Ring Again.

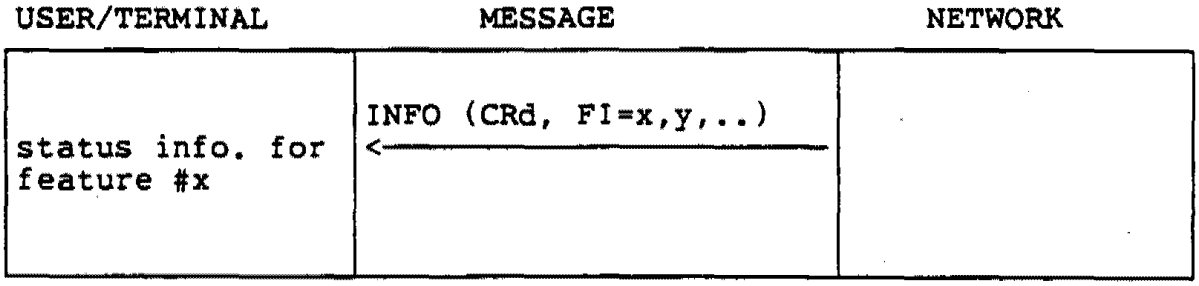


Figure 23. Network Notification of Feature Information

5.12 G10 – NETWORK NOTIFICATION OF EVENTS

The network will send NOTIFY message(s) with Notification indicator, Display Text, and other information elements to convey information on events that have occurred to a call in progress or to an active call. The terminal does not have to acknowledge the receipt of this message.

If multiple events are being reported by the network, one or more NOTIFY messages will be sent containing Notification indicator and optionally including a Display Text information element.

Notification indicator and Display Text information elements will also be included in certain call control messages.

If the user receives a NOTIFY message, even if there is an information element error, the call state shall will not change.

Examples of features using this procedure are Executive Busy Override, and Flexible Calling.

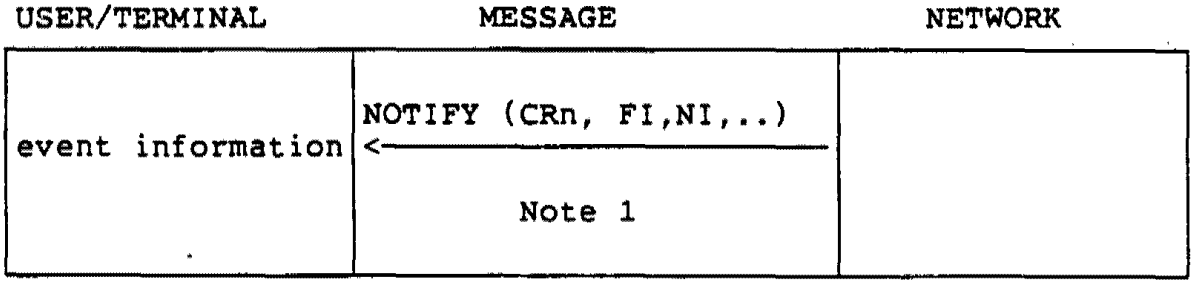


Figure 24. Network Notification of Event

5.13 G11 - CALL RELATED NOTIFICATION OF FEATURE INFORMATION

The network will send INFOrmation message(s) with Feature indication (FI), Display Text(DT), Connected Number (CN) and other information elements to convey information relating to a call in progress or to an active call. The terminal does not have to acknowledge the receipt of this message.

Examples of features using this procedure are Speed Call and Name and Reason.

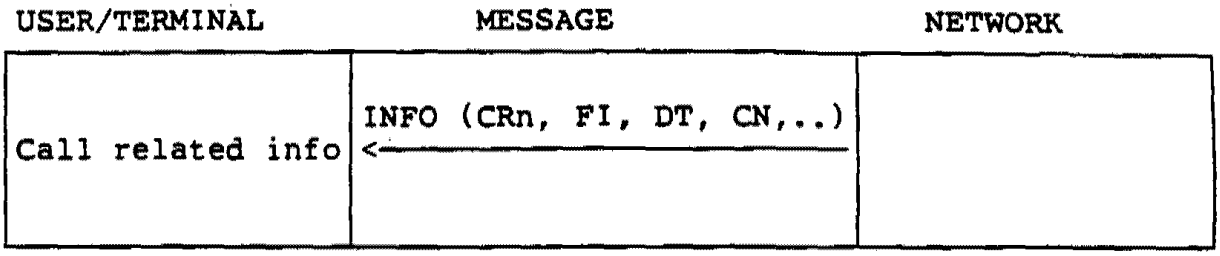


Figure 25. Call Related Notification of Feature Information

5.14 COMMON CALL CLEARING/ESTABLISHMENT PROCEDURES

The following two sections describe the continuation of those sequences described earlier in this section for generic procedures which, depending on the specific feature, result in a call either being established or being cleared.

5.14.1.1 Call Establishment following Feature Request

This procedure applies when the user has initiated a call to invoke a feature using Dial Code Access or Feature Key Management (FKM), and the feature dictates that a call should be established.

The network will return a Call PROCeeding message containing the establish Call Reference (CRn) and, if no SETUP ACKnowledge returned in the previous sequence, the B-channel assignment (CID=B-ch). If Feature Key Management was used to invoke the feature (i.e. a Feature Activator was sent to the network), the Call PROCeeding message will also contain the Feature Indicator information element correspoding to the specific feature with the appropriate status (FI=x, "status"). Also, if in the preceding sequence the network sent the Information Request information element to prompt the terminal for supplemental information, the Call PROCeeding message will contain the Information Request information element indicating digit collection is complete (IRQ=complete). See Figure 26 on page E-77.

Call establishment/connection continues as described in section D of this specification.

5.14.1.2 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 section D of this interface specification. The network will return a CALL PROCeeding message containing the B-channel asignment (CID=B-ch) if the previous sequence (e.g. the enbloc sequence), has not returned a SETUP ACKnowledge message. A PROGress message will be sent by the network containing the established Call Reference (CRn), the Progress Indicator (PI) coded to "inband information or appropriate pattern now available", and the Signal Information element (Signal) coded to "confirmation tone". At this time the network will provide confirmation tone. Following the PROGress message the network will send a DISConnect message containing the established Call Reference (CRn), the Signal Information element (Signal) coded to "tones off", and the Cause Value (CSE=normal) coded to indicate "normal clearing". The Information

Request information element, coded to "complete" (IRQ=complete) to indicate that digit collection has ended, will also be included in the DISConnect message if the Information Request information element was used in the preceeding sequence to request supplemental information.

If this sequence follows a feature key management sequence, the first call clearing message from the network will also include the Feature Indicator (FI=x,"status") with the appropriate status parameter for the particular feature. This clearing message will either be a RELEASE, RELEASE COMPlete or DISConnect message depending on whether the user/terminal sends a DISConnect or RELEASE messages before network release.

Scenario: Upon completion of feature activation sequence a call is established.

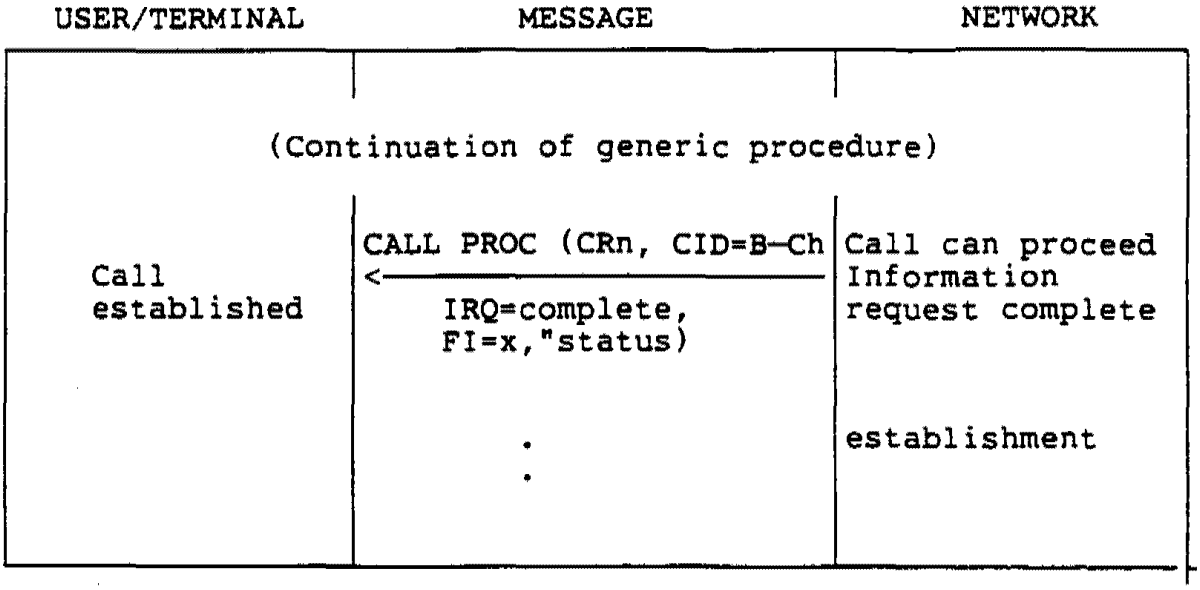


Figure 26. Call Establishment – Following Feature Request

Scenario: Upon completion of feature activation sequence the call is cleared.

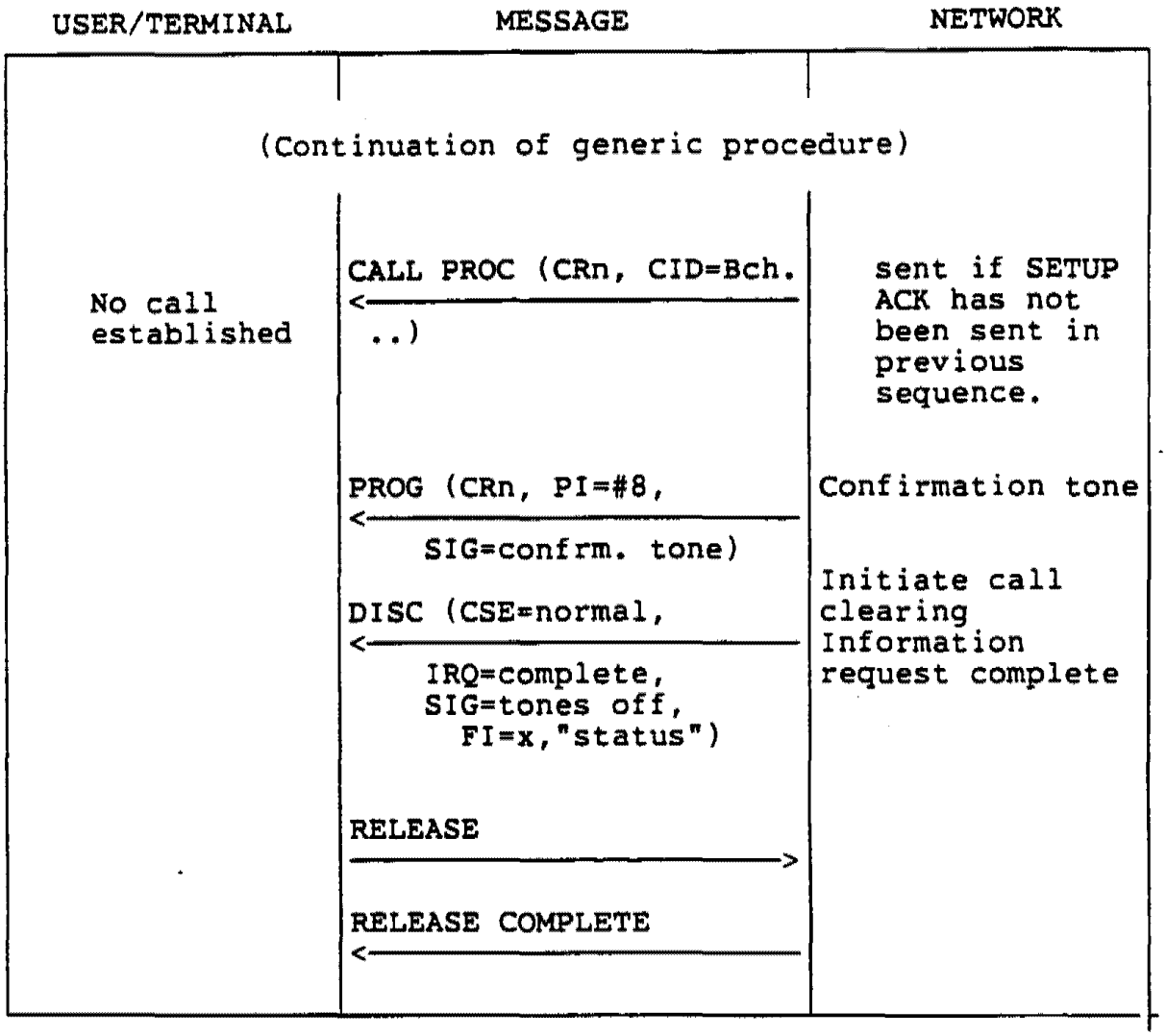


Figure 27. Call Termination – Following Feature Request

6.0 SUPPLEMENTARY SERVICE PROCEDURES

This section describes feature operation and procedures for the invocation of supplementary services.

The procedures are described using overlap sending of call and feature information. En-bloc sending of address information may also be used.

Note: Multiple information elements shown in the figures as being contained in a single INFOrmation message, may in some cases be sent in multiple INFOrmation messages. Messages may also be sent in a different order than they appear in the figures.

Note: The network may send Feature indication information elements to the user at any time to update the terminal status or provide other information.

All existing Meridian Digital Centrex restrictions and interactions apply to the following supplementary services. For information on the current MDC feature restrictions and interactions for the equivalent Business Set features and other features refer to reference 2.

6.1 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

6.2 ADDITIONAL CALL OFFERING (ACO)

6.2.1 Definition

This feature uses the basic functional call offering procedures with no channel indication for Additional Call Offering.

The Additional Call Offering (ACO) service 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 (ie. the number of simultaneous incoming calls that can be offered to the given ISDN directory number) is specified at subscription time, as a Notification Busy Limit.

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.

6.2.2 Procedures

When an incoming call arrives at the terminating exchange, the network will check that the bearer capability 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 call type, the network will offer the call using the normal call offering procedures specified in Section D of this interface specification.

When all user-subscribed B-channels over which the call may be offered are in use and the Notification Busy Limit has not been exceeded, then the network will offer the incoming call using a broadcast SETUP message, specifying a "no channel" condition in the Channel identification information element.

The user may choose to handle the incoming call in one of the following ways:

a. Ignore the incoming call, (i.e. not respond to the incoming SETUP message);

b. Reject the call by sending a RELease COMplete message, as defined in section D of this specification;

c. Accept the additional call by first clearing the existing call, using the clearing procedures defined in section D;

d. Accept the incoming call by first placing the existing call on hold, using the Hold procedures defined in Hold and Retrieve;

In cases c and d, on receipt of the first CONNect message from the user, the network will complete the circuit switched path to the selected B-channel, and subsequently sends a CONNect ACKnowledge message to the user. The CONNect message may contain a Channel identification information element and can either be assigned as "any channel", "preferred B1/B2", or "exclusive B1/B2". If the Channel identification information element is not present the network assumes any channel is acceptable. If the channel is successfully assigned, the CONNect ACKnowledge message will contain the Channel identification information element specifying the assigned B-channel indicated as exclusive. Otherwise the network will respond with a RELease message with the appropriate cause value: cause value #34, "no channel/circuit available"; or cause value# 44, "requested circuit/channel not available". The network will then release any other users which had responded to the incoming call, as specified in section D.

If a user sends a CONNect message prior to a B-channel being made available, the call will be rejected by the network using a RELease message and following the procedures described in Section D of this specification.

If the network is unable to select a free B-channel, the network will reject a CONNect message from the user by sending a RELease message and following the procedures described in section D of this specification.

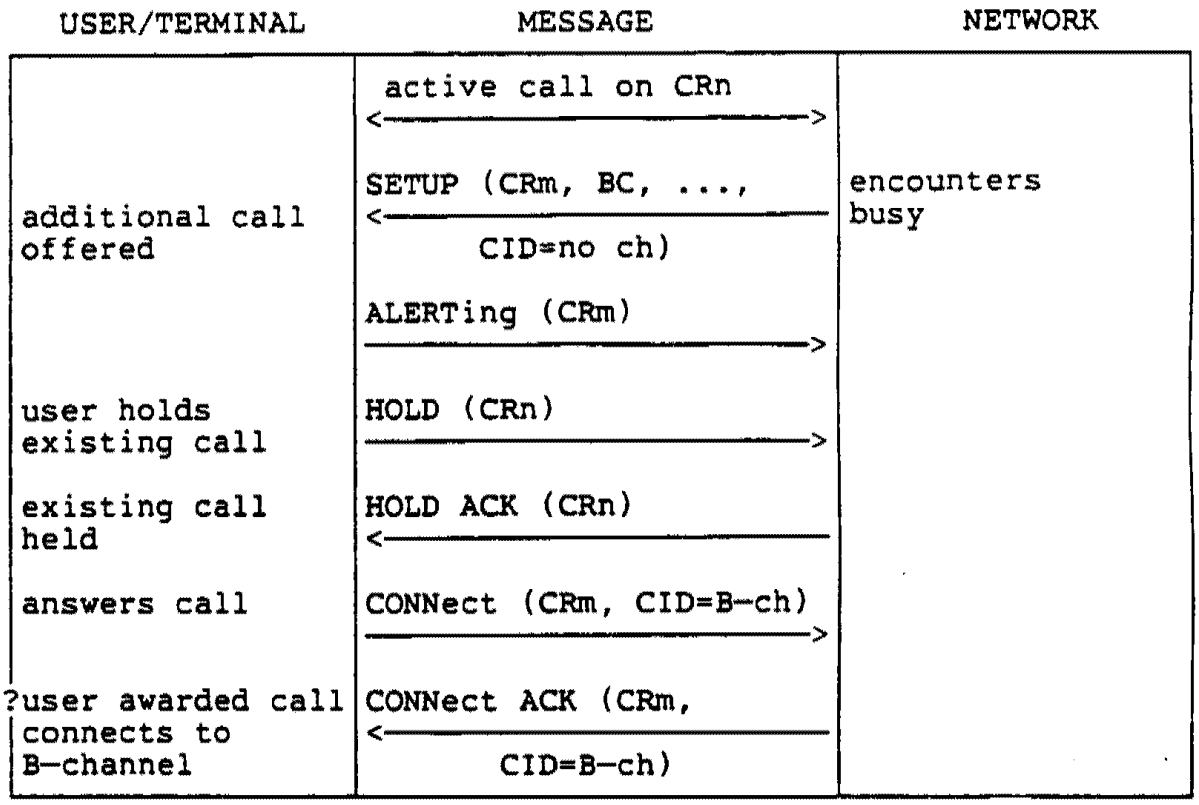


Figure 28. Additional Call Offering with Explicit Hold

6.2.3 Feature Interactions and Limitations

6.2.3.1 Hunting

The Additional Call Offering feature is not compatible with Directory Number Hunting (DNH), Multiline Hunting (MLH), and Distributed Line Hunting.

6.2.3.2 EKTS

Additional Call Offering is not compatible with EKTS whereas a comparable capability is inherent to the normal call offering procedures within EKTS.

6.2.3.3 Series Completion

Additional Call Offering is not compatible with the Series Completion feature.

6.3 AUTOMATIC DIAL (AUD)

6.3.1 Definition

This feature provides a terminal the capability of automatically dialing a frequently called number by selecting the Automatic Dial (AUD) feature activator. The user is permitted to program the automatically dialed number from the terminal.

6.3.2 Programming and Feature Activation

To assign, change or delete the number stored against the AUD feature activator, the terminal cannot have any calls in an active state, although a call can presently be on hold.

Assigning a number – To assign an AUD number the subscriber selects the AUD feature activator, waits for the prompt for parameter entry from the network, enters the stored number and selects the feature activator to signify that the last number has been entered.

Changing a number – To change an automatic dial number, the subscriber overwrites the existing number by following the same practice as assigning a number.

Deleting a number – To delete a number, the subscriber selects the feature activator, enters an octothorpe (#), and selects the AUD feature activator for a second time to complete the action and turn off the AUD feature indicator.

Originating a call – The subscriber originates a call request and then selects the AUD activator.

6.3.3 Procedures

This feature is invoked by feature key access during call initiation, using any one of the sequences specified in generic procedure G3. Upon receiving the selected AUD feature activator, the network will proceed to establish the call based on the stored digits and return the Called Party Number information element containing the stored digits to the user, in the CALL PROCeeding message. Figure 30 on page E-88 shows the application of one the sequences, described by generic procedure G3, to this feature.

To initiate programming of the AUD number, the user invokes any one of the sequences specified in generic procedure G2. Figure 29 on page E-87 shows one such sequence. When programming is complete, the AUD indicator will have status "idle".

Although not mandatory, an octothorpe (#) may be entered as the last keypad entry to serve as a 'last digit entry flag'. It will not be stored.

The network will not validate the programmed AUD numbers.

The programmed number can be:

a) any DDD (direct distance dialing)
b) any DDO (direct dialing overseas)
c) any local or operator assisted numbers
d) an account code
e) an authorization code
f) or a feature access code

To delete the programmed number, the user again invokes generic procedure G2 and enters a single octothorpe character.

The programming sequence may be abandoned at any time by selecting the Release activator.

6.3.4 Feature Interactions and Limitations

The maximum number of digits which can be stored as a valid AUD destination address is 24.

The following conditions relate to actions taken while the user is programming a new AUD number:

- If two INFOrmation messages with Feature activation information elements corresponding to the Automatic Dial feature are received by the network consecutively they will not affect the current number stored. Upon receiving the second INFOrmation message the network returns an INFOrmation message with a Feature indication information element specifying the AUD feature indicator with status "idle".

- The selection of any feature activator will not invalidate the programming procedure. This activator selection is not processed. Only the second Automatic Dial activator selection shall end the programming sequence. Call initiation while programming will invalidate the procedure, and the associated AUD feature indicator will have status "idle".

Scenario: Terminal is idle. The user programs a frequently dialed number by using the Automatic Dial activator #x.

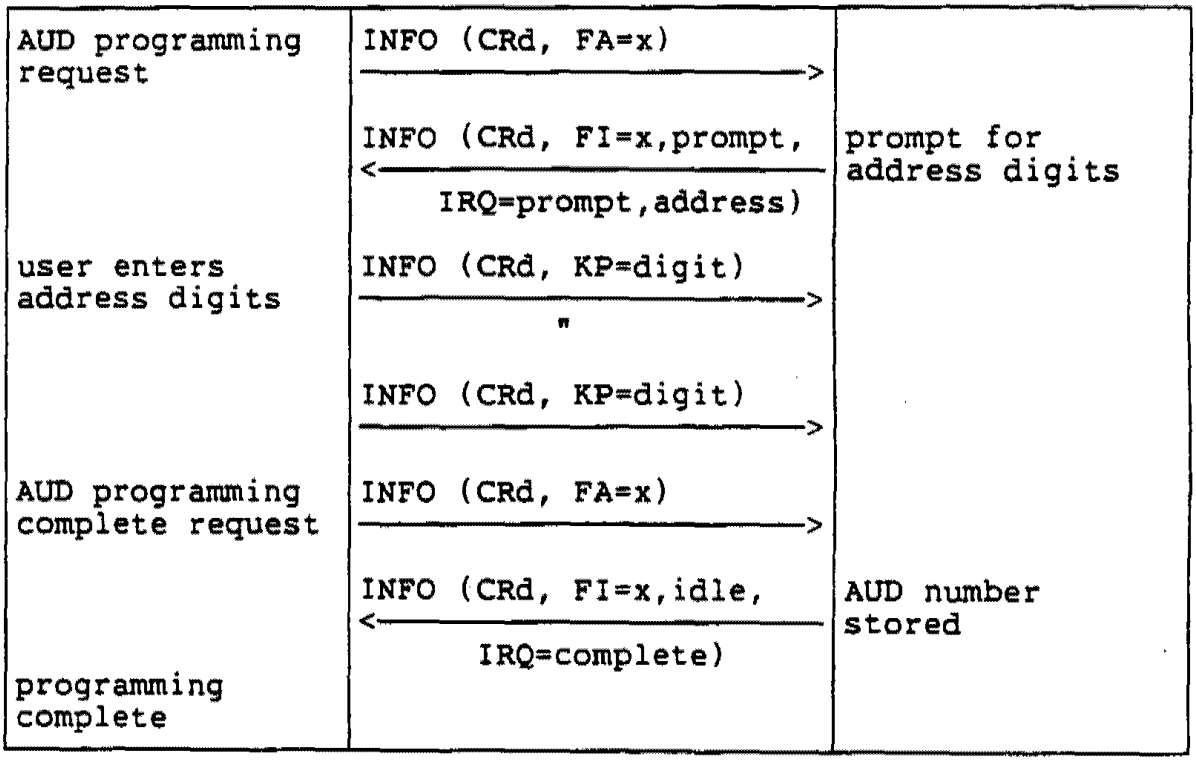


Figure 29. Automatic Dial Programming

Scenario: Terminal is idle. The user has previously programmed an automatic dial number. The user now uses the Automatic Dial activator #x to make an outgoing call.

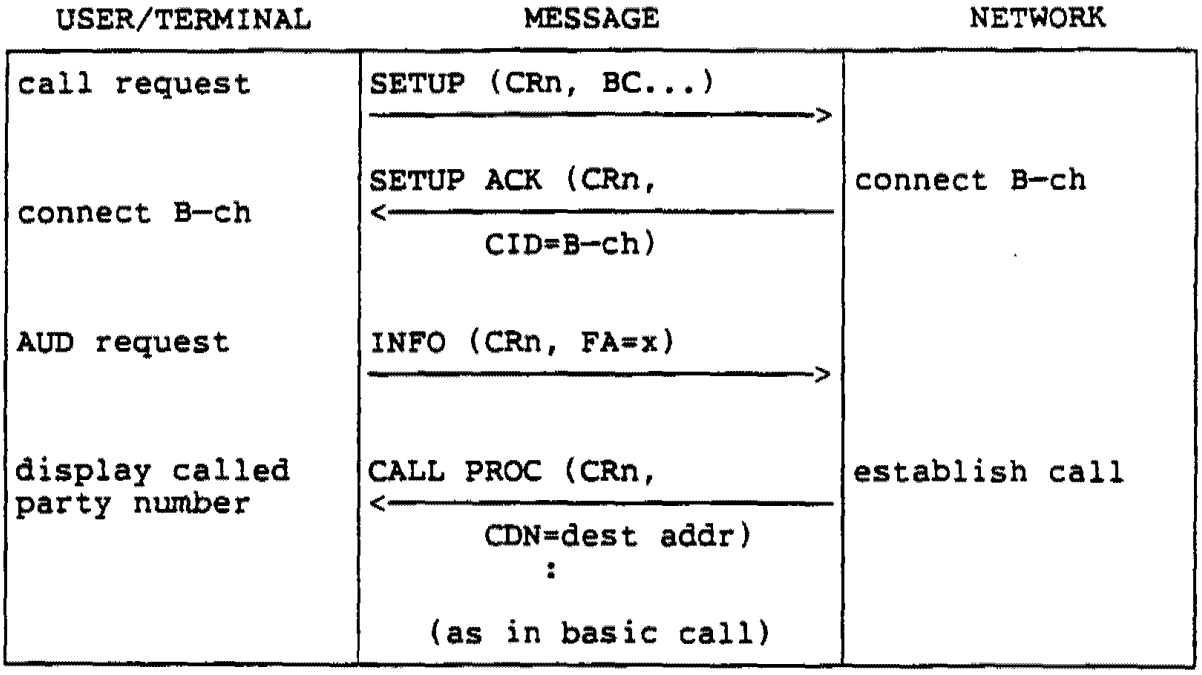


Figure 30. Automatic Dial Usage

6.4 AUTOMATIC LINE (AUL)

6.4.1 Definition

The Automatic Line (AUL) feature provides the user the capability of accessing a predetermined destination by selecting the call appearance preassigned to this destination.

6.4.2 Procedures

To activate the feature, the terminal initiates a call request by sending a SETUP message to the network which may include a Calling party number information element containing an AUL directory number. If the primary DN is an AUL DN, the Calling party number information element need not be included.

Upon receiving the SETUP message, the network commences to establish the call based on the preassigned destination address and returns a CALL PROCeeding message with a Channel identification information element specifying the B-channel to the user.

The call will then proceed in accordance with the basic call establishment procedures described in section D.

6.4.3 Feature Interactions and Limitations

The destination of the AUL call is determined by digits entered during subscription time. The maximum number of digits stored against an AUL DN is 15 digits.

A terminal can be equipped with more than one AUL DN.

Features such as Speed Calling, Automatic Dial, Last Number Redial and Last Number Redial Associated with Set can not be used with Automatic Line.

6.4.3.1 Call Pickup

A call terminating on an AUL DN may be picked up but a call may not be picked up on an AUL DN.

6.4.3.2 Call Park

A call may be parked from an AUL DN, but it may not be retrieved from an AUL DN.

6.4.3.3 Call Forward Validation

Routing validation is supported but terminating validation is not supported.

6.4.3.4 Ring Again/Call Back Queuing

These features may be activated from an AUL DN, but cannot be re-called from an AUL DN.

Scenario: Terminal initiates a AUL call by including an AUL directory number in the SETUP message.

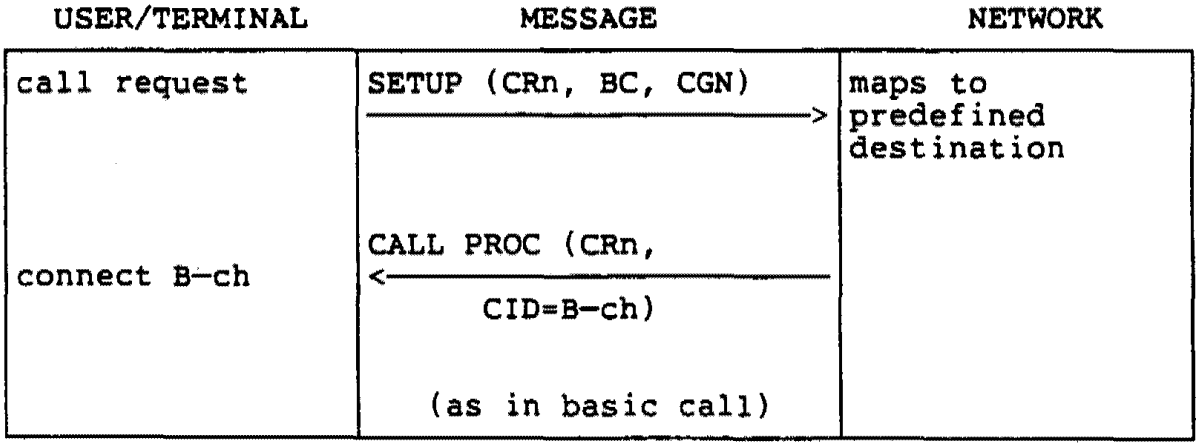


Figure 31. Automatic Line Call Origination

6.5 CALL BACK QUEUING (CBQ)

6.5.1 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 Call Back Queuing 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 Call Back Queuing 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 CBQ.

6.5.2 Feature Activation/Deactivation

Same operation as Ring Again, see "Feature Activation/Deactivation" on page E-124.

6.5.3 Call Offer

Same operation as Ring Again, see "Call Offer Notification" on page E-125.

6.5.4 Recall Answer

Same operation as Ring Again, see "Recall Answer" on page E-126.

6.5.5 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.

6.6 CALL FORWARD ALL CALLS

6.6.1 Definition

The terminal that is assigned Call Forward is referred to as the base terminal. The terminal to which the calls are to be forwarded is referred to as the remote terminal.

Call Forward All Calls is a subset feature, that is, it is available to any combination of the DNs on the set. Call Forwarding All Calls allows a base terminal to have incoming calls associated with a DN forwarded to a predetermined address regardless of the status of the base terminal.

The remote terminal DN is programmed by the user.

One of the following options may be assigned to a terminal.

CFI = Call Forward Intragroup
Allows a base terminal to forward calls to a user-defined remote terminal within the customer group.

CFU = Call Forward Universal
Allow a base terminal to forward calls to a user-defined remote terminal inside or outside the customer group.

6.6.2 Feature Activation and Programming

CFI and CFU are user programmable types of Call Forwarding. This feature may be activated by using feature key or dial access methods. The feature key method may be used by the subscriber either during call establishment or outside the context of a call.

6.6.2.1 Outside The Context Of A Call

The subscriber will use generic feature access procedure G2, to perform call forward programming outside the context of a call. There are several possible sequences within generic feature access procedure G2. One example of how this procedure may be applied when the user is activating call forwarding is illustrated in Figure 32 on page E-97.

The subscriber selects the Call Forward feature identifier as the feature activator. An INFOrmation message with the Feature activation information element corresponding to the Call Forwarding feature activator is sent to the network. The network will respond with an INFOrmation message containing the Feature indication information element specifying the Call Forwarding feature indicator with status "prompt", and the Information request information element specifying "prompt" for address information.

The user then sends the forwarding number using the Keypad information element contained in one or more INFOrmation messages. When the complete address has been sent, the user shall again send an INFOrmation message with the Feature activation information element corresponding to the Call Forwarding feature activator, to signal the end of parameter entry. The network will respond with an INFOrmation message containing the Feature indication information element specifying the Call Forwarding feature indicator with status "active".

The programming sequence can be abandoned at any time by selecting the Release activator. The terminal shall send an INFOrmation message, containing a Feature activation information element, with the Release feature activator

If no address is entered during programming, the subscriber simply reactivates 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 the asterisk and any following digits will not be stored. If the octothorpe is entered, any further digits are ignored by the network. If the octothorpe is entered as the only addressed digit, then this cancels the previously stored number.

6.6.2.2 During Call Establishment

The user may activate the CFU and CFI features during call establishment by using either the feature key access method or the dial access method. Generic feature access procedure G4 is applicable when activating call forwarding via feature key access during call establishment. Generic feature access procedure G8 may be applied when the subscriber is activating call forwarding during call establishment via the dial access method. When generic feature access procedure G4 or G8 is used to activate CFU or CFI, the network does not attempt to establish a call to the remote DN unless the subscriber's customer group has the CFWVAL terminating option.

6.6.3 Deactivation

6.6.3.1 Outside The Context of A Call

CFU and CFI may be deactivated, outside the context of a call, by using the generic feature access procedure G1. This procedure may be invoked by the subscriber at any time. Call forwarding deactivation via generic feature access procedure G1 is illustrated in Figure 33 on page E-98. The INFOrmation message sent from the user to the network contains the call forwarding all calls feature activator. The network will return an INFOrmation message with the feature indication information element specifying the call forwarding all calls feature indicator with status "idle". When the feature is deactivated, the digits that were used to forward calls are left intact so they will not have to be re-entered when the feature is re-activated.

6.6.3.2 During Call Establishment

CFU and CFI may be deactivated during call establishment by either the feature key method or the dial access method. Specifically generic feature access procedures G3 or G7 may be used to deactivate call forwarding all calls.

6.6.4 Forwarding A Call

If a call is forwarded, the originating terminal receives the redirecting and redirection addresses if the base terminal is within the same ISDN, as shown in Figure 34 on page E-99. Otherwise, the originating terminal is not aware that its call is being forwarded.

The remote terminal receives the origination and redirecting addresses if the remote terminal and the originating terminal are within the same ISDN, as shown in Figure 35 on page E-102.

When call forwarding occurs a reminder notification is sent to the served user. The reminder notification consists of a NOTIFY message with a null call reference, the notification indicator set to "call is forwarded", and the signal information element with value of alerting on, pattern 4, reminder ring.

A terminal with an activated Call Forward feature can originate calls.

6.6.5 Feature Interactions and Limitations

- During call forwarding of any kind, the bearer capability of the originator of the call will be used to determine whether or not it is possible to terminate on a terminal. If it is possible to terminate on a terminal, the call will be forwarded, otherwise the call is routed to treatment.

- Programming can only take place when there are no call appearances active and when call forwarding all calls is inactive. If call forwarding all calls is active, it must be deactivated before programming can take place.

- CFU and CFI may be assigned to a terminal in a hunt group, i.e. call forwarding takes precedence over hunting.

- Speed Calling may be used to enter the remote terminal address when activating Call Forwarding.

- Call forwarding cannot be assigned to Automatic Lines, lines with denied termination or denied origination, or lines that are suspended.

- A terminal user activating CFU or CFI may enter a forwarding address which the terminal is not permitted to dial (this can be prevented if Call Forward validation is assigned to the customer group). However, calls to the terminal are not forwarded to that number. These calls receive the same treatment as the terminal user would receive upon attempting to dial the number as a basic call.

- A call forwarded to a remote terminal with an activated call forwarding feature is forwarded to the next remote terminal. Up to 5 consecutive call forwards can be handled. When the call progresses to a sixth remote terminal with an activated Call Forward 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 the multi call forwarding option is assigned to the customer group.

Scenario: Terminal is idle. Call Forward All Calls indicator (#x) shows status "idle". The user programs Call Forward All Calls by using the Call Forward activator #x.

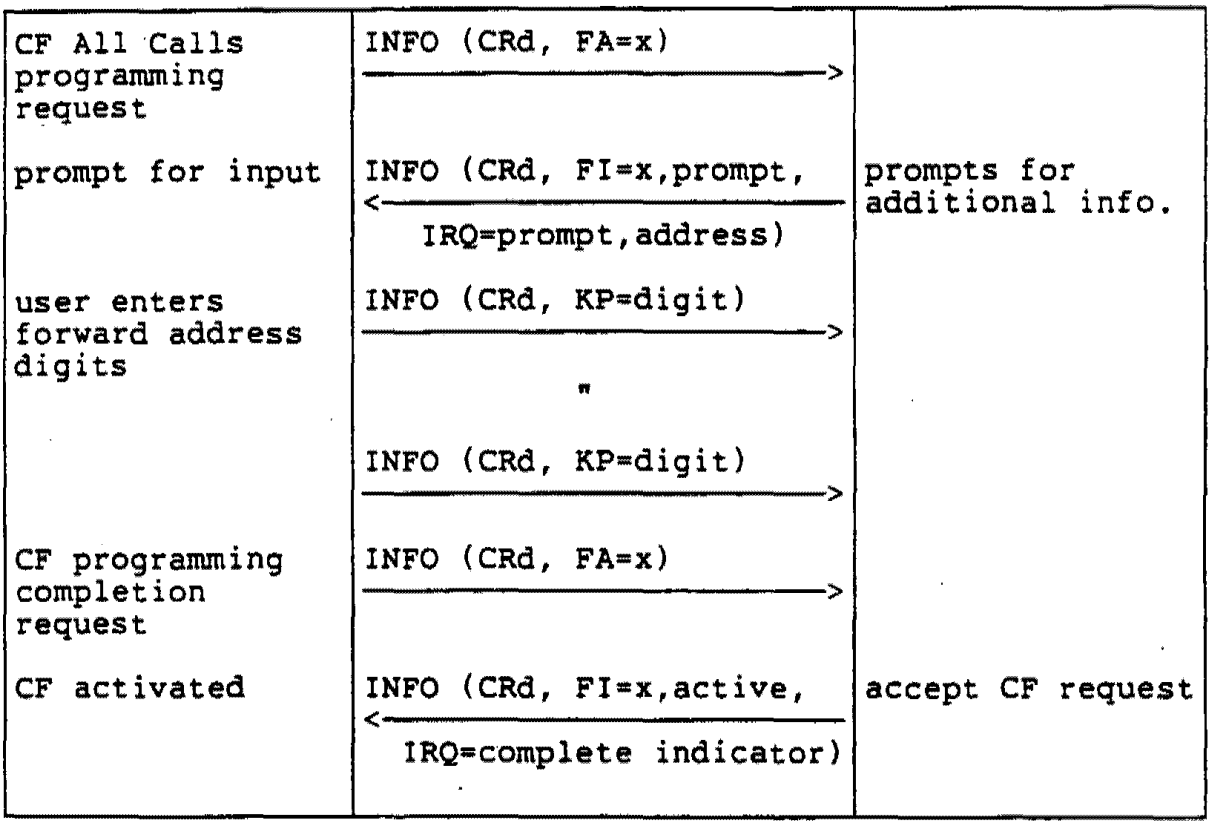


Figure 32. Call Forward All Calls – Programming by Key Access

Scenario: Call Forward All Calls is in effect. Call Forward indicator #x shows status "active". The user cancels call Forward by the Call Forward activator #x.

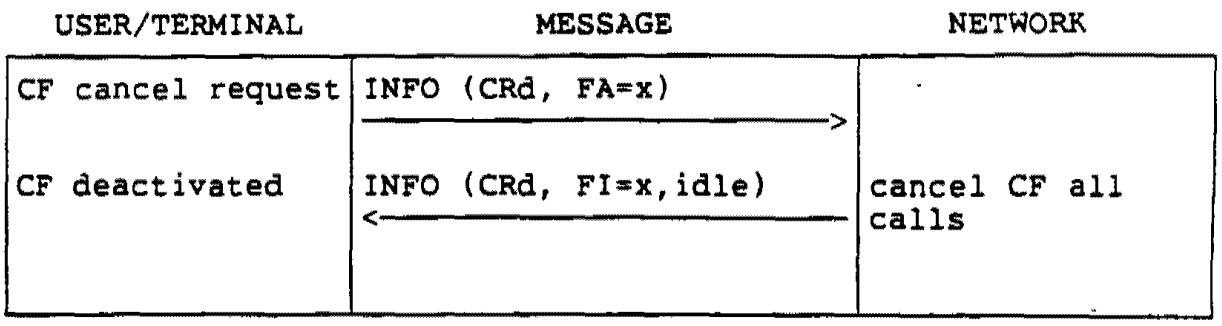


Figure 33. Cancellation of Call Forward All Calls — Key Access

Scenario: An idle terminal initiates an outgoing call. The destination (the base terminal) has activated Call Forward All Calls. The calling terminal and the base terminal are located at the same network node.

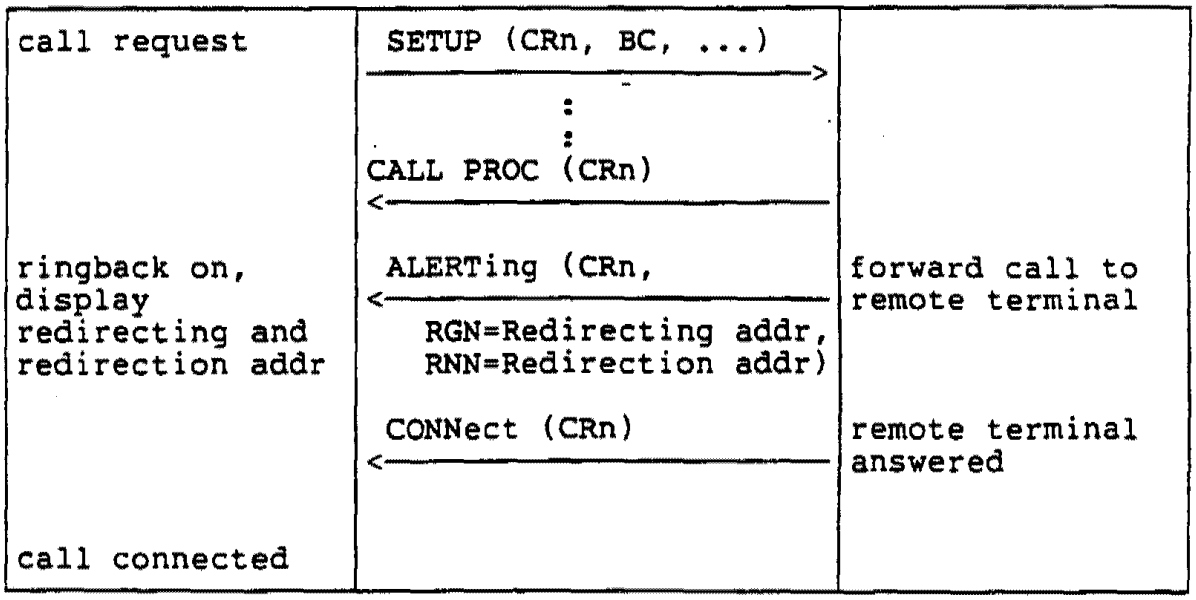


Figure 34. Call Forward All Calls – Originating End

6.7 CALL FORWARD BUSY (CFB) AND CALL FORWARD DON'T ANSWER (CFD)

6.7.1 Definitions

6.7.1.1 Call Forward Busy

This feature allows calls to a terminal to be forwarded to a predetermined terminal within the customer group when the base terminal is busy. Busy is defined as call reference busy (see section 3.1 for busy definitions) for this feature.

An option is available on this feature to prevent the forwarding of incoming intragroup calls. Where a high proportion of incoming calls are of an intragroup origin, this option prevents the remote terminal from being flooded with calls.

6.7.1.2 Call Forward Don't Answer

This feature 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 the attendant station. An option is available with this feature to prevent the forwarding of intragroup calls to a remote terminal.

6.7.2 Feature Activation

6.7.2.1 Activated Upon Assignment

CFB and CFD may be activated at subscription time. When they are assigned to a terminal, the remote terminal's destination address must also be assigned.

6.7.2.2 During Call Establishment

The dial access method may be used to activate CFB and CFD during call establishment. Generic feature access procedure G8 shall be used when CFB and CFD are activated via the dial access method.

6.7.3 Deactivation

6.7.3.1 Deactivation Upon Assignment

CFB and CFD may be deactivated by service order.

6.7.3.2 During Call Establishment

The dial access method may be used to deactivate CFB and CFD. Generic feature access procedure G7 shall be used when CFB and CFD are being deactivated by the dial access method.

6.7.4 Forwarding a Call

Figure 35 on page E-102 illustrates the delivery of the redirection address to the called user interface during the forwarding of a call. Figure 36 on page E-103 illustrates the calling user interface during CFD feature operation. In this case the calling user receives the redirecting address and the redirection address.

6.7.5 Feature Interactions and Limitations

- During call forwarding of any kind, the bearer capability of the originator of the call will be used to determine whether or not it is possible to terminate on a terminal. If it is possible to terminate on a terminal, the call will be forwarded, otherwise the call is routed to treatment.
- If a line is assigned both CFB and CFD, the remote terminal can be different for each feature.
- When the base terminal activates the Call Forward All Call 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 is not permitted to receive the type of call being forwarded, the base terminal will be alerted until answered or abandoned.

- Call Forward Don't Answer does not apply to calls that are rejected by the user.

Scenario: A terminal receives an incoming call which has been redirected. This terminal, together with the base terminal and the originating terminal are located at the same network node.

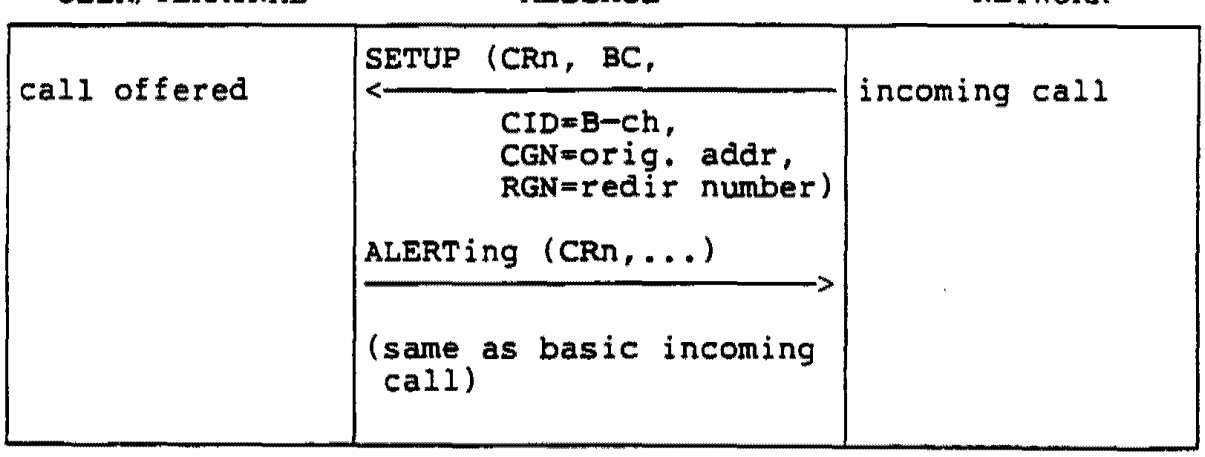


Figure 35. Call Forward All Calls, Busy or Don't Answer — Terminating End

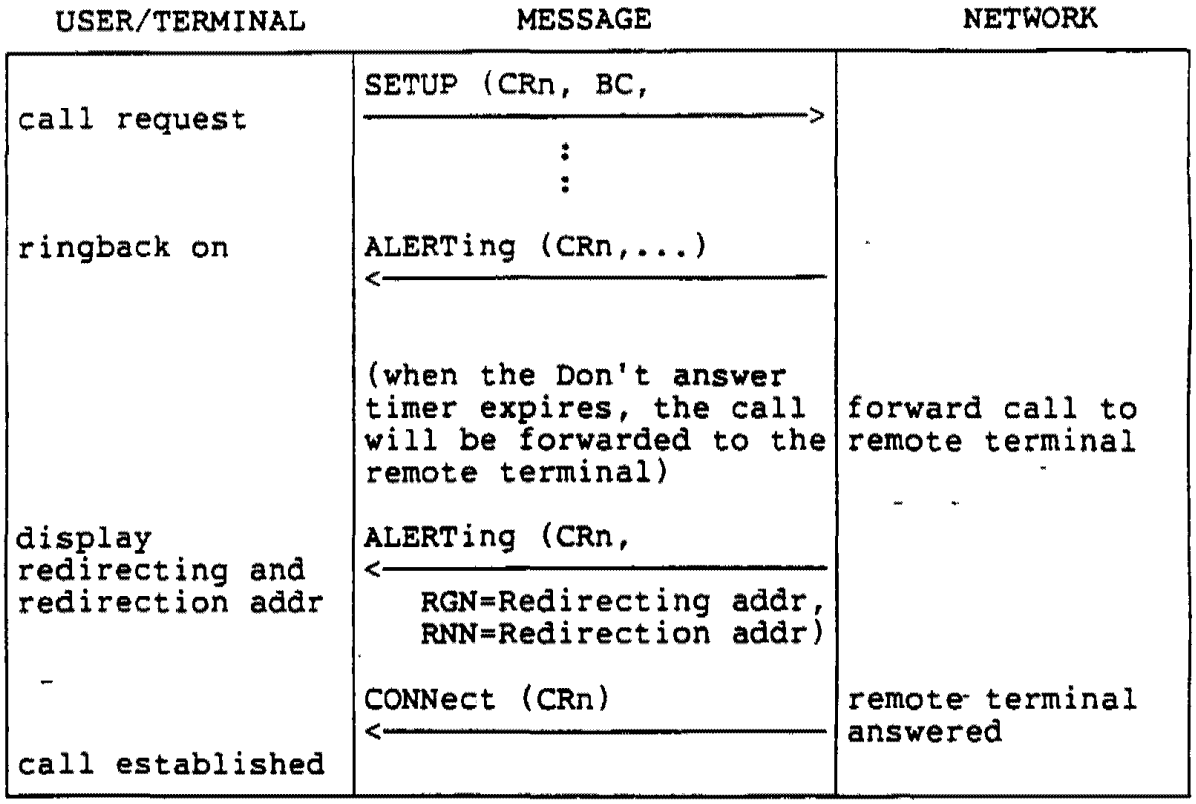


Figure 36. Call Forward All Calls, Don't Answer - Originating End

6.8 CALL FORWARD VALIDATION (CFWVAL)

6.8.1 Definition

This feature provides the capability for call forwarding universal (CFU) or call forwarding intragroup (CFI) to automatically validate the forwarded to DN when a station activates CFU or CFI. The following 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 feature activation.

6.8.2 Procedures

With call forwarding validation, the call forward confirmation indicates that the forwarding DN was successfully stored and validated according to the validation option used (routing or terminating).

6.8.2.1 Routing Option

If the routing option is assigned, call forwarding feature activation may take place via generic feature access procedure G2, G4, or G8. If the routing option is assigned, then the user at the base station will not attempt to terminate the forwarding DN. If the received remote dn is not routable, the network will return the call forwarding feature indication of "idle" to the calling user. The calling user will also receive re-order tone in this case. If the received remote DN passes screening by the network, the calling user will receive confirmation tone and call forwarding feature indication with status "active".

6.8.2.2 Terminating Option

If the terminating option is assigned, call forwarding feature activation may take place via generic feature access procedure G4 or G8. If the terminating option is active, the network will attempt to establish a call to the remote DN received from the calling user. If the network determines that the remote DN is valid and an

answer is received from the remote address, the call forwarding feature will be activated. In this case the network will send the call forwarding feature identifier, to the base user in the feature indication information element with the status field coded to "active". If a "busy" indication is received, when attempting the call to the remote DN, the call forwarding feature will not be activated. In this case the calling user will receive the call forwarding feature identifier with the status field coded to "idle", and confirmation indication that call forwarding has been activated.

The base station user has the option of forcing call forwarding activation even though the remote party is busy. To do this the base user must issue a 2nd call forwarding activation attempt to the same remote DN. If this is done within two minutes of the original request and the same DN is dialed, call forwarding activation will take place regardless of the busy/idle condition of the remote station. In this case the calling user will receive confirmation tone and the call forwarding feature identifier with the status field coded to "active".

6.9 CALL PARK (PRK)

6.9.1 Definition

The Call Park feature provides terminals with the capability of holding a call against a directory number (that of the terminal call appearance issuing the feature). The call may later be retrieved by the same or another terminal.

The feature may be divided into two components: the Call Park Store feature, which enables a subscriber to park calls against his own directory number, and the Call Park Retrieve feature, which enables a subscriber to retrieve parked calls from any call appearance.

6.9.2 Feature Activation

6.9.2.1 Parking Calls

To park a call that is in the talking state, the user activates the Call Park feature by selecting the call park activator. The call park indicator comes on and the user receives confirmation tone indicating that the call is parked. If for any reason the call cannot be parked, the user receives five seconds of reorder tone, after which the original call is re-established.

6.9.2.2 Retrieving Parked Calls

To retrieve a parked call, the user selects the call park activator. The Primary DN is selected if free. The user then hears a recall dial tone which indicates to the user to dial the DN against which the call is parked.

6.9.3 Procedures

6.9.3.1 Call Park Store

Activating Call Park

It is assumed that a call has been established between parties A and B, and A wishes to park the call. In order to park the call, party A uses generic procedure G5 as illustrated in Figure 37 on page E-109. An INFOrmation message with Feature activation information element specifying the Call Park feature activator is sent to the network from A. If the request is accepted, the network will send an INFOrmation message with Feature indication information element specifying the call park feature indicator with status "active".

If the call cannot be parked, the call will be reconnected.

Parking the Call

The call is actually parked when the call is cleared by the network and the requesting user's call park feature indicator shows status "idle". The Call Park timer is then started, which will recall the requesting user if it times out. The call is now considered to be in the Call Park held state. Call Park provides additional capabilities such as listening to music while parked.

Parked Party Exit

If the parked party exits while in the Call Park held state, the feature is cancelled. Furthermore, the recall timer, started when the call was parked, will be stopped.

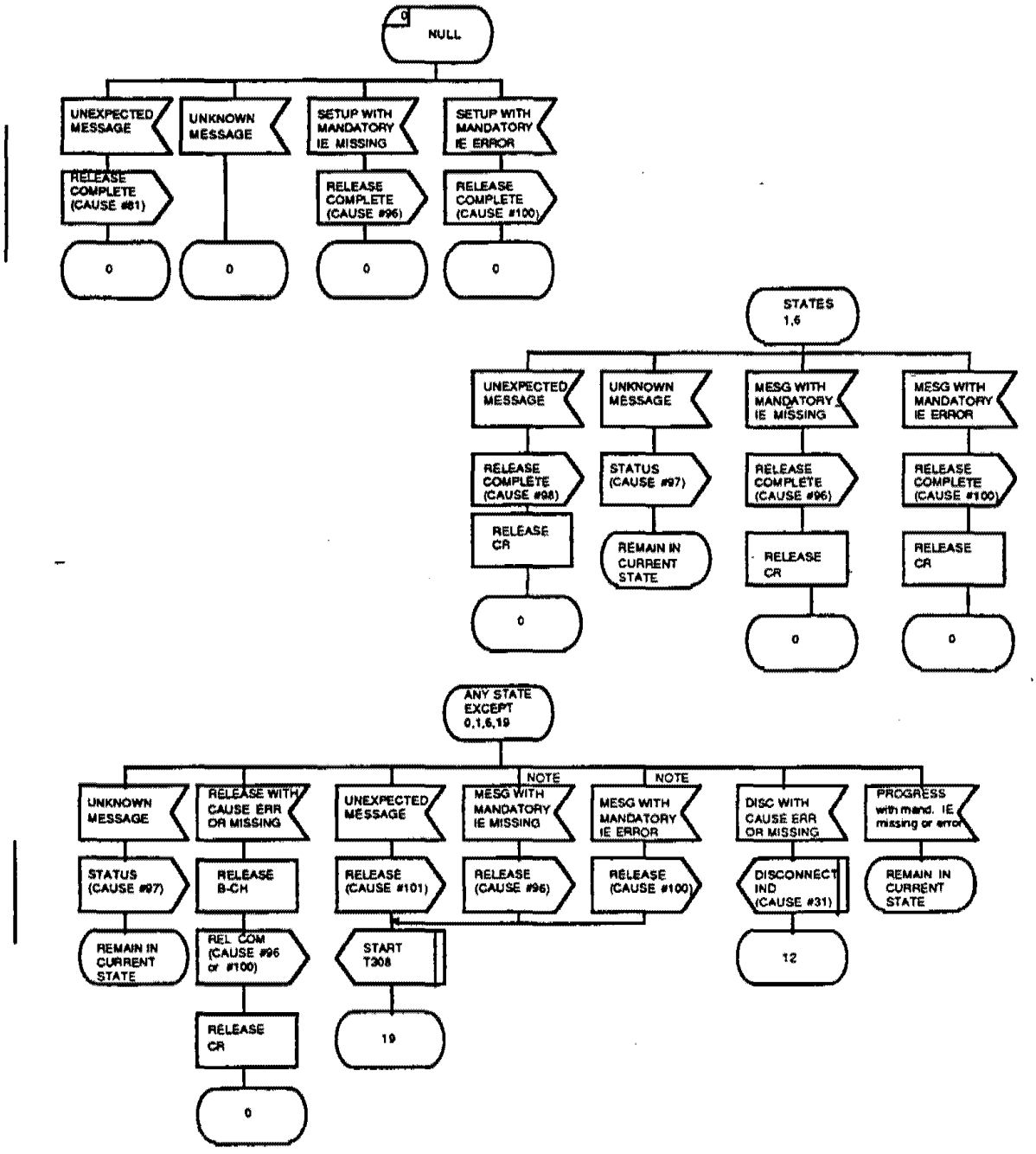
6.9.3.2 Call Park Retrieve

A user may retrieve a parked call, from another terminal, using any one of the sequences specified in generic procedure G4 (feature key access), or generic procedure G8 (dial code access).

One of the feature key access sequences is shown in Figure 38 on page E-110. On receipt of the feature activator, the network prompts the user to enter the address from which the call has been parked. The user enters the address digits in the Keypad information element contained in multiple INFOrmation messages. When all address digits have been received, the network returns a CALL PROCeeding message followed by a CONNect message to connect the user to the parked call.

For a complete description of this and the other sequences applicable to call park retrieval, refer to generic procedure G4, and generic procedure G8.

Note that a Feature indication information element is not sent by the network during call park retrieval.



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6.9.3.3 Call Park Re-Call

The Call Park Timer

Once a call is parked and has entered the "call park held" state, the call park timer is started. If the call park timer expires, the parking party is recalled. The timer is stopped when the call is unparked, which can occur when the parked party exits, the call is retrieved, or the recall occurs.

Recall To The Parking Terminal

When the call park timer expires, it will cause the parking party to be recalled. The recall will always be presented to the DN against which the active call was originally parked. The recall procedure is the same as a basic incoming call. At this point, the call enters the "Call Park Recall" state. While in this state, the call 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 Call Park timer is restarted and the parked party remains in the "Call Park Held" state (i.e. the call continues to be parked). This is true even when the parking terminal is assigned the Call Forwarding Feature, as the Call Park recall will never be Call Forwarded.

Scenario: The user activates Call Park using activator #x during an active call.

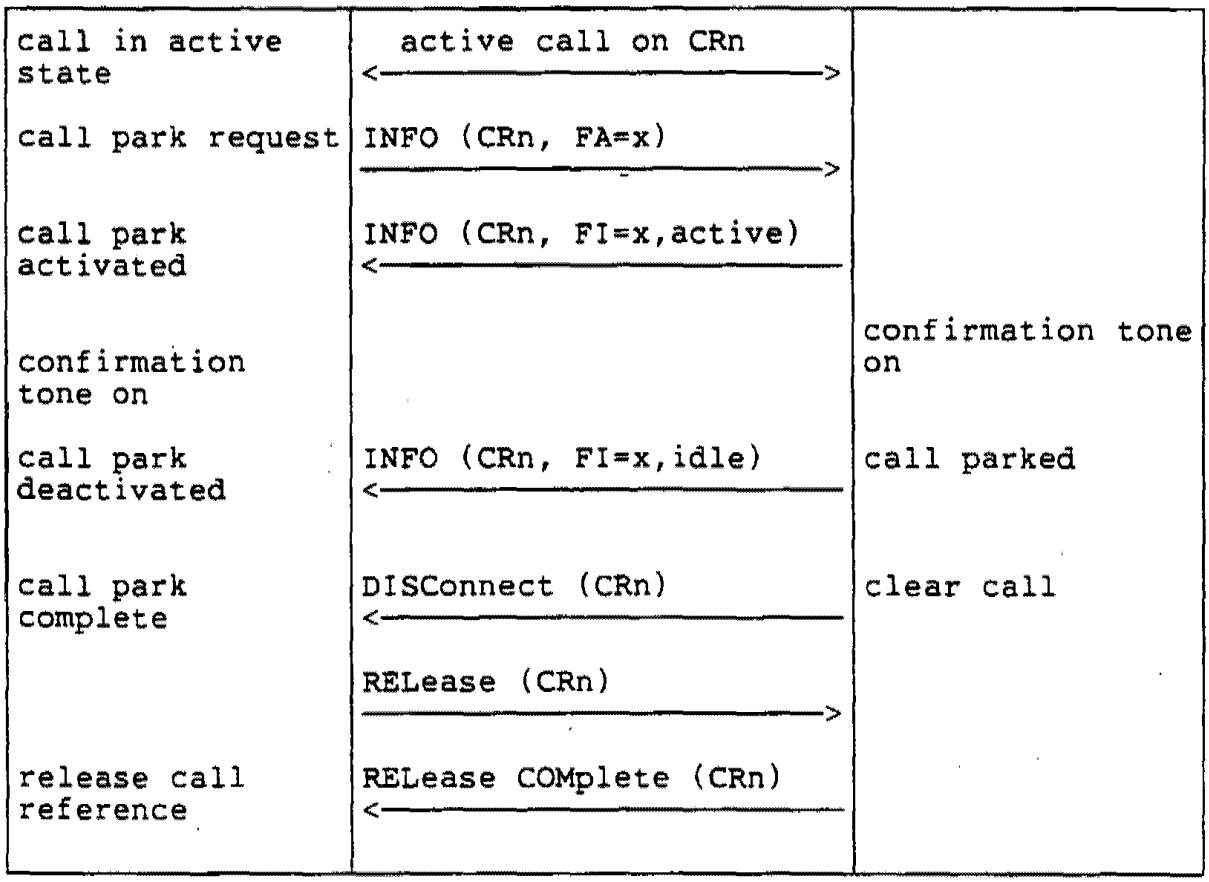


Figure 37. Call Park Store

Scenario: A call has been parked by terminal 1. The user retrieves the parked call by Call Park activator #x from terminal 2.

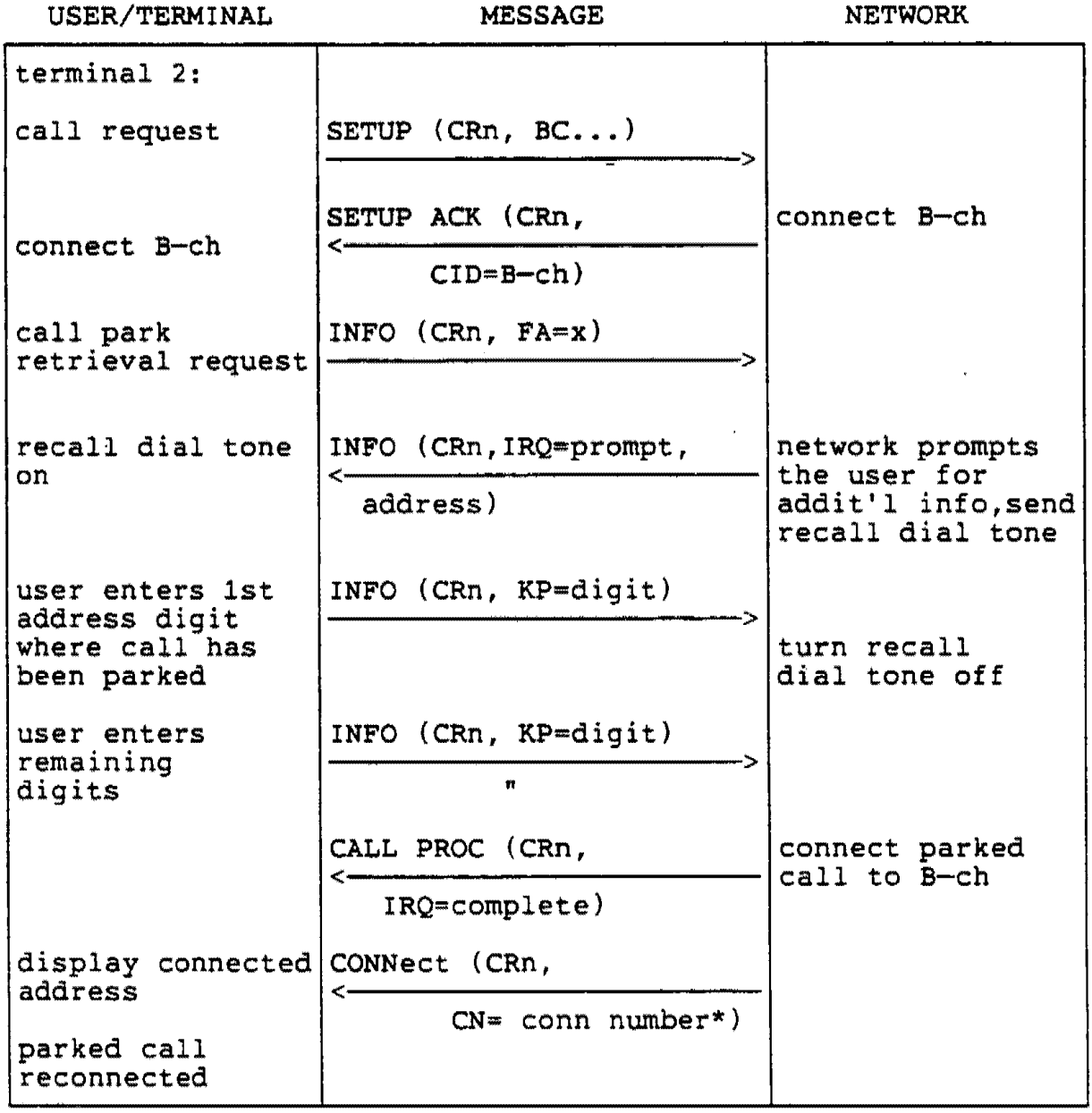


Figure 38. Call Park Retrieval

* In certain circumstances the connected number may sent by the network in an INFOrmation message subsequent to the CONNect message.

6.9.4 Feature Interactions and Limitations

Calls can be parked by any terminal having this feature. Calls should only be unparked by terminals which have a bearer capability compatible with that of the parked call.

A call must be in the active state to be parked.

Calls involving an operator position or an attendant console cannot be parked.

Conference call cannot be parked.

Only one call can be parked against a given directory number. 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.

The parked party cannot activate any feature while in the parked state.

When the parking party is recalled, the features Call Forward, Do Not Disturb and Make Set Busy have no effect on the recall. They remain applicable to other call appearances on the terminal.

The Call Park Store feature is disabled on calls in which Three-Way Call are in effect.

The activation of Call Park on a call will not affect Ring Again 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 call park recall, upon call park recall timeout, the network will clear the entire call.

6.10 CALL PICKUP (CPU)

6.10.1 Definition

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 may optionally be associated with only a subset of the DN appearances on the set. The feature is assigned at subscription time.

6.10.2 Feature Activation

A call can be picked up by a second terminal using feature key access, or dial code access, as specified in generic procedure G3 and generic procedure G7, respectively.

Figure 39 on page E-113 illustrates one of the feature key access sequences which may be used to invoke call pick up.

6.10.3 Feature Interactions and Limitations

Calls may only be picked up by terminals which have a bearer capabilities compatible with the incoming call.

Speed Calling may be used to dial the Call Pickup Group access code.

A user at a busy terminal cannot pick up a call. The call must be terminated before using the Call Pickup feature unless the terminal has another idle call appearance. In the later case, the terminal can put the current call on hold and pick up calls via the idle call appearance.

A terminal can only pick up calls within the defined Call Pickup group.

Scenario: A user attempts to pick up an incoming call to another terminal, by initiating a call and activating the Call Pickup activator #x, while in the Overlap Sending state.

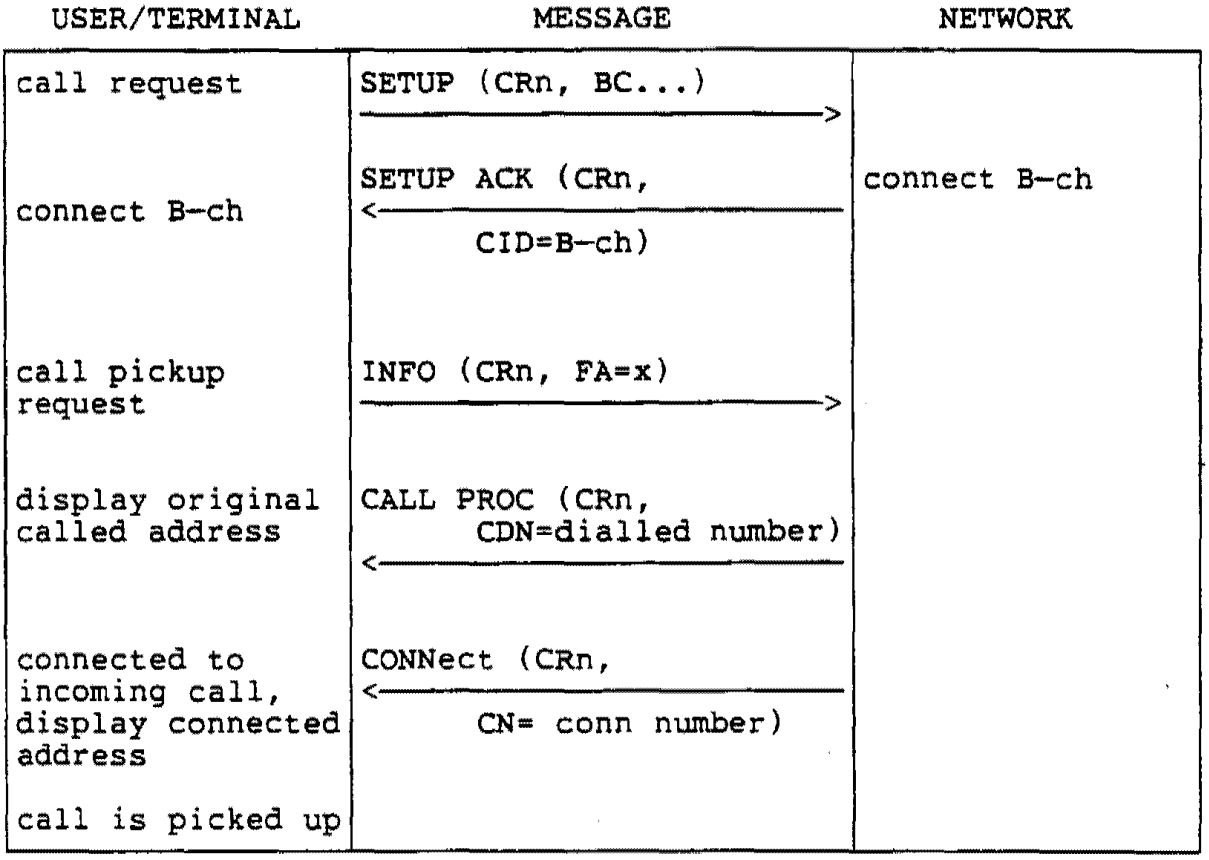


Figure 39. Call Pickup Group Activation

6.11 FEATURE CODE ACCESS

6.11.1 Definition

Feature code access provides an alternate method of accessing features other than through the use of feature keys. This situation would arise when a customer has all of its keys assigned but wants 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 dial code access, using generic procedures G7 or G8 during call initiation:

Speed Calling - long & short
Speed Call user
Call Forward programming/activation,
Call Pickup,
Call Park retrieve,
Loudspeaker paging, and
Make Set Busy.

6.12 MAKE SET BUSY (MSB)

6.12.1 Definition

The Make Set Busy (MSB) feature 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 will receive either busy tone or some other treatment (tone or announcement). For intragroup calls blocked by the MSB feature, the calling party will always receive busy tone. Also the made busy set will receive no indications, either audible or visible, that calls are attempting to terminate on it.

A made busy set is still free to originate calls from any of its DN appearances. Feature programming shall also be possible on a made busy set.

When the feature is supported, two variations of the MSB feature shall be available on the ISDN set. One variation, referred to as MSB all calls, shall enable the user to make the set appear busy to all types of incoming calls, both internal and external to the customer group. The other variation, referred to as MSB intragroup, only affects intragroup calls.

6.12.2 Procedures

This feature is activated/deactivated using either Feature Key Management (FKM) or dial code access procedures.

- Using the generic non-call-related FKM procedures for feature activation (G1), the user shall invoke Make Set Busy by sending an INFOrmation message with the Feature activation information element specifying the Make Set Busy feature activator, as shown in Figure 40 on page E-116. The network will respond with an INFOrmation message with the Feature indication information element specifying the Make Set Busy feature indicator with status "active".

  To deactivate the feature, the user shall again send an INFOrmation message with the Feature activation information element specifying the Make Set Busy feature activator. The network will respond with an INFOrmation message with the Feature indication information element specifying the Make Set Busy feature indicator with status "idle".

Using FKM procedures, this feature may be activated or deactivated during or outside a call at any time. However, invocation of the MSB feature in the middle of a feature programming sequence (e.g. Call Forward or Speed Calling) will be ignored by the network.

- Using any one of the generic dial access procedures for feature activation/deactivation during call initiation (see generic feature access procedure G7), the user shall activate/deactviate Make Set Busy by sending either

  - The entire Make Set Busy access code in a SETUP message
  - A partial Make Set Busy access code in a SETUP message, followed by INFOrmation messages to complete the code, or
  - The Make Set Busy Access code in a single INFOrmation message, or series of INFOrmation messages, sent in response to a SETUP ACKnowledge.

  When the network determines it has received the entire Make Set Busy activation/deactivation dial access code, it returns in-band confirmation tone to the user and subsequently clears the call. As an example of Make Set Busy activation using dial access code, see Figure 41 on page E-117.

Scenario: The terminal is idle. The Make Set Busy activator #x is used to make all call appearances on the terminal appear busy to all incoming calls. Subsequently, the user deactivates this feature.

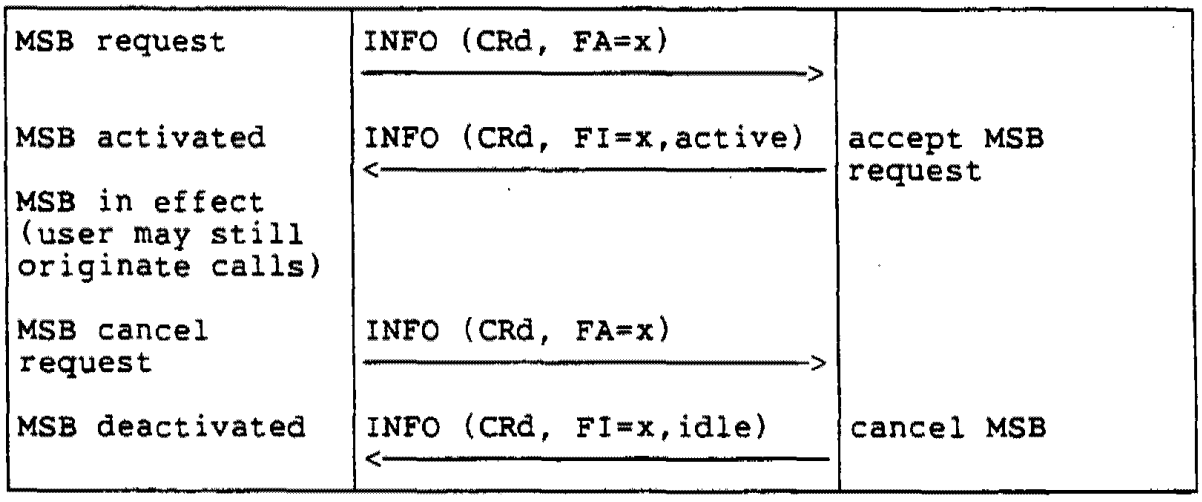


Figure 40. Make Set Busy FKM Activation/Deactivation

Scenario: The terminal is idle. The user includes a partial access code in the SETUP message when activating Make Set Busy.

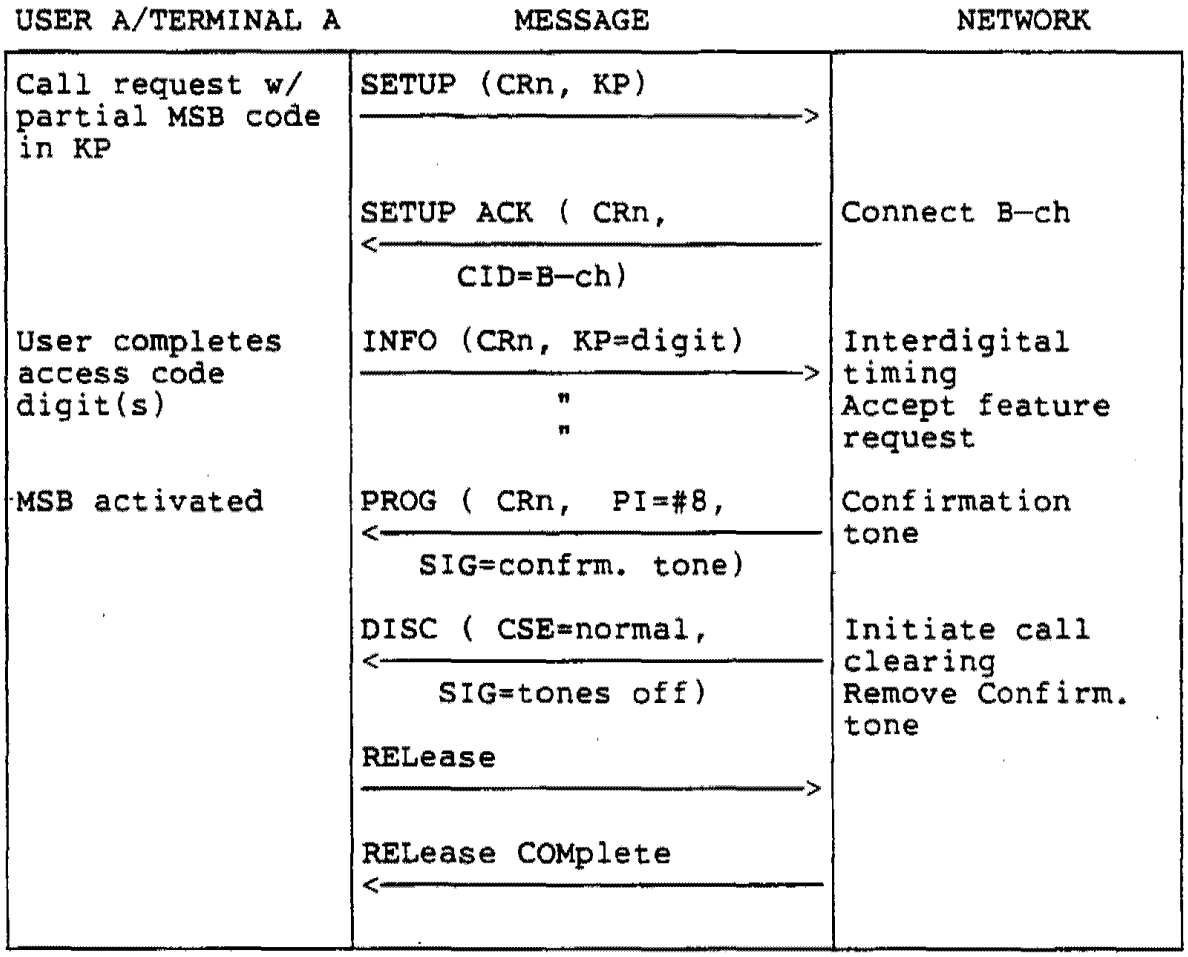


Figure 41. Make Set Busy Dial Access Code Activation

6.12.3 Feature Interactions and Limitations

Make Set Busy will work 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.

6.12.3.1 EKTS Group Intercom and Intercom

The Intercom feature will not be affected by Make Set Busy. Intercom calls will still be allowed to terminate on terminals even after the Make Set Busy feature has been activated on the terminal.

6.12.3.2 EKTS Shared DN

For basic EKTS group members activation of the Make Set Busy feature will only cause audible alerting to be suppressed. The EKTS call may still be answered while MSB is active on the set.

6.12.3.3 Ring Again

The Ring Again feature will take precedence over Make Set Busy such that Ring Again requests made by the user prior to enabling the make busy feature will be handled in the normal fashion. However, Ring Again requests received after the terminal is in the made busy state will not be permitted.

6.12.3.4 Executive Busy Override

Attempts by incoming calls to activate the Executive Busy Override feature will receive re-order tone and not be completed.

6.12.3.5 Call Forward

The Call Forward feature will interact with the Make Set Busy feature in the following manner:

- Calls to call appearances on which the Call Forward Universal and/or Intragroup variations have been activated will be forwarded regardless of whether the terminal has been made busy or not.
- Calls to call appearances assigned the Call Forward Busy and/or Don't Answer variations will be forwarded.

6.12.3.6 Attendant Originated or Extended Calls

Attempts by the attendant to originate or extend a call to a call appearance on a terminal in the made busy state will be blocked if the terminal is assigned the Make Set Busy All Calls feature.

If the Make Set Busy Intragroup feature is assigned to a set, an attendant call will always be delivered to the terminal provided an idle call appearance is available. This interaction will occur whether or not Make Set Busy has been activated on that set.

6.12.3.7 Do Not Disturb

The Made Set Busy feature will take precedence over the attendant activated Do Not Disturb feature such that treatments specified for Make Set Busy will apply when both Make Set Busy and Do Not Disturb have been activated on a given line.

Furthermore, if both Make Set Busy and Do Not Disturb are active on a given terminal and Make Set Busy is deactivated then Do Not Disturb will also be deactivated.

Attempts by the attendant to activate/deactivate Do Not Disturb on a terminal in the made busy state will result in the network sending a 'Disallowed' indication to the attendant's display.

6.12.3.8 Operator Verification

The Busy Verification feature overrides the Make Set Busy feature. An attendant applying Busy Verify on a terminal in the made busy state will be unaware of the Make Set Busy feature.

6.12.3.9 Attendant Camp-On

Attendant Camp-On is not be possible on terminals in the Made Busy state. Attempts by the attendant to activate this feature on a terminal in the made busy state will result in the network sending an 'MSB Active' indication to the attendant's display.

6.13 MESSAGE WAITING (MWT) AND CALL REQUEST (CAR)

6.13.1 Definition

When a user's message waiting 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 message waiting indicator. Call Requests are retrieved by using the activator associated with the message waiting indicator.

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.

6.13.2 Procedures

6.13.2.1 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 the message waiting indicator of the called user, using generic procedure G9, if the indicator is not already on. The network sends the user an INFOrmation message containing a Feature indication information element with the Message Waiting feature indicator with status "active".

6.13.2.2 Call Request Activation

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. The user sends the network an INFOrmation message containing a Feature activation information element with the identifier of the Call Request Activation feature.

The network, if the Call Request activation is accepted and the called station's Message Waiting indicator is not already on, turns on the called station's Message Waiting indicator using 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 indi-

cator. If there is already a queue entry for the same caller, a new queue entry is not created.

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.

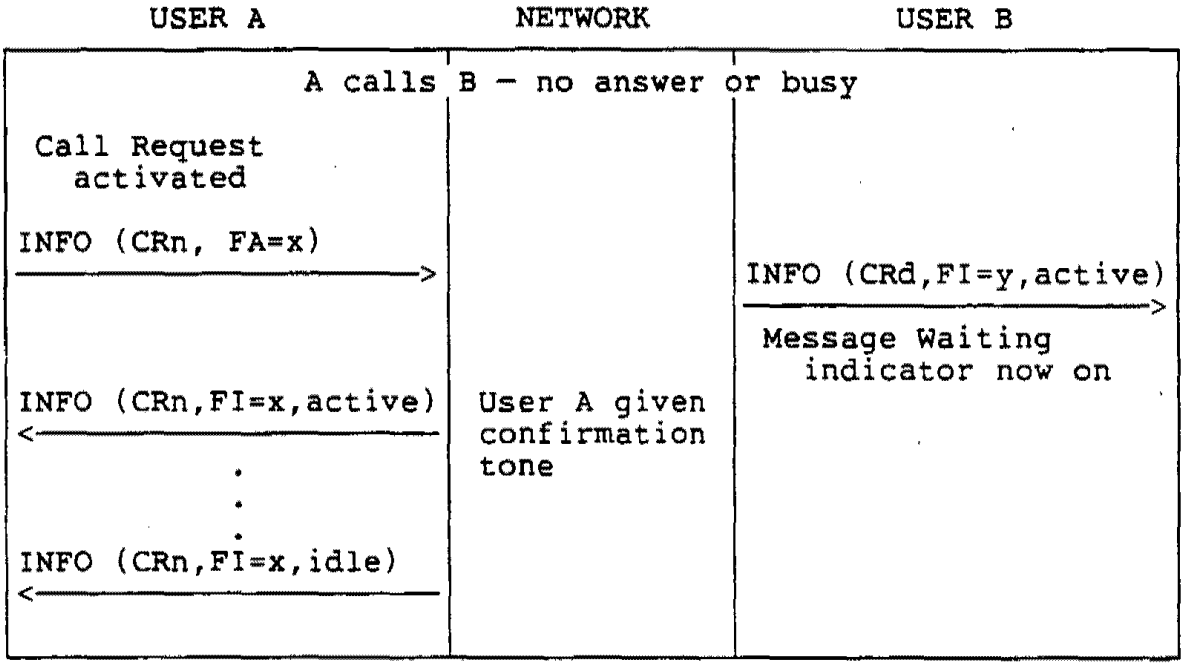


Figure 42. Call Request Activation

6.13.2.3 Retrieval of Messages and Call Requests

When a user sees that the message waiting indicator is on, 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.

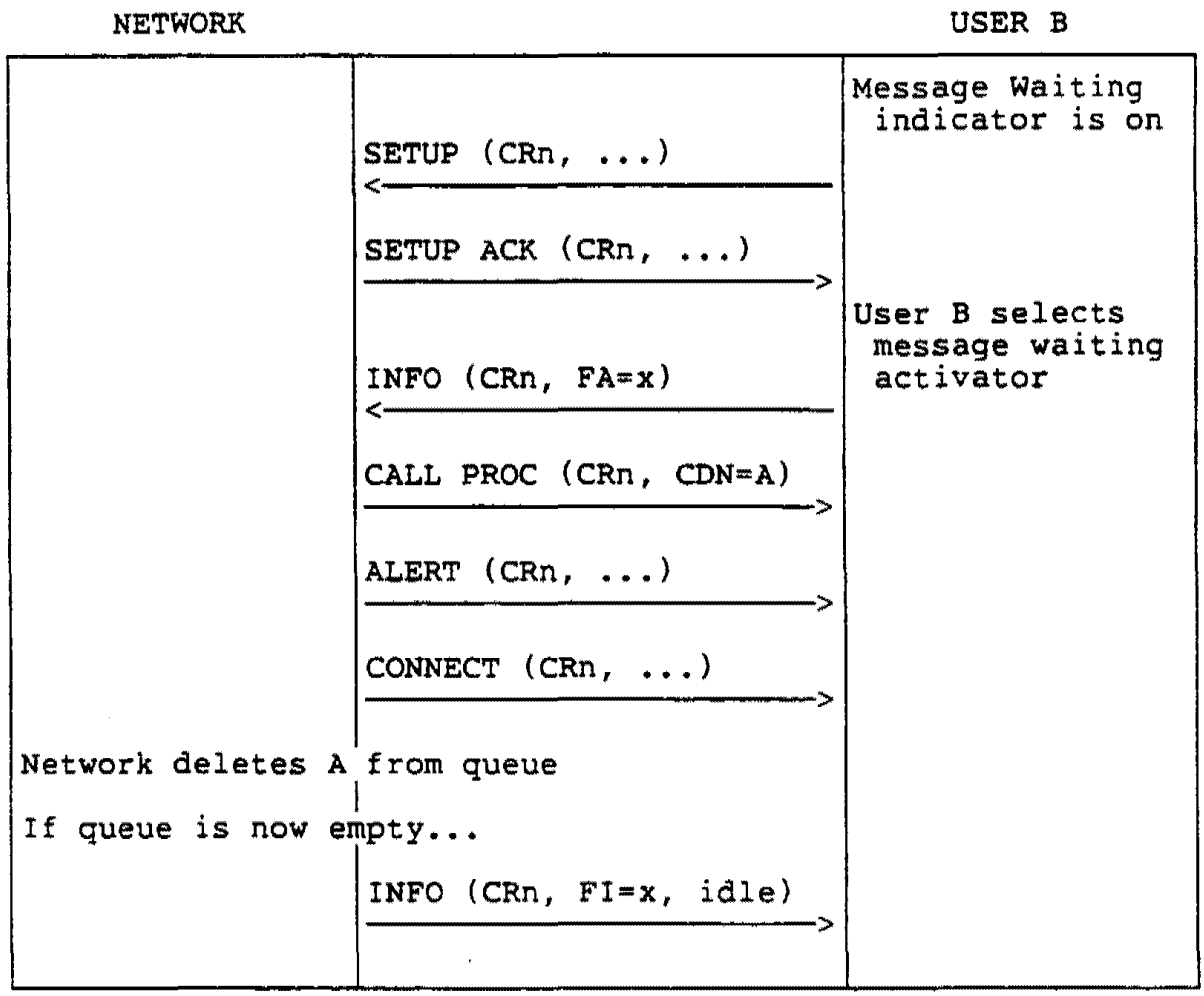


Figure 43. Call Request Retrieval

The user can retrieve a message or call request using any one of the sequences specified in generic procedure G3. Figure 43illustrates 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 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.

6.13.3 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, the 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 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).

6.14 RING AGAIN (RAG)

6.14.1 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.

6.14.2 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 timeout value is reached, the RAG request is cancelled. The user can cancel RAG at any time by selecting the RAG feature activator.

6.14.3 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 Figure 44 on page E-131, 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.

Note: 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.

6.14.4 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 that 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 timeout, A may follow the basic outgoing call procedures to access terminal B.

6.14.5 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 (ie. by sending the network a SETUP message followed by an INFOrmation message that contai 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 (eg. 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 (ie. 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.

6.14.6 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 indica information element specifying the Ring Again feature indicato status "idle".

Cancellation is permitted at any time or state EXCEPT during the call offer notification.

6.14.7 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.

6.14.8 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 feat 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.

6.14.8.1 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.

6.14.8.2 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.

6.14.8.3 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 prioritization takes place for Attendant Camp-On.

6.14.8.4 Three-Way Calling

A cannot delete a pending request against a party which is part of a three-way call.

6.14.8.5 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.

6.14.8.6 Hunt Groups

A can activate a Ring Again request for a DN in a DNH, MLH, DLH group.

6.14.8.7 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.

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 <——————	called end free
	patn 2, FI=x, prompt, NI=monitored pty idle)	
call request	SETUP (CRm, BC...) ——————>	
connect B-ch	SETUP ACK (CRm, <——————	connect B-ch
	CID=B-ch)	
RAG answer request	INFO (CRm, FA=x) ——————>	
RAG deactivated	INFO (CRm, FI=x,idle) <——————	
display destination addr	CALL PROC (CRm <——————	establish call to previously busy destination
call established	CDN=dest addr)	
	(as in basic call)	

Figure 44. Ring Again Procedures

6.15 SPEED CALLING (SCS, SCL, SCU)

6.15.1 Definition

This feature allows a subscriber to store frequently dialed strings against access codes and to make calls to these by entering only the corresponding abbreviated access code. The desired string can be a directory number, authorization code, account code or feature access code and can include either an asterisk or octothorpe.

To store the string, a Short List and a Long List are provided. A Short List consists of a maximum of 10 stored strings. A Long List is one that consists of a maximum of 30, 50 or 70 stored strings. In other words, there are three versions of the Long List.

There are two flavors of Speed Call lists. Personal lists are limited to individual terminals. The user assigns and changes numbers against these lists and these are not accessible by other stations. Group lists can be accessed by a number of terminals, but only one controlling station in the group can alter its contents. Group lists can be up to 70 numbers and are accessed by a two digit code.

6.15.2 Programming Procedures

The speed call Short List or Long List can be programmed using either feature key access or dial code access as specified in generic procedures G2 and G8, respectively. Generic procedures G2 and G8 provide a number of sequences any one of which may be used to program speed call Short List or Long List.

For feature key access, the terminal must be either inactive or it may have a call on hold. The user first selects the feature activator, followed immediately by the Speed Call number to be stored. At completion of programming, the Speed Call feature indicator will show status "idle". While in the programming mode any out of context input shall abort the session and the old number will be retained. During feature key access, the programming sequence can be abandoned at any time by selecting the Release feature activator. The terminal shall send an INFOrmation message containing a Feature activation information element with the Release feature activator (See the description of the Release feature in Section E 6.34).

When using code access, generic procedure G8, the user shall indicate the end of the dialing/digit sequence by an octothorpe (#).

Any successful programming attempt will overwrite the old Speed Call number stored against the access code.

6.15.3 Usage Procedures

Speed call usage can be invoked using either feature key access or dial code access, as specified in generic procedures G4 and G8, respectively. Generic procedures G4 and G8 provide a number of sequences to support feature access, any one of which may be used to invoke speed call.

Figure 45 on page E-135 shows speed call usage invocation using one of the feature key access sequences specified in generic procedure G4. After SETUP ACKnowledge is received, the terminal sends an INFOrmation message with a Feature activation information element corresponding to Speed Call feature activator. The network will return an INFOrmation message with a Feature indication information element specifying the Speed Call feature indicator with status "active" and Information request information element corresponding to "prompt, address" while waiting to receive the abbreviated access code.

After the network has accepted the access code from the user, it will return an INFOrmation message with Feature indication information element specifying the Speed Call feature indicator with status "idle". The call proceeds as described in section D for basic call. The CALL PROCeeding message may include the Called party number information element corresponding to the character string stored against the abbreviated access code.

6.15.4 Feature Interactions and Limitations

A Speed Call code is 1-digit long (0 - 9) for the Short list and it is 2-digit long (00-29/49/69) for the Long list.

A stored number can be up to 24 digits, including an asterisk.

A user can use Speed Calling to activate Call Forward.

If a user stores a number in a Speed Call list with an asterisk (*) as the final digit, the network treats this 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.

The user is not allowed to dial a partial number and then use speed call to complete it.

An attempt to use a Speed Call code with an invalid or nil number stored against it will be indicated by error treatment.

It is possible to put a call on hold and update a number in a Speed Call list. However, it is not possible to program when put on hold by the remote terminal (unless the user also holds the current call).

Scenario: Terminal is idle. The user has previously programmed Speed Call with a 1-digit abbreviated address. He now initiates a speed call using Speed Call activator #x.

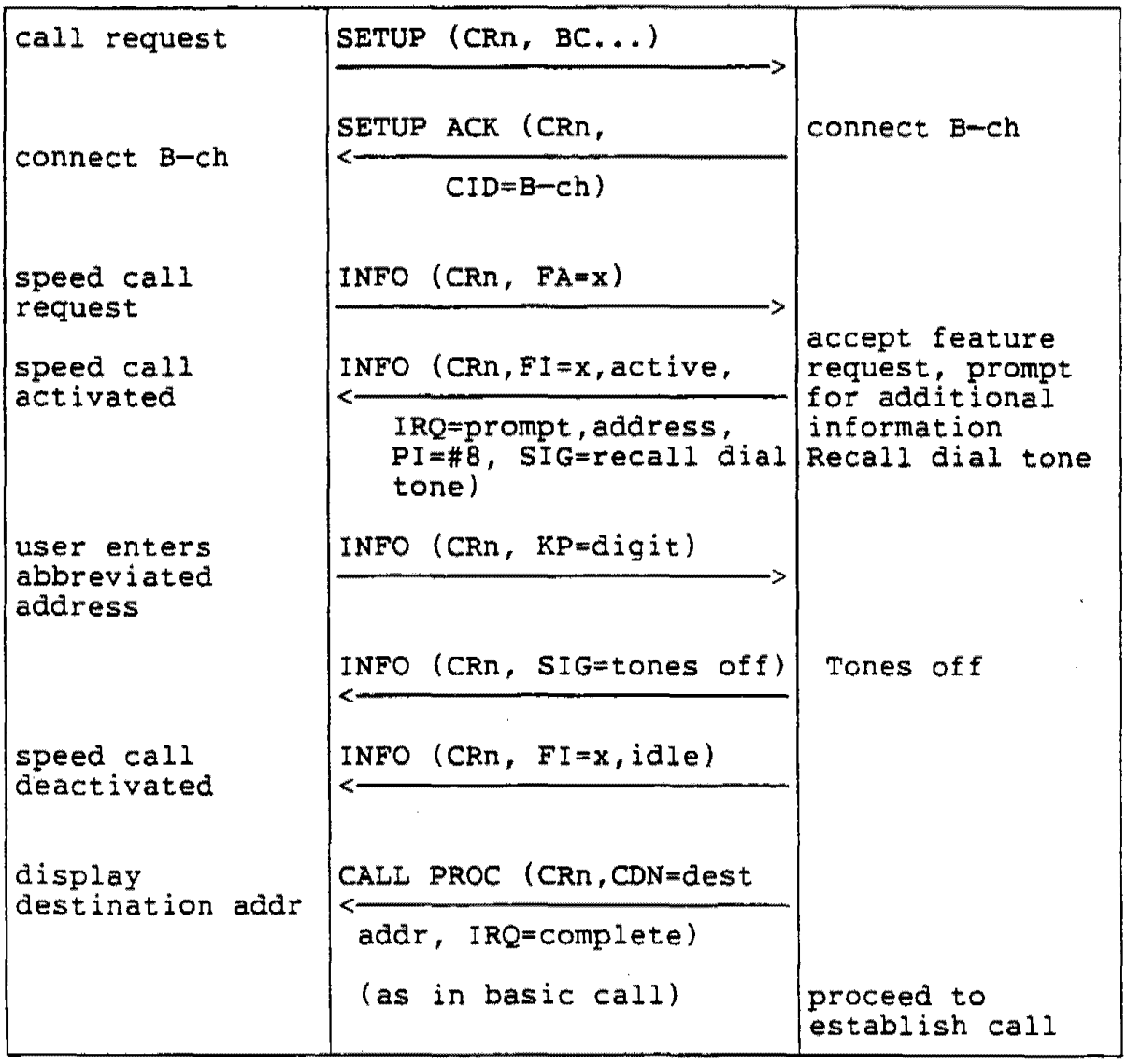


Figure 45. Speed Call Usage

6.16 CALLING NUMBER IDENTIFICATION

Calling Number Identification allows the calling party to provide a specific DN when originating a call for (1) use in identifying service options related to the call, and/or (2) 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 is applicable to both circuit and in-band packet mode calls.

Circuit mode subscribers can

- Select Privacy Options which either restrict or allow Calling Party Number (CGN) presentation to the called user
- Include subaddress information when originating a call that can then be transferred to the called party as part of CGN delivery
- Receive Redirecting Number information identifying the original called party when a call has been forwarded to them.

6.16.1 Functional Procedures

The following sections describe protocol procedures for CGN Provision/Validation, Number Privacy, and Number Delivery as they relate to circuit mode calls. See "In-Band Packet Procedures" on page E-141 for protocol related to packet mode calls.

6.16.1.1 CGN Provision/Validation

If the user provides calling number information as part of call origination (ie. includes a CGNIE in the SETUP), the Type Of Number/Numbering Plan Indicator and calling party number must match one of the values shown in Figure 46 on page E-137.

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

Figure 46. Coding for CGNIE in SETUP message

If (1) the User–Provided CGN violates any CGNIE coding conventions in Figure 46 or (2) the CGN provided by the user does not match one of the valid DNs assigned to the user's service profile, the network will

- Discard the User–Provided (UP) CGN information
- Return a STATUS message containing cause #100, "invalid information element contents (location: public network serving local user, diagnostic: calling party number information element identifier)"
- Proceed with call processing using the Default DN (ie. as if the user had not provided a Calling Party Number during SETUP).

If the user does not provide CGN information, the network uses the Default DN associated with the user's service profile as the CGN.

Regardless of whether the user–provided CGN passed validation or a Default DN is in use, the DMS currently configures the CGN as follows before passing it on the called party:

- The Screening Indicator (SI) value is always 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 (1) the call takes place on the same switch between two members of the same customer group, and (2) 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 CGN will be 10. If the TN/NPI is "Abbreviated Number, Private Numbering Plan", the number of digits sent is from 1 to 7, depending on the numbering plan conventions.

- The Privacy Indicator (PI) is coded according to the Privacy options assigned to the calling party (see "Number Privacy" on page E-138).

6.16.1.2 Number Privacy

DMS supports a CGN Presentation Allowed parameter (ie. SUPPRESS) that sets a default PI value for all calls originated from a given DN (ie. PI equals either "Presentation Allowed" or "Presentation Restricted"). Another DMS feature, Calling Number Delivery Blocking (CNDB), allows a user to change his default privacy indicator value on a per-call basis via an access code. This PI value applies to both Calling Party Number (CGN) and Redirecting Number (RN) delivery.

6.16.1.3 Calling Party Number (CGN) Delivery

If (1) the called party subscribes to CGN Delivery and (2) the PI value associated with the incoming CGN is "Presentation Allowed", the network codes the CGNIE elements as follows when sending a SETUP to the called party.

INCOMING CALLS FROM SS7:

CODING OF INCOMING CGN INDICATORS			CODING OF CGN INDICATORS FOR CGN DELIVERY		
SI	NA/NP		PI/SI	TN/NPI	DIGITS
NP	Nat'l Number, E.164 Plan (digits=10)	—>	Pres. Allowed, NP	National Number in E.164 Plan	10 Mapped
UPPS	Nat'l Number, E.164 Plan (digits=10)	—>	Pres. Allowed, UPPS	National Number in E.164 Plan	10 Mapped
NP	Internt'l Number, E.164 Plan	—>	Pres. Allowed, NP	Internt'l Number in E.164 Plan	Mapped
UPPS	Internt'l Number, E.164 Plan	—>	Pres. Allowed, UPPS	Internt'l Number in E.164 Plan	Mapped
NP or UPPS	Other Than Nat'l or Inter-nat'l Number, E.164 Plan or Nat'l Number E.164 Plan (digits≠10)	—>	Number Unavailable Due To Interwking, NP	Unknown, Unknown	None
NP or UPPS	No Value	—>	Number Unavailable Due To Interwking, NP	Unknown, Unknown	None
UPFS Only	Any Value	—>	Number Unavailable Due To Interwking, NP	Unknown, Unknown	None
UPNS Only	Any Value	—>	Number Unavailable Due To Interwking, NP	Unknown, Unknown	None

INTRA-SWITCH CALLS:

CGN TO BE OFFERED FOR DELIVERY		CODING OF CGN INDICATORS FOR CGN DELIVERY		
		PI/SI	TN/NPI	DIGITS
User-Provided, Validated or 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 Interwking, NP	Unknown, Unknown	None

* The "Abbreviated Number" TN/NPI and format will only be used if (1) the call is intra-customer group and intra-switch, and (2) the customer group subscribes to a private numbering plan.

If (1) the called party subscribes to CGN Delivery and (2) the PI value associated with the incoming CGN is coded to "Presentation Restricted", the network codes the CGNIE as follows:

- The PI value is coded to "Presentation Restricted"
- The SI 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 CGN, no CGNIE is included in the SETUP message.

6.16.1.4 Redirecting Number Delivery

DMS circuit mode subscribers assigned Calling Number Delivery will also receive Redirecting Number (RN) information for a forwarded call, provided delivery is permitted by the redirecting user's privacy subscription. This information (1) identifies the original called party and (2) is included in the Redirecting Number Information Element (RNIE) in the SETUP message sent to the called party.

6.16.1.5 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 (CPSIE) in the SETUP message used for circuit-mode call origination. This SETUP must also include a valid CGN (see Figure 46 on page E-137). If the CPS information can be delivered, the network includes it in a CPSIE in the SETUP message sent to the called user. In such cases, however, the calling party receives no indication that CPS information has been delivered.

In any of the following situations, the network will discard the Calling Party Subaddress (CPS) information sent by the calling party and return a STATus message containing cause #43, "access information discarded" (location: public network serving local user; diagnostic: calling party subaddress information element). In these cases, the called party does not receive notification that the CPS has been discarded.

- The calling party includes CPS information, but no CGN information, in a SETUP message
- The user provided CGN in the SETUP is invalid
- The CPS Information Transfer feature is not assigned to the validated, user-provided CGN
- The CPS information is more than 20 octets in length

If the called party does not subscribe to CGN Delivery, the network will discard Calling Party Subaddress (CPS) information without notifying either the calling or called party.

6.16.2 In-Band Packet Procedures

6.16.2.1 Number Provision/Validation for In-band Packet

To take full advantage of Calling Number Identification functionality and be able to specify a CGN 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 seven-digit or ten-digit E.164 format. However, if a seven-digit value is provided, the network will convert the address to 10-digits before validation takes place (ie. the network will prefix the seven-digit the 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 (1) no match is found or (2) 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 (ie. the channel Default DN subscribed for the Semi-Permanent B-channel or LAPD D-channel packet connection in use).

The Calling Number Privacy capabilities are not supported for packet mode calls.

6.16.2.2 Number Delivery for In-Band Packet Calls

Number Delivery is required for all in-band packet calls and, for each call offered, the network will always deliver 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 following 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 following form:

  0 + Data Network Identification Code + Network Terminal Number

6.17 ELECTRONIC KEY TELEPHONE SERVICE GROUP INTERCOM (EKTS-GIC)

6.17.1 Definition

Electronic Key Telephone Service (EKTS) Group Intercom (GIC) is based on the Meridian Digital Centrex GIC feature that enables a customer to terminate, using abbreviated dialing, on a member of a predesignated group.

An intercom group can have a maximum size of either 10 members, 100 members, 1,000 members or 10,000 members. Users in a 10-member group dial a single digit (0-9) to reach others in their group. Those users in a 100-member group dial a two digit number (00-99). In a 1,000 member group, users dial a 3-digit code (000-999). In a 10,000 member group, users 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 intercom group 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 customer groups.

6.17.2 Procedures

These procedures are based on the intercom capabilities described in TR-TSY-000205 Issue 1, "ISDN Electronic Key Telephone Service".

A terminal subscribed to GIC must support the terminal identification procedures as described in section 4.

6.17.2.1 Originating Operation

The originating user invokes the GIC feature by sending a SETUP message with the Call appearance information element corresponding to the selected intercom group to the network as shown in Figure 47 on page E-145.

If en-bloc dialing procedures are used, the user also includes the intercom address in a Keypad information element in the SETUP message.

If overlap procedures are used, the network will return a SETUP ACKnowledge message to allow the user to enter the intercom group address. The user shall send the appropriate number of address digits using the Keypad information element contained in one or more INFOrmation messages.

If an invalid intercom group is included in the Call appearance information element, the network will reject the call request by sending a RELease COMplete message with cause value #50 "requested facility not subscribed".

Normal call establishment procedures are followed as defined in section D of this interface specification.

6.17.2.2 Terminating Operation

If there is no active intercom call on the selected intercom appearance, the network will offer the intercom call by sending a SETUP message with the following information:

- Channel identification information element specifying "no channel".
- Endpoint identifier information element specifying the terminal to which the GIC call is directed.
- Calling party number information element containing the originating intercom address.
- Call appearance information element specifying the selected intercom group.

The terminating user shall answer the call by using normal call establishment procedures as defined in section D of this interface specification as shown in Figure 48 on page E-146. The only difference being that the B-channel is selected upon answer (i.e. with the CONNect and CONNect ACKnowledge messages) as described in the Additional Call Offering (ACO) feature.

If the destination terminal is busy, the terminating user can accept the GIC call by freeing up a B-channel (eg. using the HOLD nessage), before and sending a CONNect message in response to the incoming SETUP message.

Scenario: Terminal is idle. The user initiates a GIC call for intercom group #x.

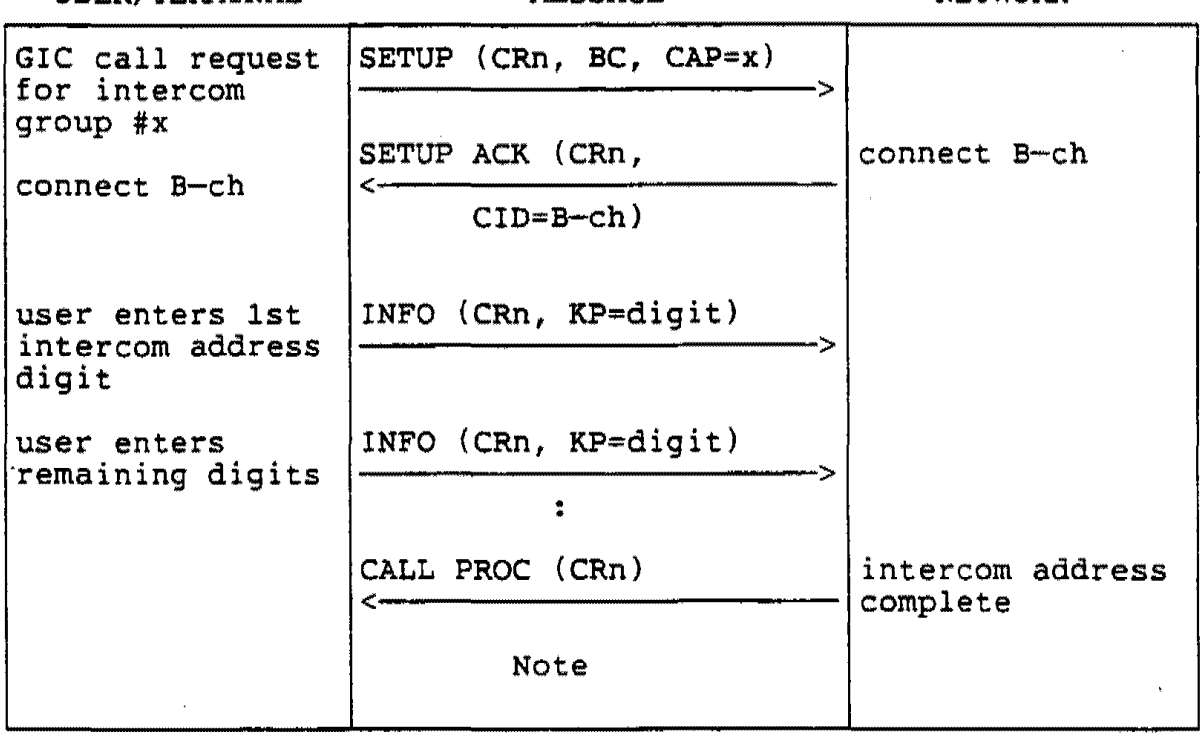


Figure 47. Group Intercom Call Origination

Note: Normal call establishment will occur with the messages specified in section D.

Scenario: Terminal is idle. The user receives a GIC call for intercom group #x.

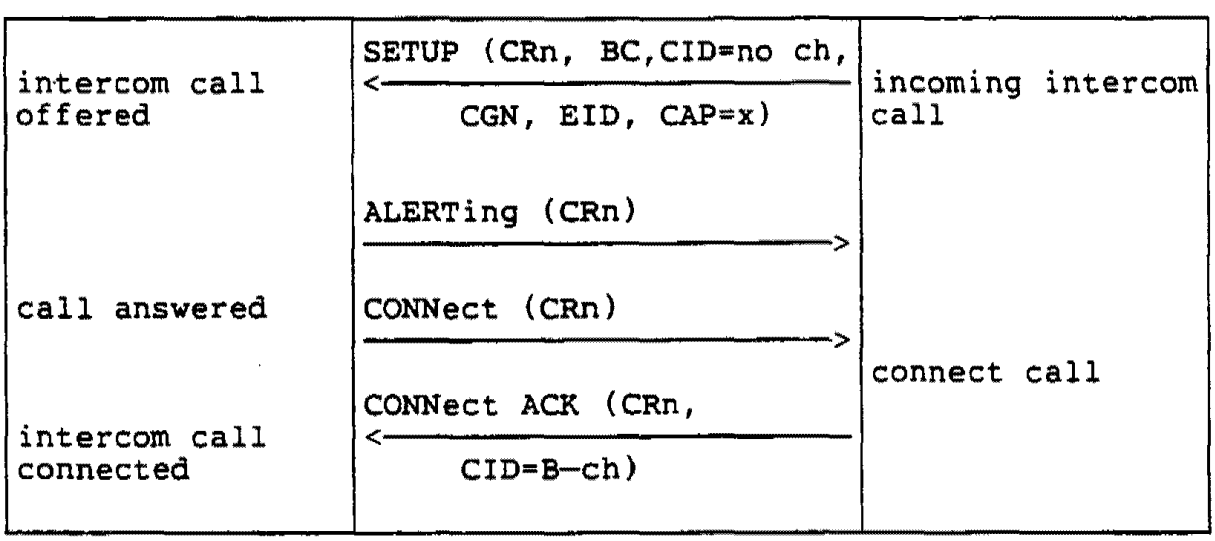


Figure 48. Group Intercom Call Termination

6.17.3 Feature Interactions and Limitations

All members of an intercom group must be members of the same customer group.

Automatic dial may be used but only destinations within the GIC group may be programmed and used for GIC calls.

A call pickup 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.

Executive busy override is supported for GIC calls.

Flexible calling is supported for GIC calls. GIC and DN calls may be bridged together and calls may be transferred between GIC and DN appearances.

The hold and retrieve feature is supported for GIC calls.

Make set busy may be applied selectively to GIC appearances.

Call park is supported for GIC calls but the parked call must be retrieved from a member of the GIC group.

Ring again and call back queuing are supported for GIC calls. GIC calls will only be recalled on GIC appearances.

Speed calling 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
- automatic line
- call forwarding
- call forwarding validation
- directory number hunting
- executive busy override exempt
- emergency service bureau
- feature code access
- last number redial
- loudspeaker paging access
- EKTS shared DN

6.18 ELECTRONIC KEY TELEPHONE SERVICE INTERCOM (EKTS-ICM)

6.18.1 Definition

Electronic Key Telephone Service (EKTS) Intercom (ICM) is based on the Meridian Digital Centrex GIC feature that allows a user, upon selecting the appropriate intercom group, to directly terminate on a predesignated terminal.

6.18.2 Procedures

A terminal subscribed to the ICM feature must support the terminal identification procedures as described in section 4.

6.18.2.1 Originating Operation

The originating user invokes the ICM feature by sending a SETUP message with the Call appearance information element corresponding to the selected intercom group to the network as shown in Figure 49 on page E-149.

The network will return a CALL PROCeeding message to the user to indicate that the call is being processed.

If an invalid intercom group is included in the Call appearance information element, the network will reject the call request by sending a RELease COMplete message with cause value #50 "requested facility not subscribed".

Normal call establishment procedures are then followed as defined in section D of this interface specification.

6.18.2.2 Terminating Operation

The network will offer the intercom call by sending a SETUP message with the following information:

- Channel identification information element specifying "no channel".
- Endpoint identifier information element specifying the terminal to which the ICM call is directed.

- Call appearance information element specifying the selected intercom group.

A call answered by the terminating user shall result in the terminal using normal call establishment procedures as defined in section D of this interface specification as shown in Figure 50 on page E-150. The only difference being that the B-channel is selected upon answer (i.e. with the CONNect and CONNect ACKnowledge messages) as described in the Additional Call Offering (ACO) feature.

If the destination terminal is busy, the terminating user can accept the ICM call by freeing up a B-channel (eg. using the HOLD message) before and sending a CONNect message in response to the incoming SETUP message.

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	

Figure 49. Intercom Call Origination

Note: Normal call establishment will occur with the messages specified in section D.

Scenario: Terminal is idle. The user receives a ICM call for intercom group #x.

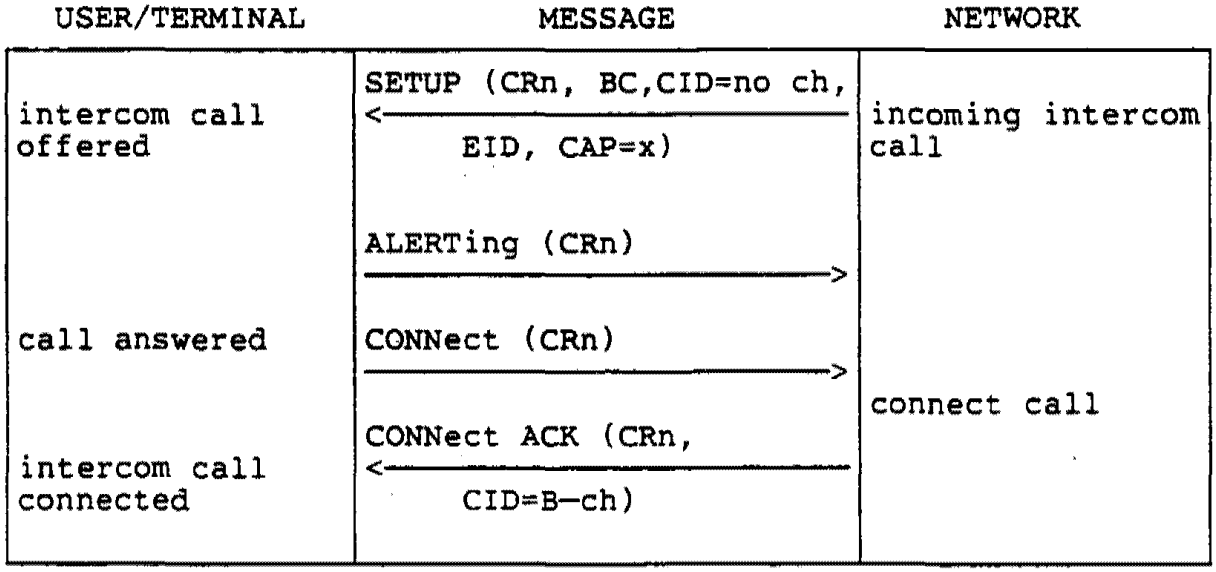


Figure 50. Intercom Call Termination

If the user does not answer within two seconds, it is recommended that the terminal make an automatic connection and send a CONNect message to the network.

6.18.3 Feature Interactions and Limitations

The only feature compatible with ICM is the Hold and Retrieve feature.

6.19 ELECTRONIC KEY TELEPHONE SERVICE SHARED DN

6.19.1 Definition

This feature is based on the requirements for basic Electronic Key Telephone Service (EKTS) identified by Bellcore in TR-TSY-000205 Issue 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 DN that is assigned to more than one set is called an EKTS DN. An EKTS group can be composed of 500/2500 sets, MBS and ISDN sets. The sets that are assigned the EKTS shared DN are known as an EKTS group. An EKTS group can be comprised of up to 32 stations. Basic EKTS allows only one call to be active (either originating or terminating) on the EKTS DN at any time. The bearer capabilities supported with EKTS are speech, 3.1 kHz audio and circuit-mode data.

EKTS allows for the following capabilities:

- The ability for users to share a directory number appearance.
- The ability to hold and retrieve EKTS calls.
- The ability for EKTS members to bridge onto an established EKTS call.
- The ability to control the privacy status of an EKTS call.
- The ability to receive delayed or abbreviated ringing for an incoming EKTS call.

A terminal subscribed to EKTS shared DN shall support the terminal identification procedures as described in section 4.

An EKTS terminal can be assigned the option of Call Appearance Call Handling (CACH) which provides an alternative signaling mechanism such that calls are directed via a call appearance rather than a DN. CACH is a subscription option assigned to the user's Terminal Service Profile (TSP). When this option is assigned terminals shall be configured to operate in CACH mode. The procedures for CACH operation are described below.

6.19.2 Procedures

6.19.2.1 Call Origination

6.19.2.1.1 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 D of this interface specification.

If the CACH option has been assigned to the EKTS user, the user shall include the Call Appearance information element corresponding to the call appearance of the selected 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 section D of this specification.

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[3] 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 EKTS group, the network will reject the call request by sending a RELease COMplete message with cause value #34 "circuit/channel congestion".

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[3] At this time the network only supports one call appearance per DN per TSP.

6.19.2.1.2 Associated Call Establishment

Upon the receipt of a valid SETUP message, the network sends a KEY SETUP message to all other members of the EKTS group. 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 at layer 2 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 (coded to the call appearance identifier as defined by the associated user's terminal service profile) 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.

6.19.2.1.3 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 section D. 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 timeout. 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.

6.19.2.1.4 Call Rejected

If before answer, the call is rejected by the remote user or network, the network will clear the call to the calling user by using the procedures defined in section D. 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.

Scenario: User A is originating an EKTS call. User B is a member of the EKTS group.

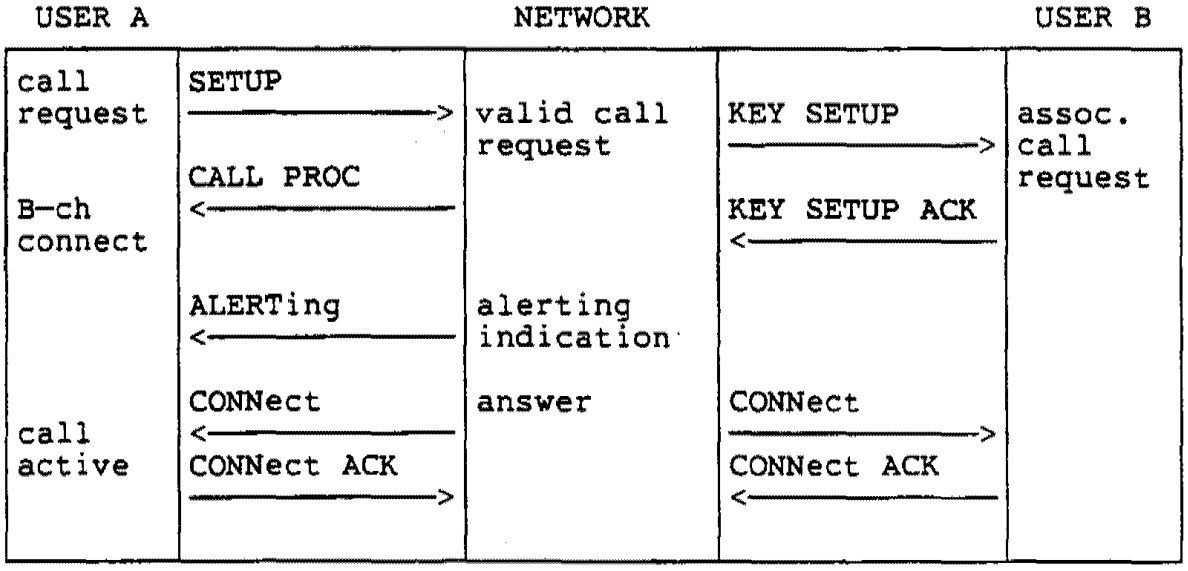


Figure 51. Successful Call Origination

6.19.2.2 Call Termination

6.19.2.2.1 Call Delivery

The call offering procedures for an EKTS call are basically the same as those defined in section D. The differences being that the call is offered to all members of the EKTS group on one or more interfaces. Each user receives its own SETUP message from the network broadcast at layer 2 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 ACKnowlege messages or RETRieve and RETRieve ACKnowledge messages for EKTS.
- Bearer Capability information element coded to the bearer capability associated with the incoming call.
- For a user that has not subcsribed 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 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.
- 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).

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 section D. 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 EKTS group receiving terminating treatment, the network will clear the call in both directions as defined in section D. 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".

6.19.2.2.2 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 section D 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 EKTS group.

6.19.2.2.3 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 ACKnowlege message will contain the Channel identification information element identifying the B-channel to which the user shall connect (see Figure 52 on page E-160).

If a B-channel is not available and at least one other user in the terminating EKTS group 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 EKTS group.

If a B-channel is not available and no other users in the terminating EKTS group 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 EKTS group 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 section D.

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 "Bridged Calls" on page E-160.

6.19.2.2.4 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 section D. For those users sent a KEY HOLD message, the network will initiate clearing by sending a RELease message and continue clearing as defined in section D.

Scenario: User A and user B are members in the same EKTS group which receives an incoming call. User A answers the call.

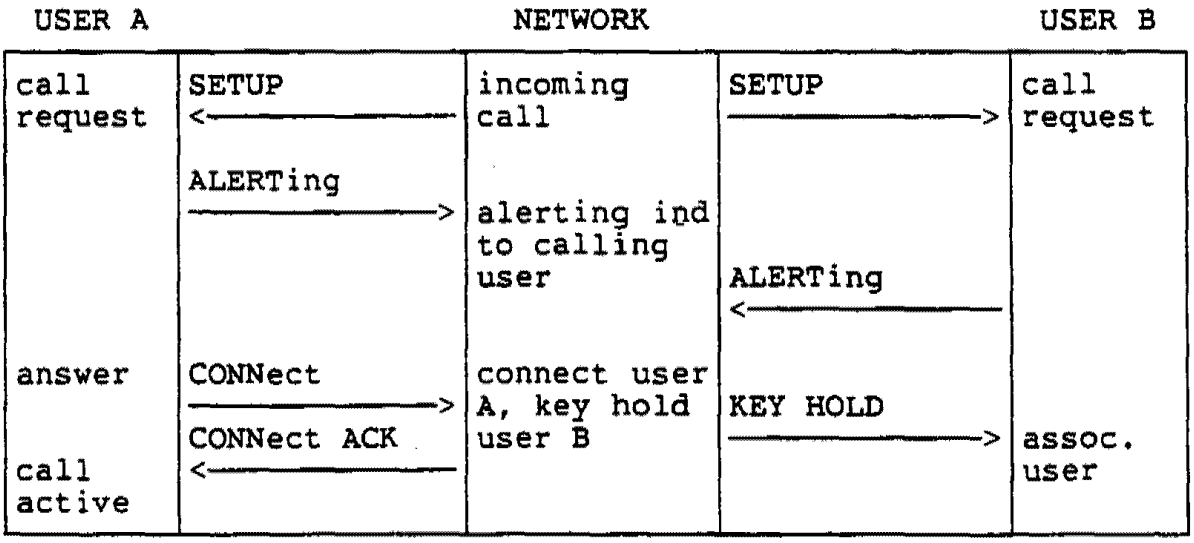


Figure 52. Successful Call Termination

6.19.2.3 Bridged Calls

When an EKTS call has reached the active state, the network will interpret the receipt of a RETRieve message from an associated user in the EKTS group 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:

a. the call is in the active state
b. privacy is not enabled on the call
c. resources are available to bridge the call
d. a B-channel is available
e. the conference size has not reached its limit
f. the remote party has not disconnected from the call
g. 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:

a. cause value #29 "facility rejected"
b. cause value #29 "facility rejected"
c. cause value #34 "circuit/channel congestion"
d. cause value #34 "circuit/channel congestion"

e. cause value #34 "circuit/channel congestion"
f. cause value #29 "facility rejected"
g. 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 EKTS group 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 Figure 53 on page E-162).

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".

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".

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.

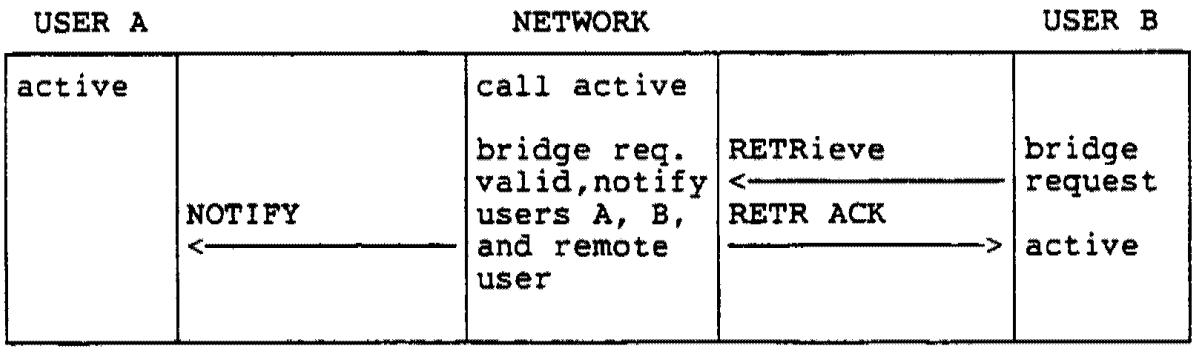


Figure 53. Successful Bridging

6.19.2.4 Bridged Call Exclusion

The bridged call exclusion option (i.e. privacy) may be used to restrict other members in the EKTS group 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 EKTS group:

1. Automatic bridged call exclusion - automatic re-enable - For this privacy option, the initial privacy status for the EKTS group is private meaning that bridging cannot occur unless an active member of the EKTS group 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 - manual re-enable - For this privacy option, the initial privacy status for the EKTS group 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 EKTS group 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 EKTS group.
- For every originating call originating from an EKTS group or terminating on an EKTS group, 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 EKTS group, 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.

6.19.2.4.1 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 "Generic Procedures For Supplementary Services 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.

- 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 "Release Treatment" on page E-170. 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 "Release Treatment" on page E-170. 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".

6.19.2.5 Hold and Retrieve

A user assigned EKTS has the capabilities of the Hold and Retrieve supplementary service. The procedures defined for the Hold and Retrieve service apply to an EKTS user.

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. 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.

6.19.2.5.1 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.

6.19.2.5.2 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.

6.19.2.5.3 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:

a. the call is currently in the active state

b. 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 EKTS group, the retrieve request is considered to be a request to bridge onto the call as defined in "Bridged Calls" on page E-160.

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 EKTS group. 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".

The network may perform the autohold procedures as described in the Hold and Retrieve feature upon receiving a RETRieve message.

6.19.2.6 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 EKTS group connected to the call, the network will determine if any other user in the EKTS group 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 EKTS group 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 55 on page E-172). If the network receives a RELease COMplete message from a user in the EKTS group, the network will clear the call to the particular user, but will only clear the entire call if no other member of the EKTS group is connected to the call.

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 54). 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".

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. The remote user disconnects.

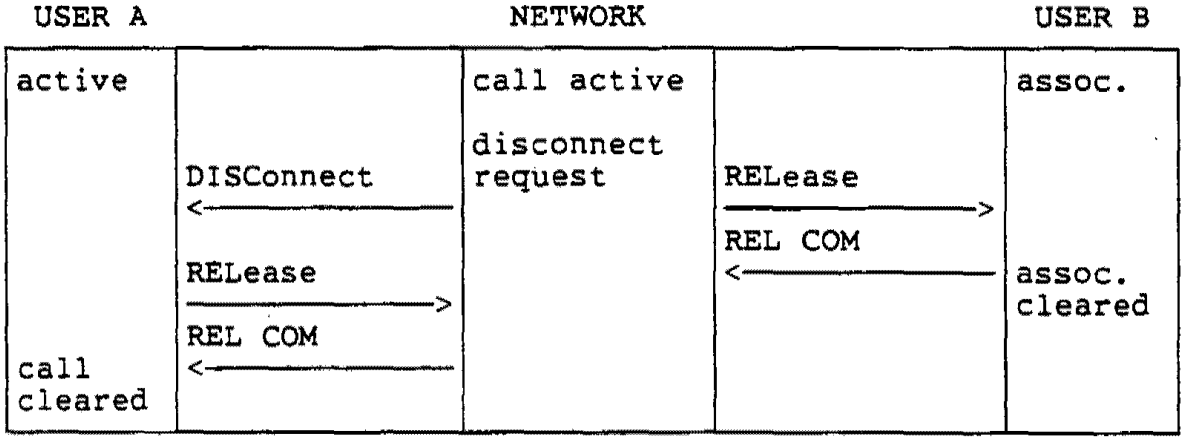


Figure 54. Clearing of Entire Call when Remote User Disconnects

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.

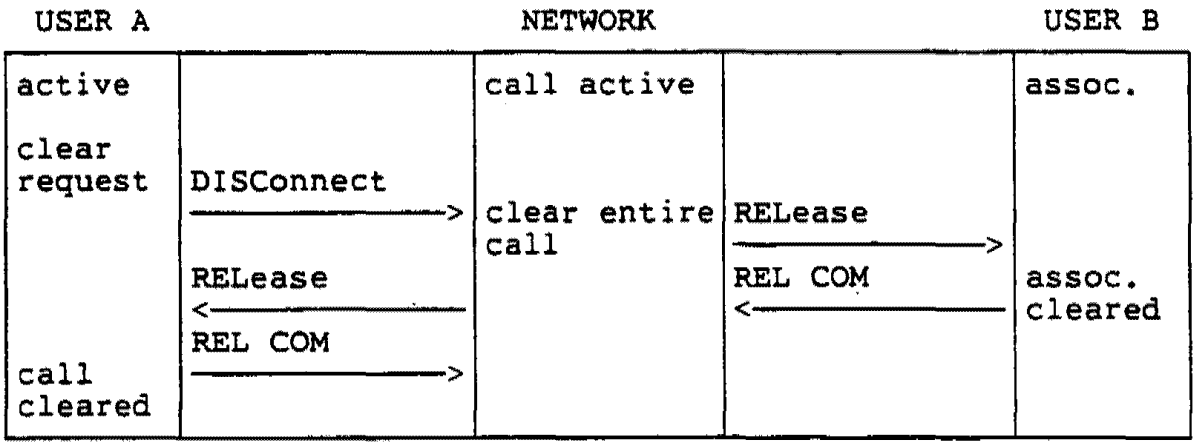


Figure 55. Clearing of Entire Call when EKTS User Disconnects

6.19.3 Feature Interactions and Limitations

The following features/options and basic EKTS are mutually exclusive:

- Hunt groups other than Key Set Short Hunt
- Uniform Call Distribution

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 EKTS group who parked the call will be re-rung. Only one call may be parked per EKTS group. 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.

Privacy release is not allowed if the external party is an attendant console or operator.

A maximum of 30 parties is permitted in a single EKTS call.

EKTS hold can interact with the following types of conference calls:

- Three-way calling
- Station controlled conference
- Attendant conference
- Preset conference
- Meet-me conference

6.19.3.1 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.

6.19.3.2 Flexible Calling

Please refer to section 6.26.4.6.3 for a description of the interactions between EKTS Shared DN and Flexible Calling.

6.20 EKTS RING FORWARD

6.20.1 Definition

EKTS ring forward is similar to the Meridian Digital Centrex feature, MADN Ring Forward, which allows flexibility in the ringing (audible alerting) options that may be assigned to each call appearance of an EKTS directory number.

When EKTS ring forward 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 EKTS group until it is answered or abandoned.
- NEVER - Calls completing on the EKTS group never cause ring alerting for this appearance.
- ABBREVIATED - The EKTS appearance rings from the time the call completes on the group until it is answered or abandoned, or until EKTS ring forward takes effect either automatically or manually.
- DELAYED - The EKTS appearance begins ringing when EKTS ring forward takes effect on the incoming call.

6.20.2 Procedures

EKTS ring forward allows the forwarding of audible ringing for an incoming call terminating to an EKTS DN from one designated subgroup of call appearances to another designated subgroup. Forwarding is invoked either automatically after a time-out period, or manually by the user using a feature activator key. This key is referred to as 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 overide the automatic mode of operation by manual activation using the MRFM key.

The MRFM feature key and the list of EKTS DN appearances which the key is associated with are designated at subscription time. A single MRFM key on a terminal can be used to activate EKTS ring forward for all EKTS DN appearances on the terminal which have the EKTS ring forward option. An ISDN terminal can have more than one MRFM key assigned and the keylist for the different MRFM keys can overlap.

6.20.2.1 Call Termination

The call offering procedures for EKTS calls are described in the previous sections on EKTS. Terminating calls are offer to each member of an EKTS group with a SETUP message sent by the network to each member of the group. When EKTS ring forward is subscribed to for a particular EKTS DN, calls are offered to each terminal sharing the EKTS DN with the Signal information element in the SETUP message coded according to the alerting option subscribed for each of the EKTS DN call appearances.

Upon sending the SETUP messages, in addition to all normal call offering timers, the network will start the EKTS Ring Forward timer. If this timer expires or manual ring forward is activated, 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-Ring forward 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 ring forward is assignable for each EKTS group and has a range from 0 to 60 second.

When EKTS ring forward is activated, only calls which are currently alerting on the associated EKTS group which have not already had EKTS ring forward activated against them, will be affected. The following calls will not be affected:

- Subsequent incoming calls;
- Calls which have already had EKTS ring forward activated against them;
- Calls which are 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 56 on page E-176. 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 message is sent from the network to each terminal with the Signal information element coded according to the subscribed ringing option as shown.

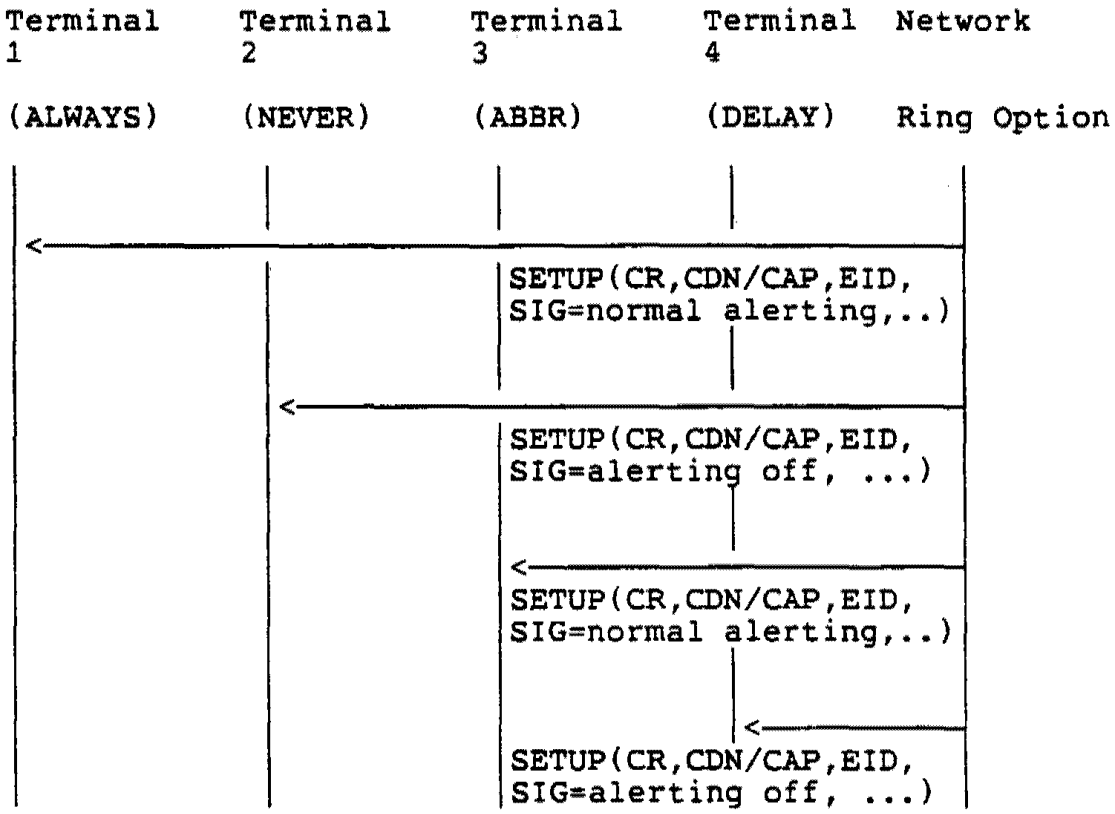


Figure 56. EKTS Initial Termination on a Group With EKTS Ring Forward

In Figure 57 on page E-177, the Ring-Forwarding has just occurred due to either timer expiry (auto Ring-Forward) or MRFM feature key hit (manual Ring-Forward). In this scenario, an INFOrmation message, with Signal information element coded with value "alerting off", is sent to Terminal 3, which has ABBReviated ringing option. This will turn off the audible ringing on that set. Another INFOrmation message with SIG="normal alerting", is sent to Terminal 4, which has DELAYed ringing option. This will turn on the audible ringing. The other two terminals (1 and 2) are not affected.

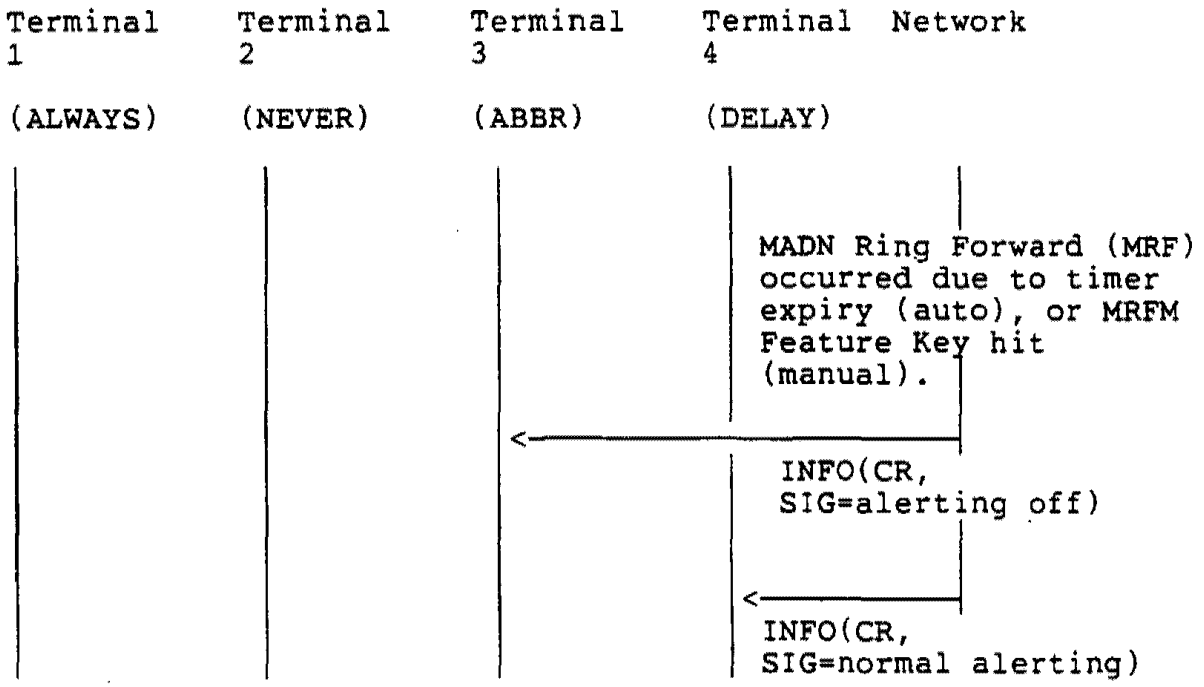


Figure 57. EKTS Ring Forward Occurred After Initial Termination

6.20.2.2 Manual activation of EKTS Ring Forward

The message sequence when a terminal tries to activate the Manual EKTS Ring Foward feature is shown in Figure 58 on page E-178. EKTS ring forward key hit is only valid after one or more EKTS calls have been presented to the terminal activating this feature. The INFOrmation message containing the feature activator (FA) for MRFM is sent when the user hits the MRFM key. The network will screen to see if the activation is allowed. If it is allowed, Ring-Forwarding will occur on all the EKTS DNs affected by this MRFM key. There is no feature indicator associated with the MRFM key, consequently there is no message returned to the terminal to directly indicate the success or failure of the MRFM activation. Indirectly, the success or failure of MRFM activation can be verified by the ringing change caused by Ring-Forwarding.

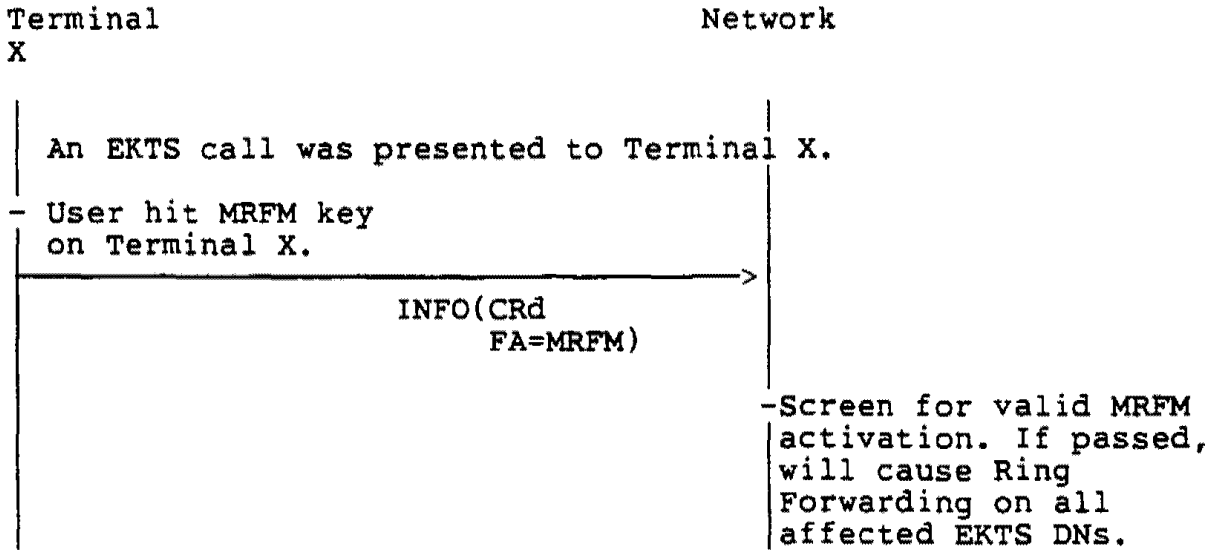


Figure 58. EKTS Manual Ring Forward Feature Activation

6.21 EKTS SECONDARY MEMBER CALL FORWARD PROGRAMMING

6.21.1 Definition

This feature is based on the Meridian Digital Centrex feature which allows secondary members of an EKTS group to program, activate and deactivate call forwarding.

6.21.2 Procedures

EKTS members are designated as either primary or secondary members at subscription time, with one member of the group designated as the primary member and all other members designated as secondary members. Call forwarding for the EKTS group is subscribed to by the primary member of the EKTS group and unless secondary members subscribe to EKTS secondary member call forward programming, only the primary member can program, activate and deactivate call forwarding. EKTS Secondary member call forwarding allows any variant of the call forward feature that can normally be programmed by an EKTS primary member to be programmed by an EKTS secondary member. Call Forward programming by a secodary member uses dial code access.

6.21.2.1 Feature Activation and Programming

EKTS secondary member call forward activation and deactivation use generic procedure G8 and G7 respectively. To activate call forwarding from a secondary EKTS member's terminal, the user originates a call by selecting the EKTS DN. Instead of dialing a destination DN, the user dials the feature access code to activate Call Forward Programming (CFP). A special dial tone is returned by the network, and the user then dials the destination DN digits to which all subsequent calls will be forwarded. Depending on whether the programming is successful or not, a confirmation or re-order tone will be returned to the user. If programming is successful, the network sends notification to the primary EKTS member of call forward activation.

Figure 59 on page E-181 illustrates on of the sequences defined in generic procedure G8 which may be used to activate call forwarding. Before entering the feature access code for CFP, the user originates a call by sending a SETUP message to the network. The feature access code for CFP is then sent to the network using the Keypad information element contained in one or more INFOrmation

messages. An INFOrmation message indicating additional digits are required is returned to the user, along with in-band special dial tone. The forward-to DN digits are then entered by the user and sent to the network using the Keypad information element contained in one or more INFOrmation messages.

If the activation is successful, the network sends a PROGress message along with in-band confirmation tone to the secondary member's terminal. The primary member's terminal is sent an INFOrmation message to turn on the Call Forward feature indicator.

If activation is not successful, negative acknowledgement treatment (re-order tone) is given to the secondary EKTS member. Negative acknowledgement treatment will be given under either of the following conditions:

- When Call Forwarding has already been activated and the user attempts to activate it for the second time, or
- When the secondary EKTS member has entered the feature access code but has not subscribed to EKTS secondary member call forwarding.

6.21.2.2 EKTS Secondary Member Call Forwarding Cancellation

Figure 60 on page E-182, shows the exchange of messages across the user-network interface when call forwarding is cancelled by a secondary EKTS member. To cancel call forwarding, the secondary member selects an appearance of the EKTS DN and then enters the feature activation code for call forward cancellation (CFC). When the cancellation is completed, an in-band confirmation tone will be heard and the primary member's terminal will be sent an INFO message to turn off the Call Forward feature indicator.

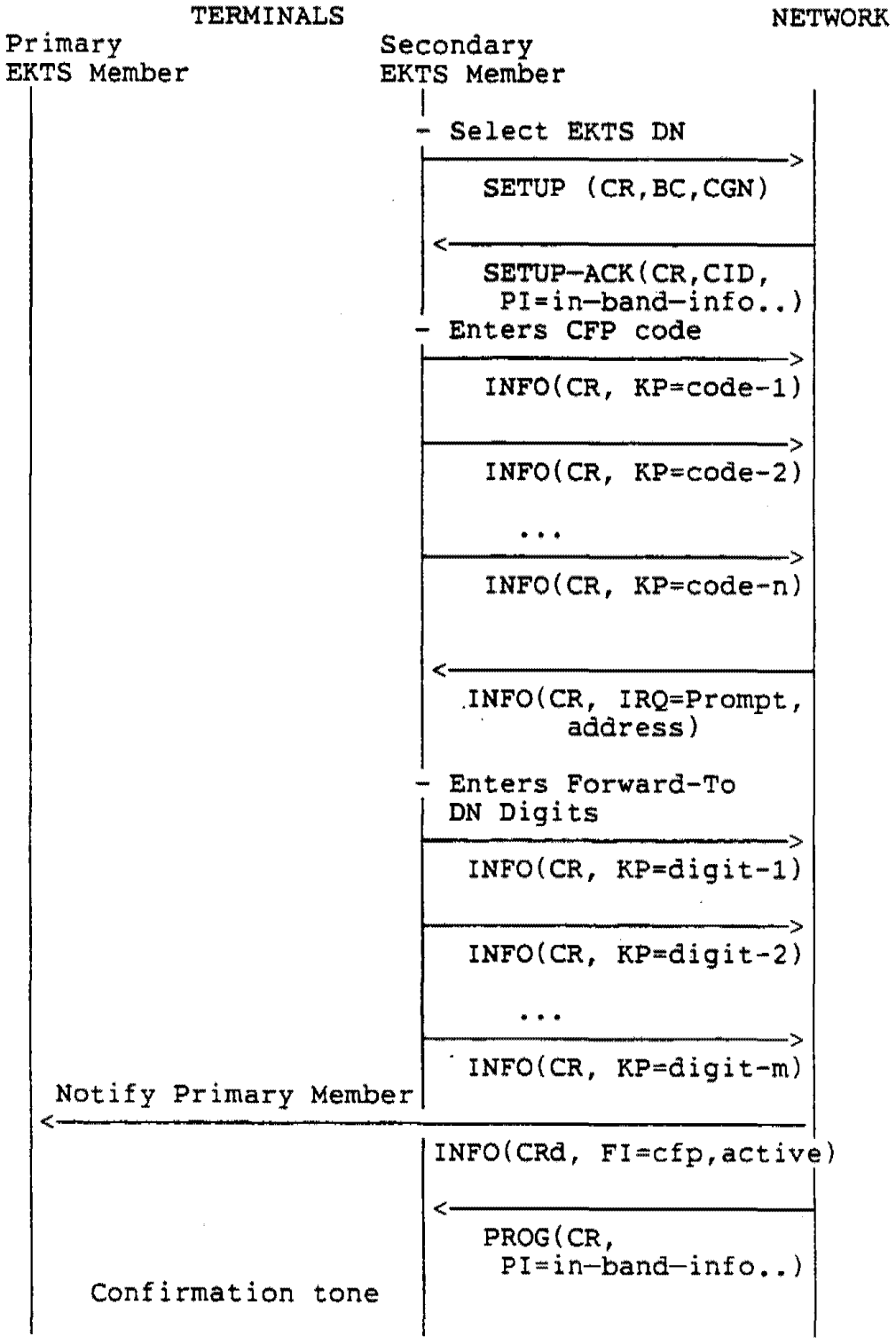


Figure 59. Secondary EKTS Member Call Forward Programming

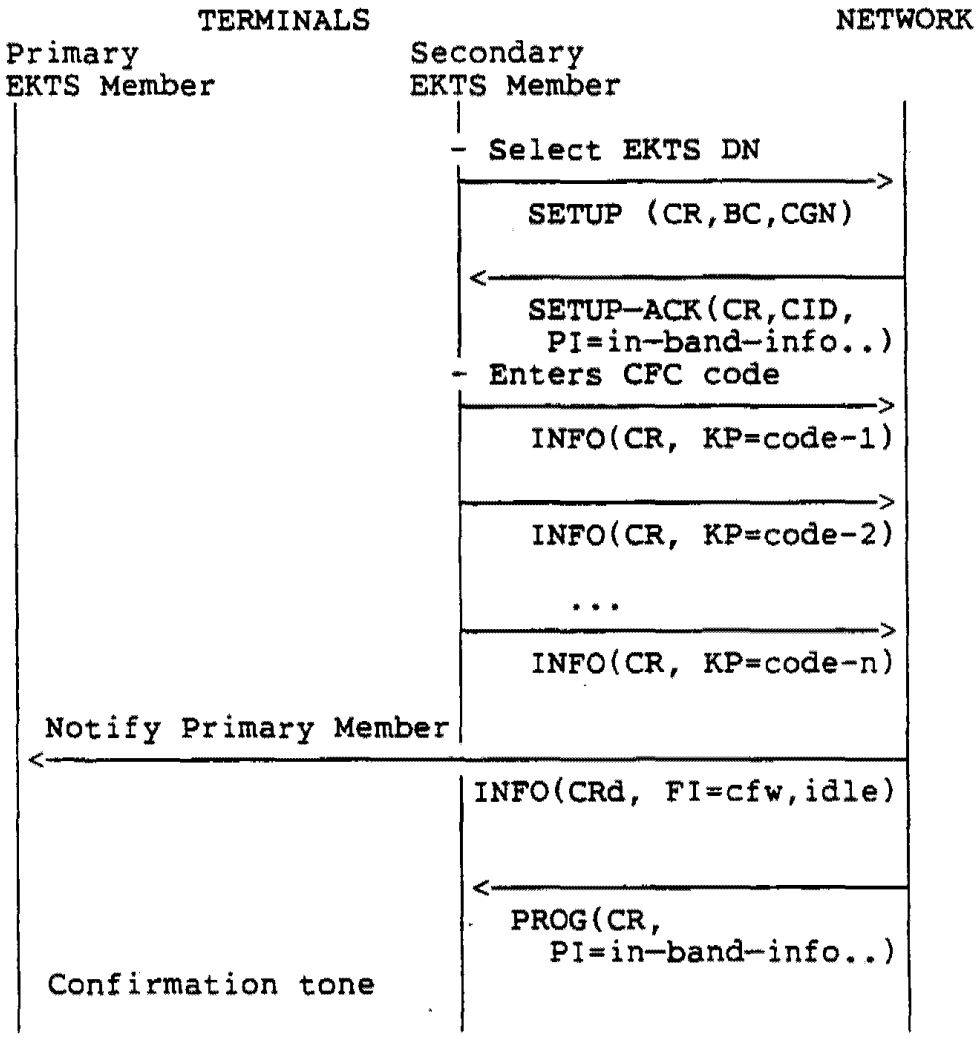


Figure 60. Secondary EKTS Member Call Forward Cancellation

6.22 KEY SET SHORT HUNT

6.22.1 Definition

This feature provides the capability for incoming calls to hunt over a set of directory number appearances (DNs) on an ISDN terminal in search of an idle DN to terminate on.

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 do not have to appear consecutively.

The hunting for an idle appearance starts with the dialed DN and hunts up the given keys from there. Hunting always takes place "up" the keys of the set where "up" means of increasing key value. Hunting is not circular and will stop once an idle DN is found or the hunt list following the dialed DN is exhausted. If the hunt list has been exhausted without an idle DN being found then an optional overflow DN or overflow route will be terminated on. If no overflow DN or route is assigned for the hunt list, busy treatment will be returned to the calling party.

6.22.2 Feature Activation

This feature is subscribed to by the end user on a service profile basis.

6.22.3 Feature Interactions and Limitations

Only one hunt list is allowed per EKTS terminal. The hunt list may not contain intercom (ICM) or group intercom (GIC) members. A given DN cannot 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.

6.23 EMERGENCY SERVICE BUREAU (ESB)

6.23.1 Definition

This feature allows an ISDN user to report an emergency by dialing 911, 9911, or another number to reach an Emergency Service Bureau (ESB).

Once active in an ESB call, the user will not be allowed to release the call. If the user does attempt to clear the call, the user will be put on hold. The ESB will be able to recall the user that has attempted to clear the call. If the user is connected to the call when the ESB recalls the user, the user will receive a receiver off-hook tone.

A user that tries to initiate another call on the same DN will be automatically connected to the ESB.

6.23.2 Procedures

A user establishes a call to an ESB using the normal call establishment procedures as defined in section D. In addition, the network will include in the CONNect message a Notification indicator specifying that the call is to an ESB. Terminals are expected not to initiate clearing after the receipt of this notification. Only the ESB will initiate clearing.

If a user does send a clearing message to the network, the network will follow normal clearing procedures as defined in section D except that the B-channel will not be released. The user is then considered to be in a special held state. Subsequent attempts by the user to establish a call from the same DN/BC will result in an automatic connection to the ESB, i.e. the network will respond to a SETUP with a CALL PROCeeding and CONNect message, regardless of any feature invocations.

When in this special held state, the ESB can recall the user. The network will broadcast a SETUP message to the user with a Signal information element specifying "English ringing", Channel identification information element coded to the B-channel that the call was originally on and the original bearer capability. Normal call establishment procedures follow as defined in section D except that the CONNect ACKnowledge message sent to the user will contain a Notification indicator information element specifying "connected to Emergency Service Bureau".

While in this special held state, attempts by the user to establish a call on any DN and bearer capability combination, the network automatically reconnects the user to the ESB call. Any keypad information or feature invocation in the call request is ignored by the network.

6.23.3 Feature Interactions and Limitations

A user is not allowed to hold an ESB call. The network will reject a HOLD message with a HOLD REJect message with cause value #29 "facility rejected".

All calls to an ESB using call forwarding universal are disabled.

The call park feature cannot be activated while a call to an ESB is in progress.

A call to an ESB cannot be included in a flexible calling conference call.

The executive busy override and speed calling features are compatible with ESB.

The attendant will not be allowed to release any call while it is active with the ESB.

6.24 EXECUTIVE BUSY OVERRIDE (EBO)

6.24.1 Definition

This feature allows a user access to a busy user. Upon receiving busy indication, the calling user may choose to invoke the Executive Busy Override feature (EBO). Once invoked, the called user and the party connected to the called user receive a custom warning tone after which the calling user will enter a three-way call connection with them.

6.24.2 Procedures

Terminal A calls terminal B. Terminal A receives busy treatment because terminal B and terminal C are engaged in an active call. The activation procedures for EBO in this situation are described below.

6.24.3 Feature Activation

User A may invoke this feature using generic procedure G5, as shown in Figure 61 on page E-188. An INFOrmation message is sent to the network with a Feature activation information element containing the EBO feature activator. The network responds with a NOTIFY message with Notification indicator information element specifying "connected via conference facility (controller)" to party A. The network will also send NOTIFY messages to terminals B and C with Notification indicator information element specifying "connected via conference facility (conferee)" and Connected number information element containing the address of party A. A three way connection is now established with terminal A as the controller.

"A" can either remain in the three-way connection or alternatively drop party C. To drop party C, A selects the EBO activator again. On selection of the EBO activator, the terminal shall send to the network an INFOrmation message with a Feature activation information element corresponding to the EBO feature activator. The network will respond with a NOTIFY message with Notification indicator information element specifying "conference facility released" and Connected number information element containing the address of party B. Terminals A and B remain connected and C will be disconnected. Terminal B will also receive a NOTIFY message with Notification indicator information element specifying "conference facility released" and a Connected number information element containing the address of party A. The NOTIFY messages are also sent if party C initiates clearing.

A may alternatively remain in the three-way connection, give a message to B, and drop out of the three-way connection. The call will be cleared using normal clearing procedures as described in section D. This allows parties B and C to continue their original conversation. B and C will also receive a NOTIFY message with Notification indicator information element specifying "conference facility released" and a Connected number information element containing the address of each other.

If terminal B disconnects during the three-way connection, the call will be cleared by the network. A DISConnect message will be sent to the controller (terminal A).

If the execution has been unsuccessful, then the calling terminal will receive re-order tone.

Scenario: Terminal A calls terminal B, using overlap sending procedures, but terminal B is busy. Terminal A receives busy treatment and its user uses the Executive Busy Override activator #x to join in the active call between terminals B and C. Terminal A then drops out and the call between terminals B and C continues.

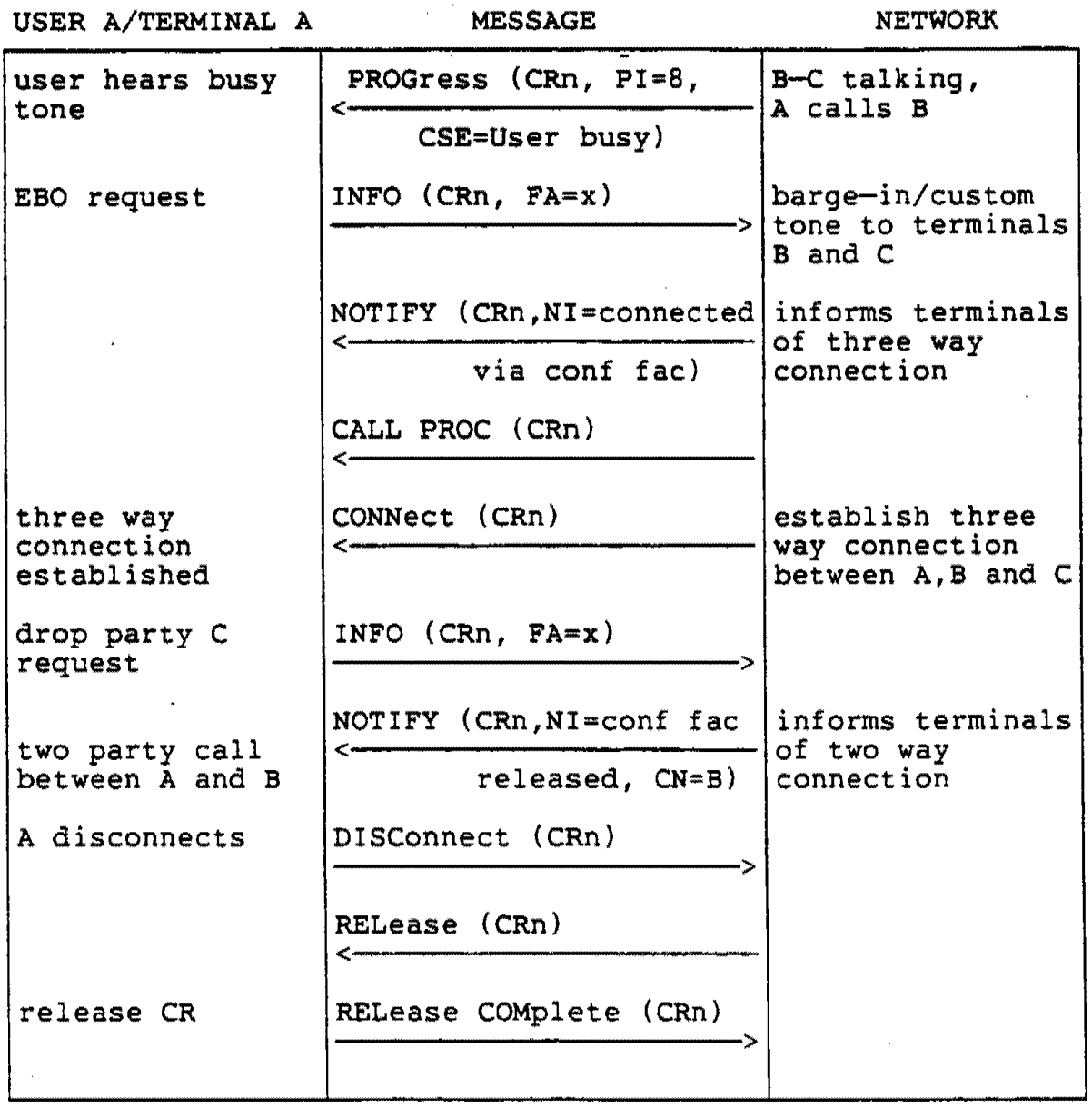


Figure 61. Executive Busy Override Procedures

6.24.4 Feature Limitations

It is not possible to barge-in a call using Executive Busy Override if the bearer capability of the call being barged into is not speech.

For successful activation of the Executive Busy Override feature, the Executive Busy Override terminator must belong to the same customer group as the originator and must not be assigned the 'Executive Busy Override Exempted' option.

EBO cannot be assigned to a hunt group station.

When the calling station is rerouted because of the flexible intercept feature, the EBO is not applicable.

When the calling station is forwarded from the called station because the called station is in the Call Forward All Calls mode or the Forward Don't answer mode, then EBO is not permitted. When the final destination of the calling station's forwarded call is busy, EBO is still not permitted.

When the calling station is forwarded from the called station because the called station is in the Call Forward Busy mode and the forwarded call is eventually connected to busy tone, the EBO can be applied to the originally called station.

When the called station is in a three-way conference/transfer mode, EBO is not permitted.

When the called station is in the do not disturb mode, the calling terminal is routed to the attendant and EBO is not applicable.

A call on a terminal with the call waiting feature and active on a previously waiting call can be barged into by EBO.

6.25 EXECUTIVE BUSY OVERRIDE EXEMPT (EBX)

6.25.1 Definition

This feature is an option of Executive Busy Override (EBO) which means that the station can not be barged into by another station using the EBO feature.

6.25.2 Feature Activation

This feature is assigned at subscription time.

6.26 FLEXIBLE CALLING (FC)

6.26.1 Definition

Flexible calling is a set of capabilities which allows 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 Feature Activators (CONF FAs) for the each of the three conference sizes supported by Flexible Calling (ie. 3-party, 6-party, and up to 30-party (in increments of six)).

The Flexible Calling feature is based on the capabilities defined by Bellcore specification TR-TSY-000858 Issue 1 "Flexible Calling for Managing Multiple Independent Calls".

The following capabilities are provided with flexible calling:

a. The user can designate a call to be a conference call.
b. The user can hold a conference call and subsequently retrieve the conference call from hold.
c. The user can bridge a call onto a conference call (a call bridged into the conference can be either incoming or outgoing in direction).
d. The user can release the last call added to the conference call.
e. The user can transfer a conference call.
f. The user can initiate clearing of the entire conference.

This supplementary service uses three feature activators for invoking various aspects of flexible calling. 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

The following summarizes the capabilities provided by the flexible calling service. A detailed description of these capabilities 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, subsequent calls can be added as follows:

- 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.

- The controller can retrieve a held call causing the held call 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 that was 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 will interpret a drop request as a request to terminate the call and both parties (as well as the conference facilities) will be released.

A transfer request from the controller will cause the network to disconnect the controller from the conference, but maintain the connection between the conferees.

The controller can take down the entire conference.

A conferee can disconnect from the conference.

Conferees in a 3-way conference can invoke a conference of their own, thereby establishing a 3-way conference chain.

6.26.2 Terminology

Established Call - For the purposes of the Flexible Calling supplementary service, an ISDN call is considered established when one of the following requirements is met:

1. For an originating ISDN user, the call on the originating user's interface is in call state "Outgoing Call Proceeding", "Call Delivered", or "Active").

2. For a terminating ISDN user, the call on the terminating user's interface is in call state "Active".

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 controller of a conference refers to 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 - Autohold refers to the automatic holding of an existing active call by the network. This is used only in Flexible calling and in EKTS DN Bridging.

6.26.3 Procedures

6.26.3.1 Invoking Conference Capability

6.26.3.1.1 Invoking Conference Facility During Call Establishment

To invoke FC while originating a call, the controller uses the generic Feature Key Management (FKM) procedures as part of call origination, ie. the controller either includes the conference feature activator information in the SETUP message or as part of subsequent INFOrmation message sent in response to the SETUP ACKnowledge. (See the generic feature access procedure G4.)

The following figures illustrate the various FKM procedures for invoking a conference during call establishment:

- Figure 62 on page E-194 shows the procedures for a conference request in a SETUP message with no address information
- Figure 63 on page E-195 shows the procedures for a conference request in a SETUP message with all address information
- Figure 64 on page E-195 shows the procedures for a conference request in a SETUP message with partial address information
- Figure 65 on page E-196 shows the procedures for a conference request in an INFOrmation message during call establishment.

Scenario: A user invokes conference during call establishment by including the conference feature activator #x in the SETUP message and no called party number information.

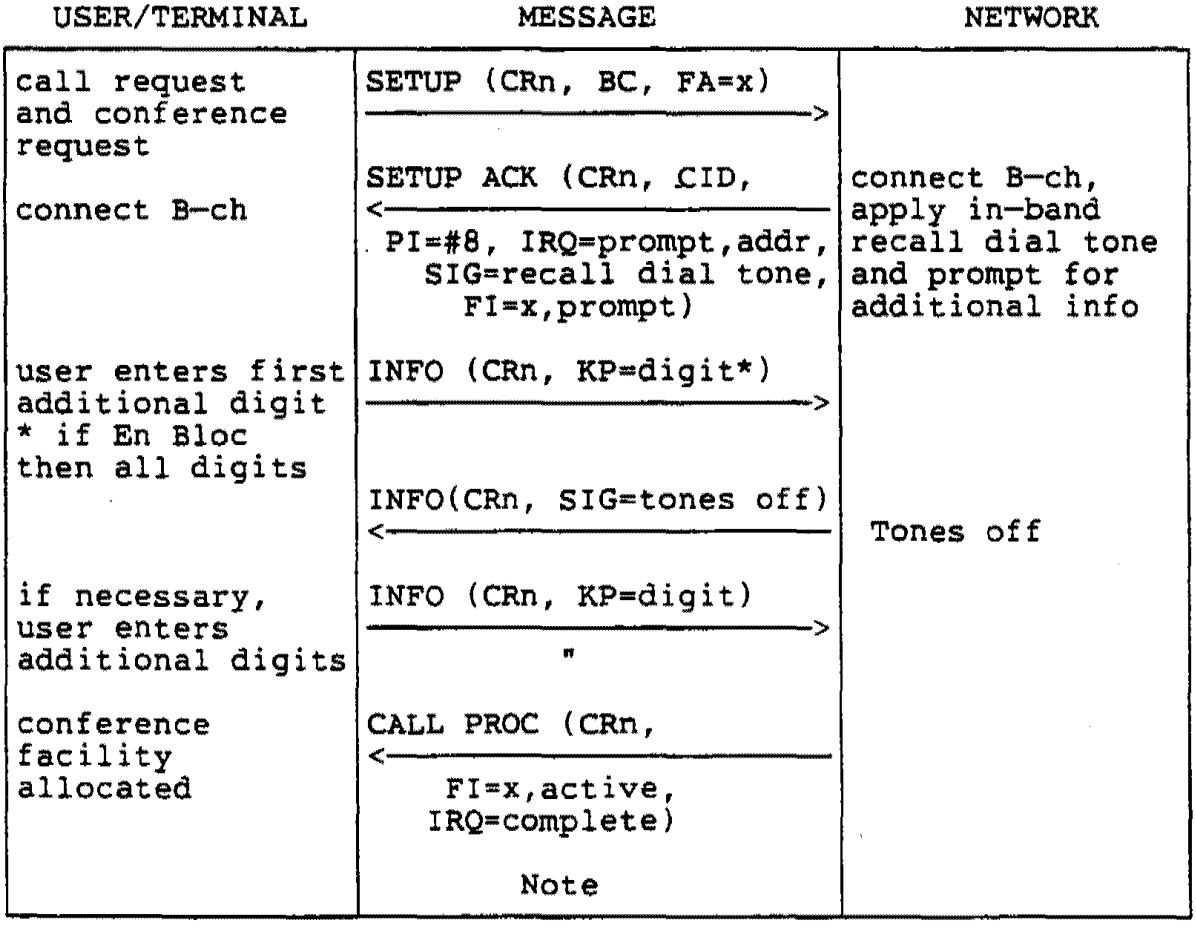


Figure 62. Conference Request and No Address Info in SETUP Message

Note: Normal call establishment occurs as described in section D.

Scenario: A user invokes conference during call establishment by including both the conference feature activator #x and the called party number information in the SETUP message.

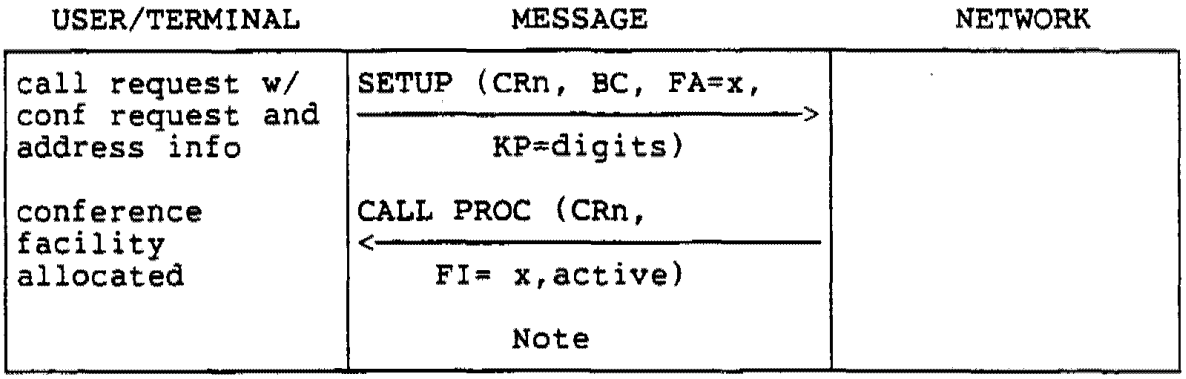


Figure 63. Conference Request and All Address Info in SETUP Message

Note: Normal call establishment occurs as described in section D.

Scenario: A user invokes conference during call establishment by including the conference feature activator #x in the SETUP message and partial called party number information.

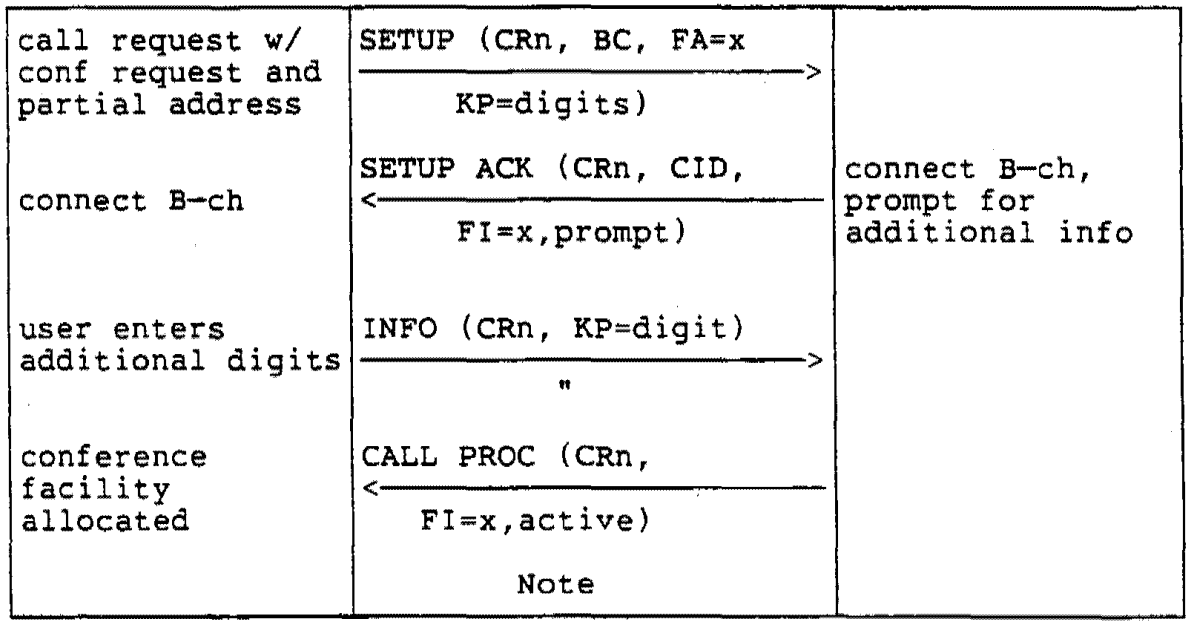


Figure 64. Conference Request and Partial Address Info in SETUP

Note: Normal call establishment occurs as described in section D.

Scenario: A user invokes conference during call establishment by including the conference feature activator #x in an INFOrmation message during overlap sending.

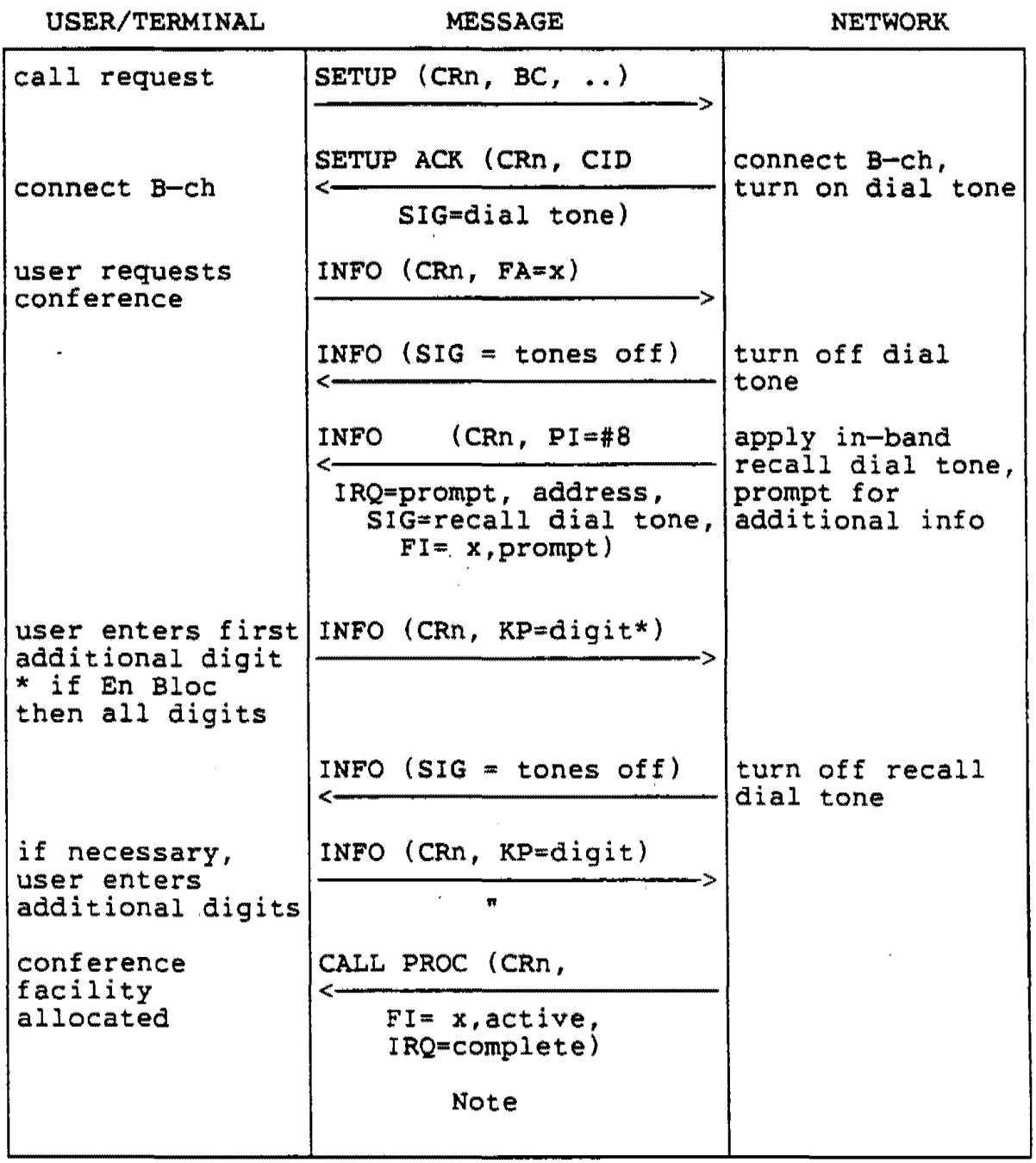


Figure 65. Conference Request Using INFOrmation Message

Note: Normal call establishment occurs as described in section D.

6.26.3.1.2 Invoking Conference Facility for an Established Call

The user can request that a conference facility be assigned to an established call by sending an INFOrmation message to the network with the call reference of the established call. The INFOrmation message contains a Feature activation information element with the conference feature activator. The network will respond with an INFOrmation message with a Feature indication information element containing the conference feature indicator with status "active". (For more details on FKM feature activation during an active call see generic procedure G5 described in this section.) Figure 66 shows the procedures for conference invocation using the call reference of an established call.

Scenario: A user invokes conference on a call already established on call reference #n by including the conference feature activator #x in an INFOrmation message.

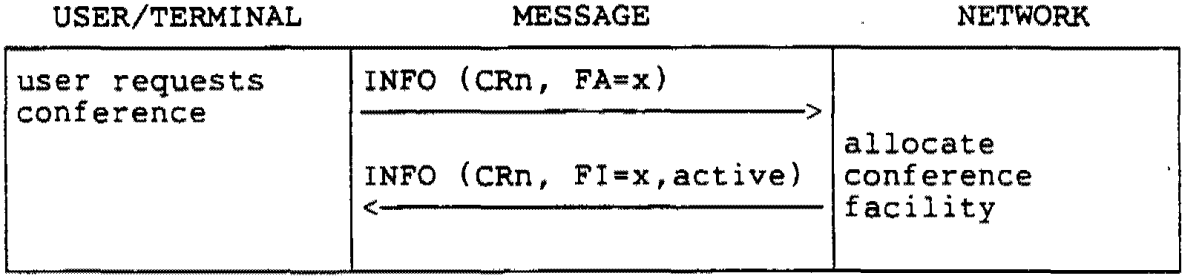


Figure 66. Conference Request of Established Call (Success)

Note: This capability can not be invoked on a held call.

6.26.3.1.3 Error Conditions

If a conference request is received during call establishment and it cannot be granted, the network will reject the request and clear the call. The conditions for rejecting the conference request and the associated cause that will be returned in the first clearing message are as follows:

- If conference facilities are not available, cause value #34 "circuit/channel congestion" is used
- If the bearer capability 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 has been received from the user, a cause value is determined as specified in Section D.

Figure 67 shows the rejection of a call setup including a conference invocation.

Scenario: A user invokes conference when establishing a call by including the conference feature activator #x in the SETUP message. The conference request is rejected.

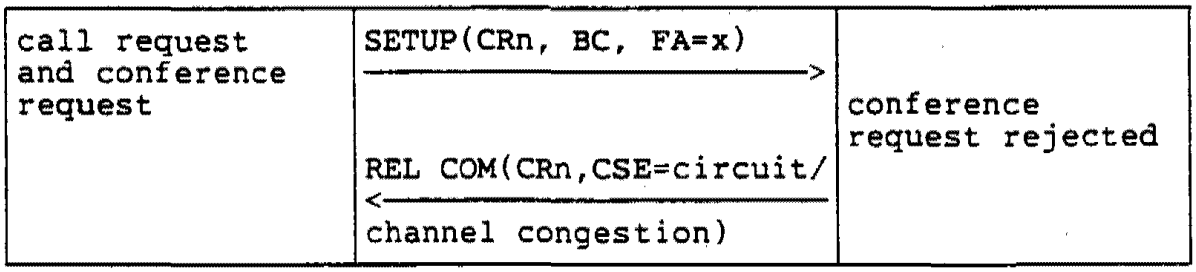


Figure 67. Conference Request during Call Establishment (Failure)

If conferencing was requested using the call reference of an established call in an INFOrmation message, the network will reject the conference request with an INFOrmation message containing the appropriate cause value. The conditions and associated cause values are as follows:

- If a conference facility is not available cause value #34 "circuit/channel congestion" is used.

- If the bearer capability 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 message will proceed as normal. Figure 68 on page E-199 shows the rejection of a conference request because conference resources are not available.

Scenario: A user invokes conference on a call already established on call reference #n by including the conference feature activator #x in an INFOrmation message. The conference request is rejected.

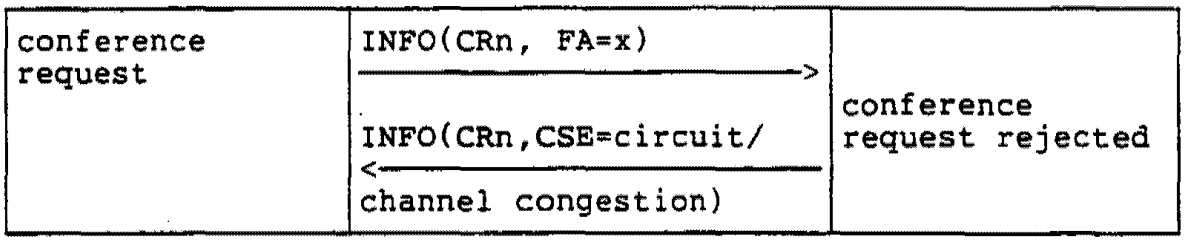


Figure 68. Conference Request of Established Call (Failure)

6.26.3.2 Adding a Call to a Conference

Once the controller is active on a conference call, subsequent calls can be added to the conference by the controller. This can be done in one of two ways using the RETRieve message:

- The controller can retrieve a held conference call onto a connected basic call.

  For example, if SETUP is sent, the conference call is placed on autohold and the new call is established. The conference can then be retrieved and the two calls are bridged (see Figure 69 on page E-201).

- The controller can retrieve a held call onto an connected conference call.

Note: The Channel identification information element if included in the SETUP or RETRieve message may contain either "any channel", "preferred B1", "preferred B2", "exclusive B1", or "exclusive B2". All of the above will be successful except if the existing call is on B1 (B2) and "exclusive B2" ("exclusive B1") is selected. In this case the call will be rejected with a RELease message from the network with a cause value #44, "requested circuit/channel not available".

In either case, upon connecting the additional call to the conference, the network will send a DISConnect message to the controller in order 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 message to retrieve the conference call before receiving a CONNect message for the additional call. Subsequent inband tones are applied to all members of the conference.

When a conference call changes from two to three members as a result of bridging, the conferees will receive a NOTIFY message with Notification indicator information element specifying "connected via conference facility (conferee)". Subsequent members that are bridged onto the conference will also receive this NOTIFY message. This is to give the conferees an indication that they are members of a conference.

When the number of parties on the conference reaches the maximum conference size (as specified by the CONF FA used to invoke the conference), the network will alert the controller by sending a NOTIFY message with the notification indication information element coded to "conference bridge full."

Scenario: A user has conference facility assigned to a call on call reference #n. The user then makes another call on call reference #m and bridges the two calls. The conference call is autoheld during this procedure.

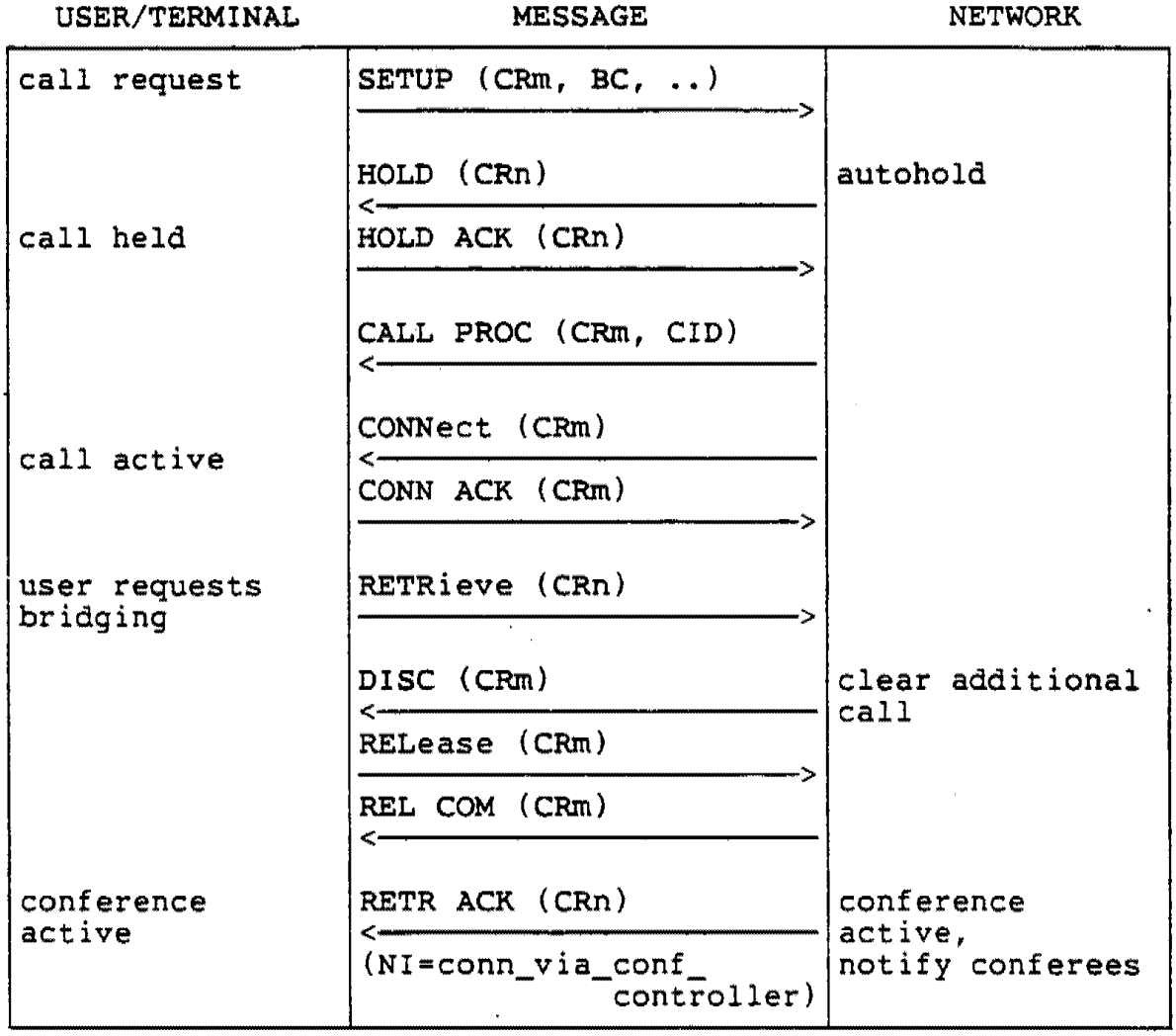


Figure 69. Bridging Call to Conference after Answer (Success)

6.26.3.2.1 Error Conditions

The network will reject a RETRieve request to add a call onto a conference when one of the following conditions exist:

a. A call on the conference has not yet reached an established state.
b. The maximum number of users allowed on the conference has been reached.
c. The bearer capability of this call to be added is not speech or 3.1 kHz audio.
d. The autohold procedures fail.

The network will reject the request with a RETRieve REJect message. The message will contain one of the following causes corresponding to the above error conditions, respectively:

a. network-specific cause value #53 "service operation violated"
b. network-specific cause value #53 "service operation violated"
c. network-specific cause value #51 "call type incompatible with service request"
d. network-specific cause value #53 "service operation violated"

Figure 70 illustrates the procedures for rejecting a retrieve request.

Scenario: A user is the controller of a conference on call reference #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 has been reached.

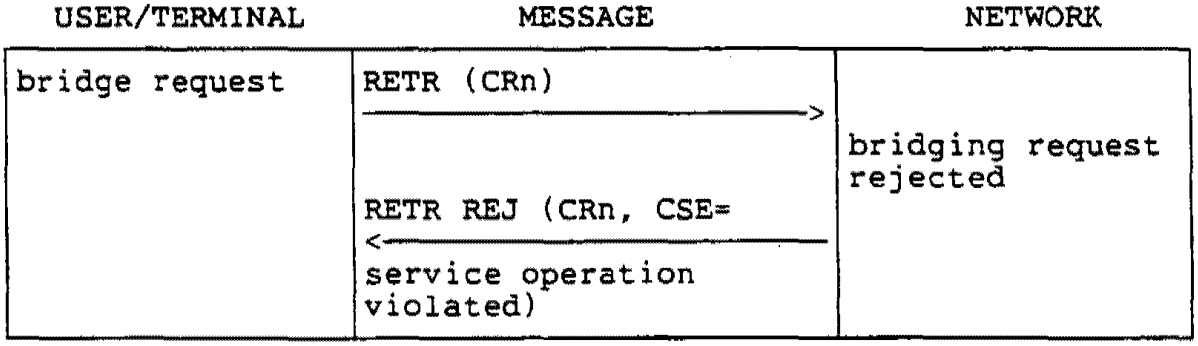


Figure 70. Bridging Request (Failure)

6.26.3.3 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 will cause the conference call to be retrieved. However, if a call is currently active a retrieve request will cause the conference call to be retrieved PLUS the bridging of the existing call onto the 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 71.

Scenario: A user has conference facility assigned to a call on call reference #n. The user also has another call on call reference #m. The user must hold the conference call before retrieving the other call if bridging is not desired.

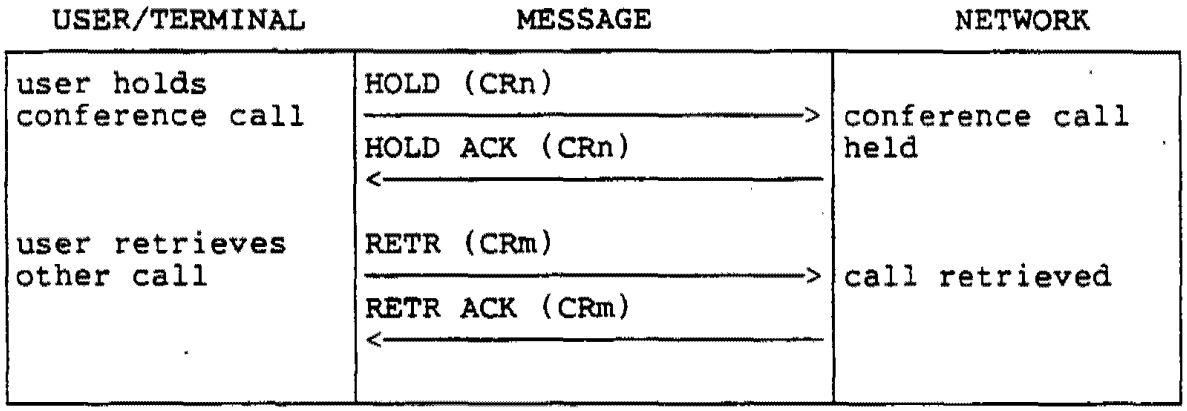


Figure 71. Holding a Conference and Retrieving without Bridging

6.26.3.4 Dropping a Call from the Conference

To drop the last call added onto a conference, the controller should send the network an INFOrmation message with the Feature Activation (FA) information element set to either the DROP or the CONF FA. (The CONF FA is interpreted as a drop request (1) when sent within the context of an established conference, and (2) 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 will also send the controller a NOTIFY message with the notification indicator information element coded to "conference bridge port available" if (1) the drop request was received while the conference bridge was full (ie. while the number of parties on the conference was equal to the maximum conference size), and (2) the controller is involved in a conference of more than 3 parties.

Whenever a conference call drops down to two parties, the network will send the controller and remaining conferee a NOTIFY message containing a Notification indicator information element specifying "two party call" and a Connected number information element specifying the connected address.

If there is only one party left in the call (in addition to the controller) when a drop request is received, then the network will release the conference facilities and clear the call to both parties using cause value #16, "normal call clearing." In addition, the clearing message sent to the controller will also contain a Feature indication information element with the conference feature indicator and status "idle".

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) feature activator #x.

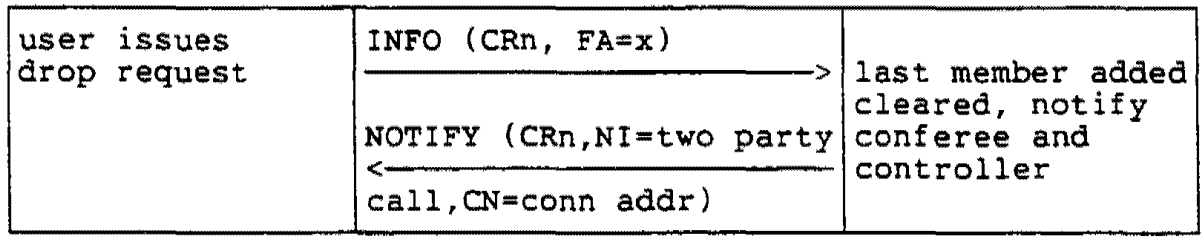


Figure 72. Dropping a Call from a Conference from 3 to 2 members

6.26.3.5 Transferring a Conference

The controller can invoke transfer capability by sending to the network an INFOrmation message with a Feature activation information element with the transfer feature activator.

If the call reference of the INFOrmation message is the conference ID, then the network will respond by initiating call clearing with a DISConnect message if the conference is connected or a RELease message if the conference is on hold with a Feature indication information element with the conference feature indicator and status "idle". The remaining conferees remain in the conference.

If the conference call is on hold and the controller sends an INFOrmation message containing the call reference of a connected call, the network will bridge 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 will receive a NOTIFY message with a Notification indicator information element 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 will both receive a NOTIFY message with a Notification indicator information element specifying "two party call" and a Connected number information element containing the address of each other.

After the controller has been released from the conference, the network will maintain the conference facility until only two calls remain connected to the conference facility at which time the call is converted into a normal two-way connection.

When only two members are left in the conference, they will both receive a NOTIFY message with a Notification indicator information element specifying "two party call" and a Connected number information element containing the address of each other.

An example of transferring a connected conference call is illustrated in Figure 73 on page E-206. Figure 74 on page E-207 illustrates the procedure when the controller issues the transfer while the conference call is on hold.

Scenario: A user is the controller of a connected conference call with two conferees. The controller transfers the conference using the transfer feature activator #x. The conference feature indicator is #y.

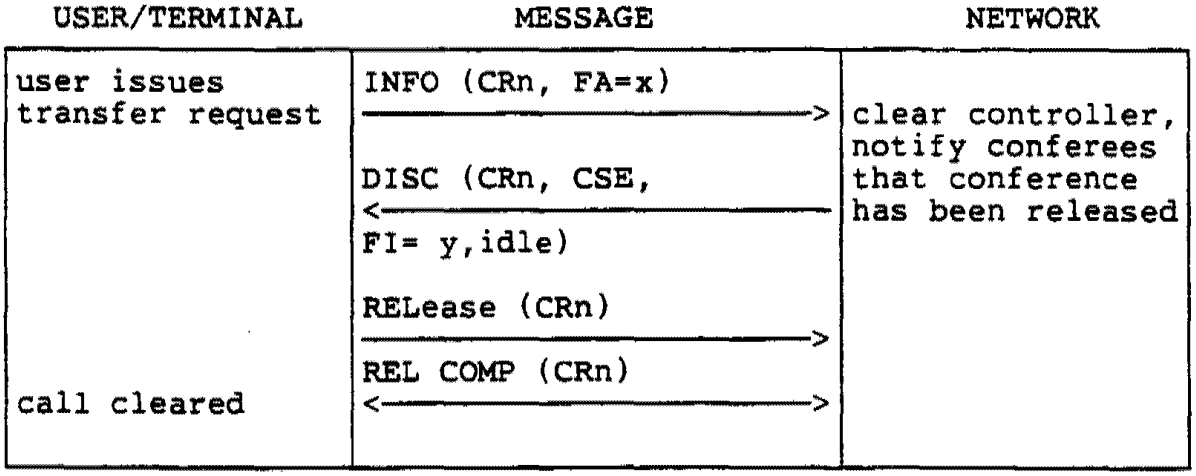


Figure 73. Transferring a Connected Conference Call

Scenario: A user is the controller of a call on hold which has conference facilities attached (i.e. 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 feature activator #x. The conference feature indicator is #y.

USER/TERMINAL	MESSAGE	NETWORK
user issues transfer request	INFO (CRn, FA=x) ——>	clear controller, notify conferee and other user that call is transferred
	RELease (CRm, CSE, #16) <—— FI= y,idle)	
conference call cleared	REL COMP (CRm) ——>	
	DISC (CRn, CSE) <——	clear established call
	RELease (CRn) ——>	
established call cleared	REL COMP (CRn) <——>	2-way connection remains

Figure 74. Transferring a Call onto a Held Conference Call

6.26.3.5.1 Error Conditions

The network will reject 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 2 established calls associated with the conference and at least one is in the active state
- 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 will reject the transfer attempt by returning 5 seconds of inband reorder tone and an INFOrmation message containing network-specific cause #53, "service operation violated". All calls associated with the controller will remain in their current state.

6.26.3.6 Clearing the Entire Conference

The entire conference can be cleared by the controller by sending a DISConnect message to the network if the conference call is currently active. If the conference call is currently on hold, the same result can be achieved with a RELease message. In response, the network will clear the entire conference (which includes all calls on the conference). The network will include the Feature indication information element containing the conference feature indicator 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.

6.26.3.7 Conferee Releases from the Conference

When a conferee sends a clearing message to the network and drops out of a conference call with more than three members, the network will clear the conferee with the clearing procedures defined in section D.

When a conferee sends a clearing message to the network and drops out of a conference call with three members, the network will clear the conferee with the normal clearing procedures defined in section D and the controller and the remaining conferee will receive a NOTIFY message containing a Notification indicator information element specifying "two party call" and a Connected number information element.

If there are only two members left and the conferee drops out, the conference facility is released and the call is cleared to both the controller and the conferee as defined in section D. The clearing message to the controller will contain a Feature indication information element with the conference feature indicator with status "idle".

If one of the conferees on a conference of more than 3 parties sends the network a clearing message while the conference bridge is full (ie. while the number of parties on the conference equals the maximum conference size), the network will clear the conferee as defined in section D and send the controller a NOTIFY message with the notification indicator information element coded to "conference bridge port available."

6.26.3.8 3-Way Flexible Call Chaining

Conferees in a 3-way Flexible Call conference who are assigned FC can establish their own conferences and create FC chains using the FC protocol described in this section. (Figure 75 demonstrates the configuration of chained conferences.)

A 3-way Flexible Call Chain is subject to two limitations:

1. 3-way Flexible Call Chaining capability cannot be used to join together two existing conference calls

2. A 3-way Flexible Call Chain cannot be transferred to another conference.

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.

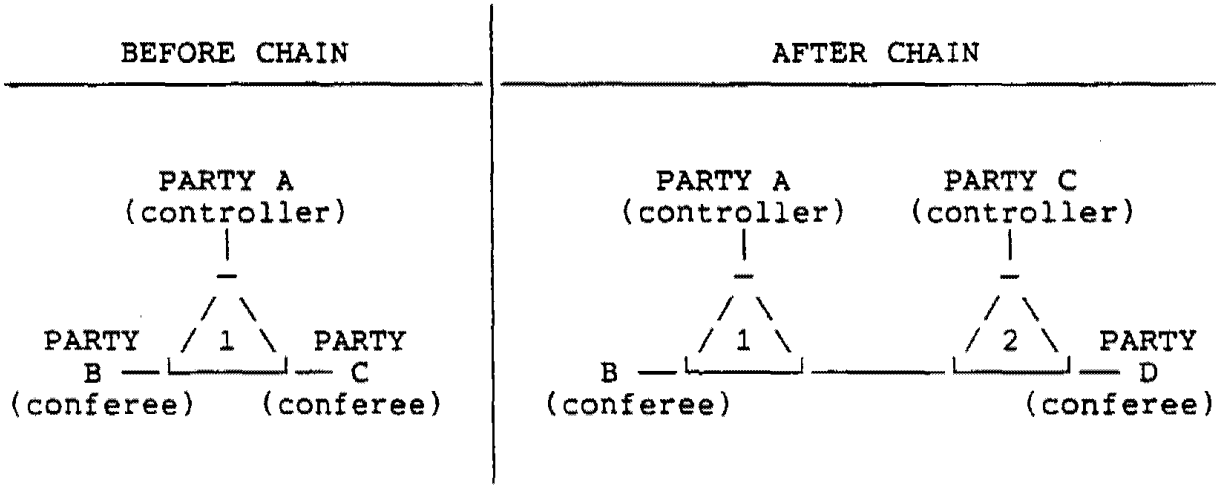


Figure 75. Establishing a 3-Way Flexible Calling Chain

6.26.4 Feature Interactions and Limitations

6.26.4.1 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 flexible calling feature.

Throughout this section, the following terms are used:

Flexible calling blocked agent - An agent which cannot be part of a flexible call. This implies one of two things:

1. The conference capability cannot be attached to a call containing this agent (e.g. attendant console, 911). If conference capability was attached during call establishment before routing, the controller will receive treatment when the call terminates on an flexible calling blocked agent.

2. Any additional call on the BRI interface containing this agent cannot be bridged or transferred into the conference. Such an attempt will be rejected with an appropriate RETRieve REJect or INFOrmation message with network-specific cause value #53 "service operation violated".

Flexible calling blocked call - A call or call state which is incompatible with flexible calling. This implies one of two things:

1. The conference capability cannot be attached to a call in this state.

2. Any additional call on the BRI interface in this state cannot be bridged or transferred onto the conference.

Add-on call - The call which was last added to the conference via the flexible calling service.

6.26.4.2 Basic IBN - Attendant Features

6.26.4.2.1 Attendant Camp-on

If the attendant is camped-on to a call involving an ISDN functional terminal, that terminal will be prevented from invoking the flexible calling service.

6.26.4.2.2 Attendant Transfer

If a call from an Attendant Console is routed to an ISDN set over a trunk (i.e., the incoming agent is a trunk), the user of the ISDN set can invoke flexible calling on the call. Otherwise, a call from an Attendant Console is flexible calling blocked.

6.26.4.2.3 Busy Verify Line

An attendant is not allowed to barge in on a conference call established by the flexible calling service. The attendant call will be routed to busy treatment.

6.26.4.2.4 Busy Verify Trunk

If the trunk being busy-verified is involved in the flexible calling conference call, the attendant call will be routed to busy treatment.

6.26.4.2.5 Attendant Message Waiting

The message center is a flexible calling blocked agent. This applies also to calls which are forwarded to the message center.

6.26.4.3 Basic IBN - System Features

6.26.4.3.1 No Double Connect (NDC)

Flexible calling and NDC are incompatible. Service orders will block the assigning of both these options to the same DN group on the ISDN functional terminal.

6.26.4.3.2 3WC Chaining

A call involved in a 3WC or 3WC chain is a flexible calling blocked call.

When an ISDN user is a conferee in a 3WC/conference six call, the network will send a NOTIFY message with Notification indicator information element specifying "connected via conference facility (conferee)". When the 3WC drops down to a two way connection an ISDN conferee will receive a NOTIFY message with Notification indicator information element specifying "conference facility released" and a Connected number information element with the address of the other remaining party.

6.26.4.3.3 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 preempt the paging equipment if the user is engaged in a conference call.

6.26.4.4 Basic IBN - Station Features

6.26.4.4.1 Call Hold

Any call that has been held by the call hold feature falls into the category of a flexible calling blocked call. The conference or add-on call cannot be held by the call hold feature.

6.26.4.4.2 Permanent Hold

A call held by the permanent hold feature falls into the category of flexible calling blocked calls. Permanent hold cannot be activated on the conference or add-on call.

6.26.4.4.3 Station Call Park

A parked call is considered a flexible calling blocked call. A conferee cannot park either the conference or add-on call.

6.26.4.4.4 Universal Call Distribution (UCD)

A UCD agent is a flexible calling blocked agent.

6.26.4.4.5 Call Forward Don't Answer (CFD)

Call Forward Don't Answer is only applicable when invoking a 3-party flexible calling conference. For greater than 3-party conferences, the CFD timer will not be started and the call will continue to ring.

6.26.4.5 IBN Enhanced Business Services - System Features

6.26.4.5.1 Executive Busy Override (EBO)

EBO calls belong to the category of flexible calling blocked calls. An EBO user cannot barge into the conference or add-on call.

6.26.4.6 Business Set Features

6.26.4.6.1 EKTS Group Intercom

A controller which is a member of a GIC group may only transfer calls to other members in the group. An attempt to transfer a call to a party outside the group will be rejected.

6.26.4.6.2 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 will be ignored if the called user is a 500/2500 set or the called user will receive treatment if it is an MBS or ISDN stimulus set. Calls held by the MCH feature are flexible calling blocked calls.

6.26.4.6.3 EKTS Shared DN

An EKTS user assigned Flexible Calling (FC) can perform conference capabilities on an EKTS shared DN if the EKTS 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 EKTS shared DN call then the following restrictions apply:

- when the EKTS user attempts to invoke conference on an EKTS shared DN, the network will reject the request in an INFOrmation message containing cause value #29 "facility rejected".

- when the EKTS user attempts to bridge an EKTS-shared DN call and the FC conference call, the network will reject the request by sending a RETRieve REJect message containing cause value #29 "facility rejected".

- when the EKTS user attempts to transfer together an EKTS shared DN call and the FC conference call, the network will reject the request by sending an INFOrmation message containing network specific cause value #53 "service operation violated".

A request from an EKTS user to invoke conference on an EKTS shared DN call that has been either MADN or EKTS held will be rejected by the network by sending an INFOrmation message to the user containing network specific cause value #53 "service operation violation".

When an EKTS 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 will reject the request with an appropriate rejection message containing cause value #29 "facility rejected".

An EKTS user who is also an FC controller on an EKTS shared DN call can place the call on hold and retrieve the call from hold. Associated EKTS members of the EKTS group may not retrieve the held call. No notification that the call has been placed on hold or has been retrieved from hold 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.

In general, notifications sent to remote parties for EKTS shared DN calls are withheld when the remote party is an FC conference.

6.26.4.6.4 Flexible Station Controlled Conference

A call involved in a flexible station controlled conference is an flexible calling blocked call. The other party in the conference call or conferee cannot invoke the flexible station controlled conference feature.

6.26.4.6.5 ACD (Automatic Call Distribution)

An ACD agent is a flexible calling blocked agent.

6.26.4.6.6 IBN Preset Conferencing

A call involved in a preset conference is an flexible calling blocked call.

6.26.4.7 IBN-ESB Compatibility

6.26.4.7.1 911 Service

The emergency service line and trunk are both flexible calling blocked agents.

6.26.4.8 IBN Superset

6.26.4.8.1 Call Waiting Originating/Dial Call Waiting

A station that has the call waiting originating feature cannot impose call waiting on the controller or any of the two conferees after bridging has occurred. The calling station will continue to receive busy treatment in this case.

Call waiting cannot be imposed via the dial call waiting feature by a station on any party involved in a conference call set up via the flexible calling service. In this case, the calling party will receive busy treatment.

6.26.4.8.2 Directed Call Pickup with Barge-in (DCBI)

This feature allows an IBN station to answer a call that is ringing any other line within the same customer group and served by the same DMS switch.: If the called station has already answered the call by the time the activating station has completed the pick-up sequence, the activating station may barge into the answered call.

A call that was barged into via the DCBI feature is an flexible calling blocked call.

6.26.4.8.3 Directed Call Park

A call on the BRI interface that was parked by the directed call park feature is an flexible calling blocked call. An ISDN user can bridge or transfer any call that was retrieved via the directed call park feature into the conference as if that call was established via normal termination procedures.

6.26.4.9 Miscellaneous

6.26.4.9.1 Operator Trunks

Flexible Calling cannot be invoked for calls using operator trunks.

A call involving an operator trunk on the BRA functional interface can either be held manually or via the autohold procedures. Thus, the ISDN hold capability temporarily disables the operator hold control feature.

6.27 HOLD AND RETRIEVE

6.27.1 Definition

The Hold and Retrieve feature is a functional version of hold, using Q.931 functional messages for activation of this feature.

The Hold and Retrieve service allows a user to interrupt communication on an existing call/connection and then subsequently, if desired, re-establish communication.

6.27.2 Procedures for Hold

Procedures for both user-initiated hold and network autohold are described below. The preferred approach for terminals is to use the user-initiated hold procedures.

6.27.2.1 User Holding a Call

The user is allowed to explicitly hold any established call by sending a HOLD message to the network, as shown in Figure 76 on page E-219. An established call is an outgoing call which has progressed passed Call Proceeding (i.e. after receiving CALL PROCeeding message from the network), or an incoming call which has received a CONNect ACKnowledge message from the network.

The user at this time, shall disconnect the B-channel.

If the hold request is valid, the network will release the B-channel at the interface and send a HOLD ACKnowledge message. If the held user was receiving CALL ALERTing, a signal information element containing signal #63 will be included in this message. Upon receiving the HOLD ACKnowledge message, the user shall release the B-channel but maintain the call reference value.

If the hold invocation was not successful, the network will return a HOLD REJect message, with an appropriate cause. The user shall then re-connect the B-channel.

6.27.2.2 Autohold Procedures

The network may also autohold an existing call by sending a HOLD message to the user, as shown in Figure 77 on page E-220. After sending the HOLD message, the network will disconnect from the B-channel at the user-network interface and start hold request timer T360 (default 4 seconds). Autohold procedures are only available for the Flexible calling and EKTS DN Bridging supplementary services. Explicit HOLD procedures shall be used in all other cases.

If a HOLD ACKnowledge message is received from the user before expiry of timer T360,[4] the network will cancel timer T360 and reserve the B-channel for use by the user on the interface.

If the network received a HOLD REJect message from the user, the network will cancel timer T360 and re-connect the B-channel. If the Cause information element is missing in the HOLD REJect message, the network will process the HOLD REJect message as if the Cause information element was included. The actions that follow will depend on the event which initiated the autohold request:

a. If the hold request was a result of a retrieve request from the user, the network will reject the retrieve request by sending a RETRieve REJect message to the user.

b. If the hold request was initiated as a result of a call request from the user, the network will reject the call request by sending a RELease COMplete message, as described in section D of this specification.

c. If the hold request was initiated as a result of a connect request from the user during additional call offering, then the network will clear the additional call to the user by sending a RELease message and following the call clearing procedures defined in section D.

d. If the hold request was initiated as a result of a feature activation request from the user, then the network will revert to the condition before the feature request was received.

In cases a to c, the network will send a cause value #34 "no circuit/channel available" to the user.

---

[4] Currently the network does not wait for the user to acknowledge the autohold request.

If the hold request timer T360 expires before any response is received from the user, the actions taken will be the same as if a HOLD REJect has been received, as described above.

Scenario: A user is active on call reference #n and invokes the Hold service by sending a HOLD message to the network. The network responds with a HOLD ACKnowledge message to denote that the request has been successfully completed.

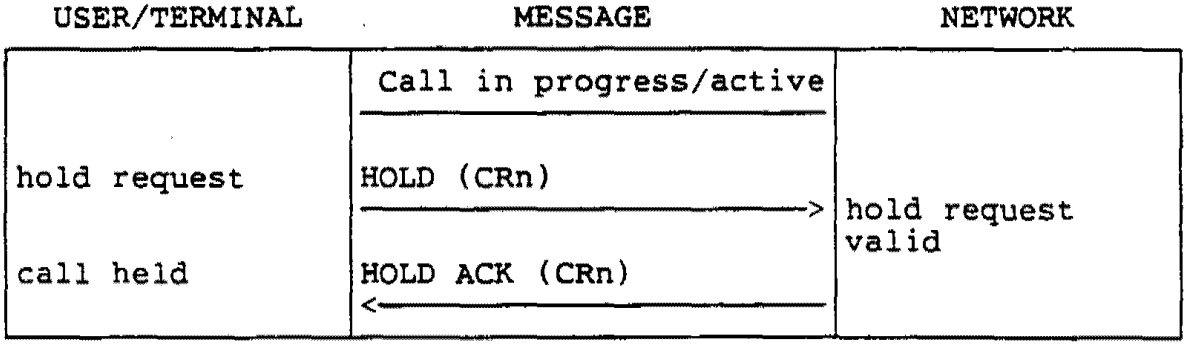


Figure 76. Hold Service Activation

Scenario: A user is active on call reference #n and attempts to originate a new call on call reference #m by sending a call request to the network. The network autoholds the active call by sending a HOLD message.

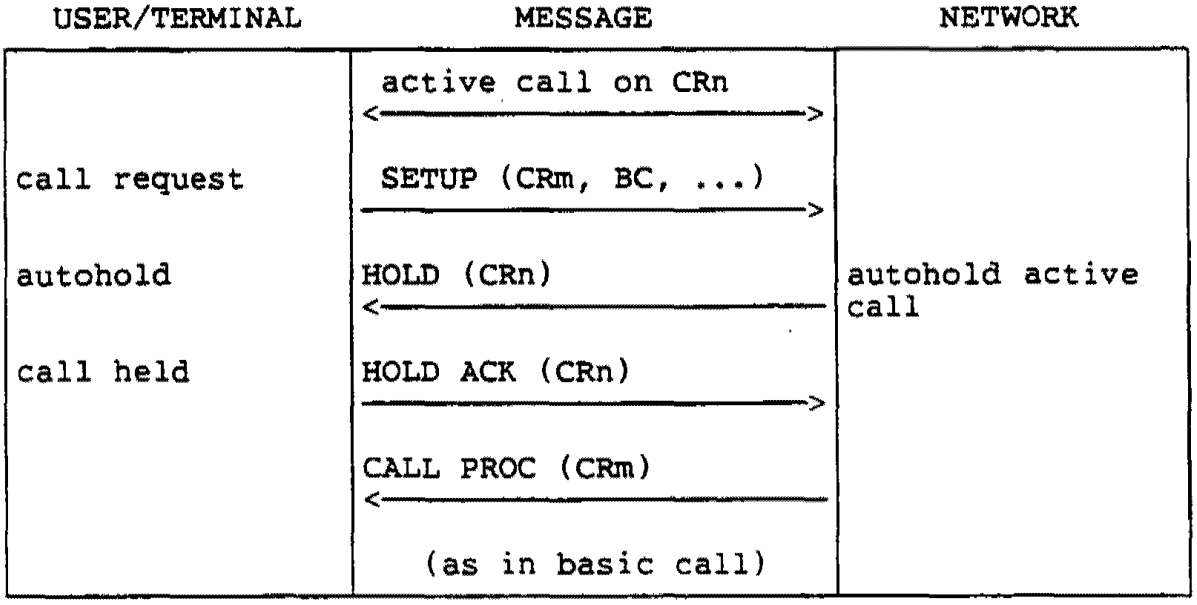


Figure 77. Autohold Procedures

6.27.3 Procedures for Retrieve

The Retrieve procedure provides the ability to re-establish a previously held call.

The user may invoke the Retrieve operation, by sending a RETRieve message to the network, specifying the call reference of the held call, as shown in Figure 78 on page E-221.

The user may or may not include a Channel identification information element in the RETRieve message. Users are encouraged not to use Channel identification set to 'exclusive B1' or 'exclusive B2' because this may result in the retrieve being rejected because 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 B1, the user then attempts to retreive the held call exclusively on B1. This will result in the retreive being rejected because the channel is already in use.

If the Retrieve invocation is successful, the network will connect the held call to a B-channel and send a RETRieve ACKnowledge mes-

sage containing the Channel identification information element specifying the B-channel to which the terminal shall connect. If the held call was receiving CALL ALERTing, a signal information element with signal, #1 will be included in the message. The user shall then connect to the specified B-channel.

If the Retrieve invocation was not successful, the network will return a RETRieve REJect message, with an appropriate cause. The call will remain in the held state.

Scenario: A user wants to re-establish a previously held call by sending a RETRieve message to the network. The network responds with a RETRieve ACKnowledge message specifying the B-channel to connect to.

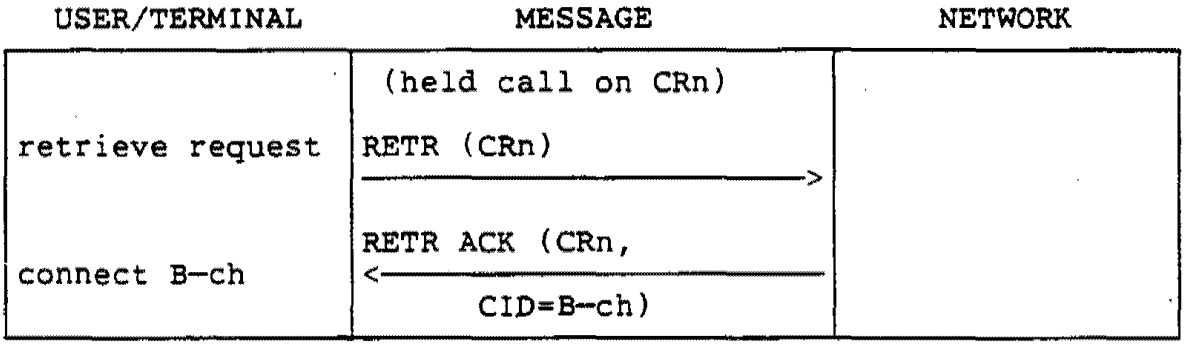


Figure 78. Retrieve Request Procedure

6.28 HUNTING (DNH)

6.28.1 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 3. This feature increases the liklihood of a call being completed.

Directory Number Hunting (DNH) - Each line in this hunt group has its own unique directory number (DN). The hunt group can be accessed by dialing any number in the hunt group but 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.

The following options are available to hunt groups:

Line overflow to a route - when all lines in a hunt group are busy, this feature enables hunting to continue to a specified route.

Line overflow to a DN - when all lines in a hunt group are busy, this feature enables hunting to continue to a specified DN, which can also be part of another hunt group.

6.28.2 Feature Activation

This feature is subscribed to by the end user on a service profile basis.

Incoming calls to a hunt group will follow normal call termination procedures.

6.28.3 Feature Interactions and Limitations

The Additional Call Offering feature is not compatible with the hunting feature.

6.29 LAST NUMBER REDIAL (LNR, LNRA)

6.29.1 Definition

The Last Number Redial (LNR) feature enables a subscriber to redial 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.

- Last Number Redial (LNR) - This permits the last number dialed to be redialed by using a single key instead of the whole number. Everytime a number is dialed, it is stored as the LNR for that DN.

- Last Number Associated with Set (LNRA) - This permits the user to redial the last number dialed from the set using one key. It is associated with the entire set, rather than a specific DN.

6.29.2 Feature Activation

This feature may be requested using en-bloc or overlap sending.

After issuing a call request the user activates this feature by selecting the octothorpe key (#) twice.

If en-bloc sending is used to send in the digits then the second '#' is not required to complete the LNR request.

6.29.3 Procedures

When activating this feature the user may include in the SETUP message a Keypad information element containing a "#". The network will interpret this as a LNR request and route the call to the last destination that was dialed. If the last dialed number was valid, the network will send a CALL PROCeeding message to the user containing a Channel identification information element and a Called party number information element identifying the destination address.

If a valid LNR request is received during overlap sending, the network will send a CALL PROCeeding message to the user containing a Called party number information element identifying the destination address.

Scenario: A user initiates a call by dialing two octothorpes as the called party number, while in the overlap sending state.

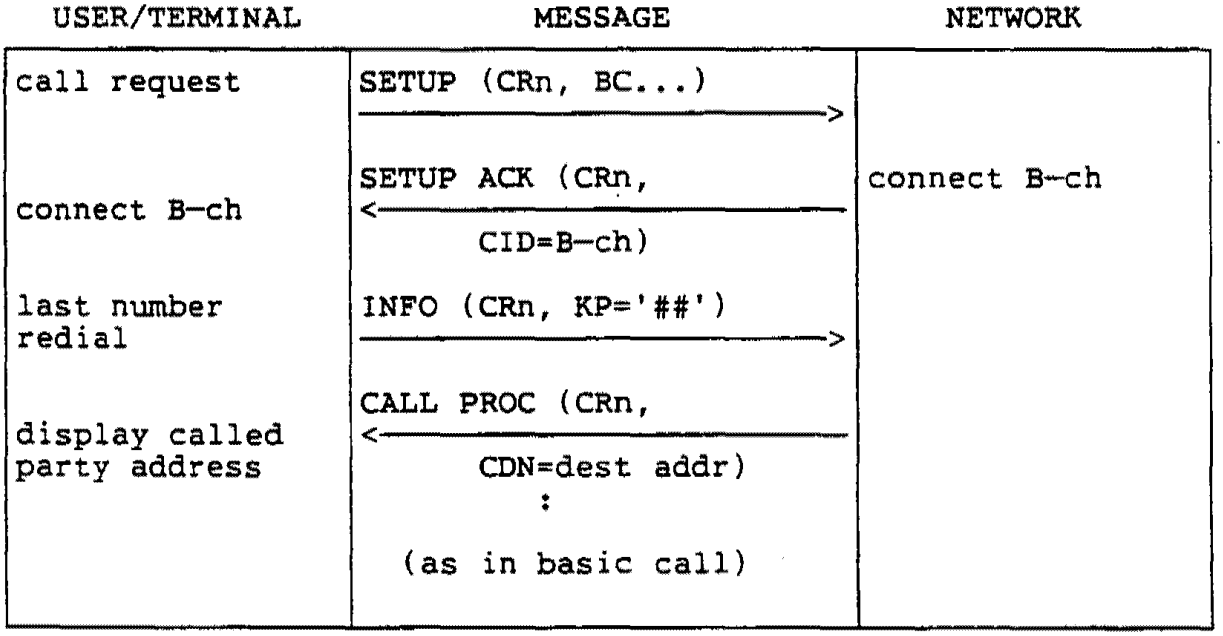


Figure 79. Last Number Redial Request during Overlap Sending

6.30 LOUDSPEAKER AND RADIO PAGING ACCESS

6.30.1 Definition

This feature 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:

1. Single zone per paging system. Single paging system.
2. Multiple zone per paging system. Single paging system.
3. Single zone per paging system. Multiple paging systems.
4. Multiple zone per paging system. Multiple paging systems.

6.30.2 Feature Activation

The above configurations are accessed by issuing a call request 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 will analyse 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 message or can be sent in the overlap sending state by sending one or more INFOrmation messages with a Keypad information element to the network.

6.30.3 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 cannot be call forward.

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 retry the call.

6.31 LOUDSPEAKER PAGING AND LINE TERMINATION

6.31.1 Definition

This feature is equivalent to the Loudspeaker and Radio Paging Access feature except that it terminates on a line rather than a trunk. Some paging equipment requires DTMF digits to be outpulsed. If required, DTMF will be provided by the terminal and not by the network.

6.32 RELEASE (RLS)

6.32.1 Definition

This feature allows a user to abandon a feature programming sequence. The user can then originate or receive other calls.

6.32.2 Feature Activation

The user activates this feature by sending to the network an INFOrmation message with a Feature activation information element corresponding to the Release feature activator. The network will abandon any active programming sequence. There is no feature indicator associated with this feature.

6.32.3 Feature Interactions and Limitations

A terminal, invoking this feature, must be equipped with a feature activator which is assigned as a Release activator.

6.33 ATTENDANT CONSOLE (AC) INTERWORKING

6.33.1 Definition

This feature enhances AC interworking with ISDN users in several new ways. Users receive explicit notification when an attendant enters or leaves a call, the network will attempt to reconnect a user to the attendant if the user releases while connected to an attendant, and new feature interactions are introduced. The enhancements made available with the AC Interworking feature are summarized below.

Additional notifications and network procedures for ISDN users when an Attendant Console (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 (i.e. transfers) or holds, an AC extended call; and
- 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 "Do Not Disturb" on a user's DN; and
- 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 following, existing supplementary services:

- parking a call by the AC against a user's DN (see "Call Park (PRK)" on page E-106);

- controling a user's Message Waiting indication from the AC (see "Message Waiting (MWT) and Call Request (CAR)" on page E-120); and
- delivering the Name and Reason for AC calls (see "Name and Reason Display" on page E-236).

6.33.2 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 generic procedure G10.

6.33.2.1 Call Origination To an AC

In the same manner that a user establishes a call to an ESB (section 6.23.2), a user establishes an intra-group call to an AC using the normal call establishment procedures as defined in Section D. In addition, the network will include in the CONNect message a Notification indicator information element 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 80 on page E-232.

6.33.2.2 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 Section D. In addition, the network will include in the CONNect ACKnowledge message sent to the user a Notification indicator information element 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 81 on page E-234.

6.33.2.3 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 6.27.2. 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 message with cause value 95 "invalid message, unspecified", and will place the call into an "AC controlled - user cleared" state.

Attempts by the user to establish a call, while in the "AC controlled - user cleared" state from the same DN/BC pair, will result in an automatic connection to the AC, that is, the network will respond to a SETUP with CALL PROCeeding and CONNect messages containing a Notification indicator information element specifying "connected to Attendant Console", regardless of any feature invocations. Attempts by the user to establish a call on the same DN but on a different bearer capability in this state will be rejected by the network with a RELease COMplete message with cause value #29 "facility rejected". If however, a user establishes a call on a different DN while in this state, it will be allowed to proceed using the normal call establishment procedures as defined in Section D.

6.33.2.4 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 message with a Notification indicator information element specifying "retrieve held call". If the call is in the "AC controlled - user cleared" state, the network broadcasts a SETUP message to the user. If the user accepts the call, normal call establishment procedures are followed, as defined in Section D, except that the CONNect ACKnowledge message sent to the user will contain a Notification indicator information element 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 will repeat the call establishment attempt every 2 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 Section D.

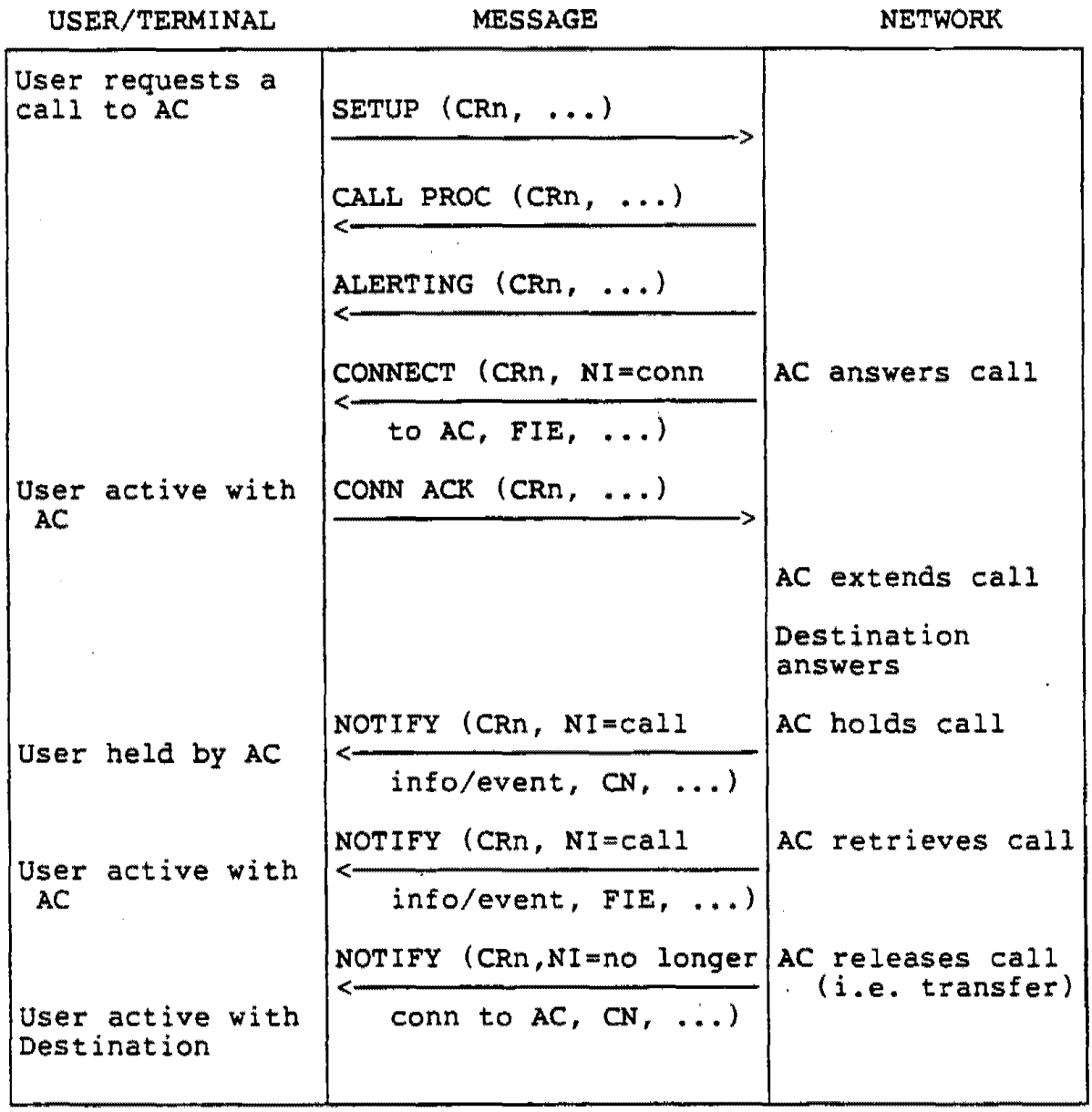


Figure 80. Example Interactions of an Originating ISDN User With an AC: The Facility information element (FIE) carries the CLLI of the AC as a name. The Connected number (CN) information element holds the DN of the destination party.

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 (i.e. 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 message with a Notification indicator information element specifying that the call is "no longer connected to Attendant Console", and a Redi-

rection number information element 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 message with a Notification indicator information element specifying "call diverted" and the Calling party number information element 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 message with a Notification indicator information element specifying "call information/event" and a Redirection number information element 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 (i.e. transfers) the call in this state, the source and destination user both receive a NOTIFY message with a Notification indicator information element specifying that the call is "no longer connected to Attendant Console" and the Connected number information element 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 message to source and destination users with a Notification indicator information element which specifies that a "call information/event" has occurred and the Connected number information element contains the address of the other user. The call remains AC controlled. When the AC retrieves the extended call, the network sends a NOTIFY message to source and destination users with a Notification indicator information element which specifies "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 generic procedure G10.

- Source and destination intra-group users that were active on an existing basic call will receive a NOTIFY message with a Notification indicator information element specifying "call con-

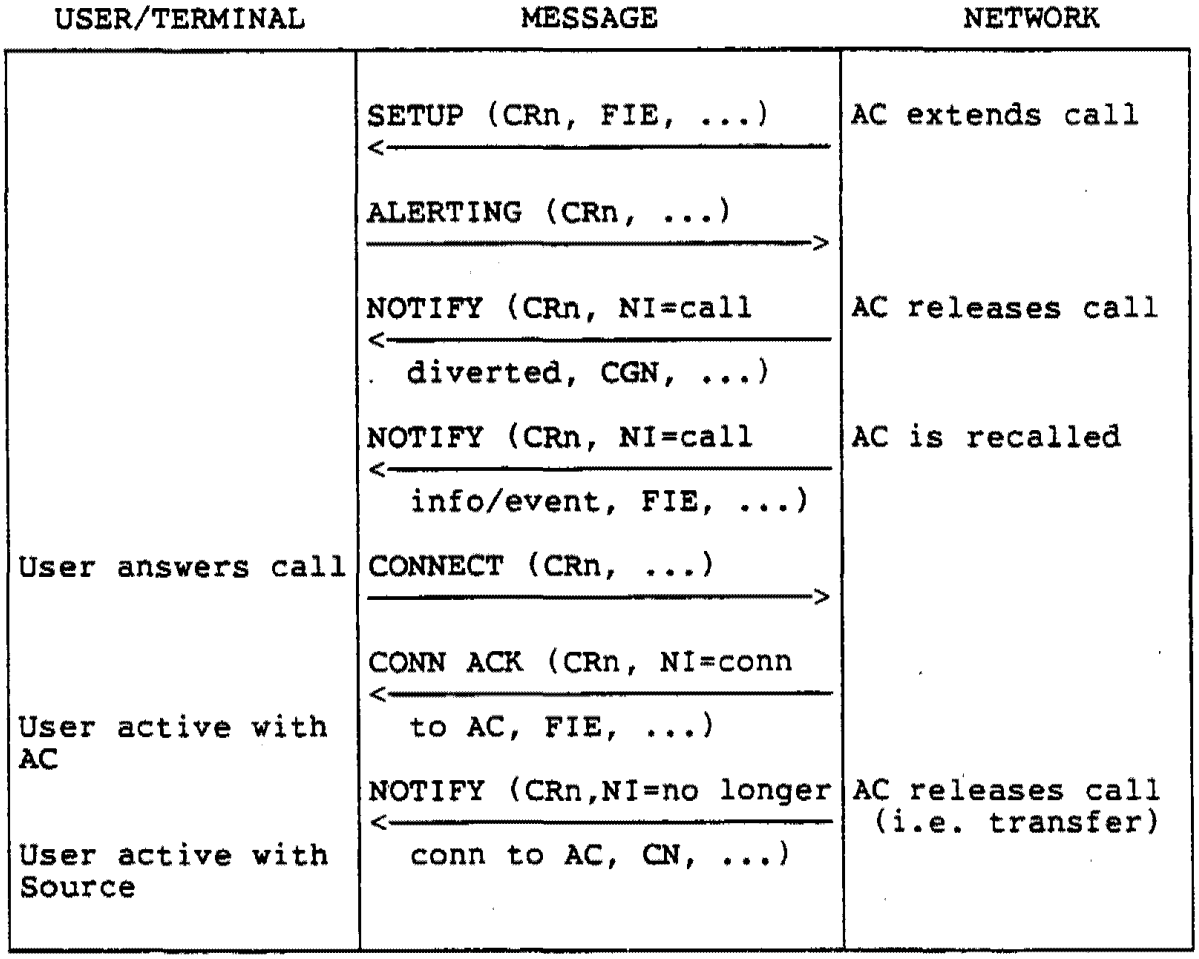


Figure 81. Example Interactions With a Destination ISDN User: The Facility information element (FIE) carries the CLLI of the AC as a name, with no reason. The Call party number information element (CGN) carries the DN of the source user. The Connected number information element (CN) holds the DN of the source user.

nected to Attendant Console". The call is now in an "AC controlled - active or extended state" and is under AC control.

- Destination intra-group users that were being alerted will receive a NOTIFY message with a Notification indicator information element specifying "call information event", and the CLLI of the AC using the feature Name and Reason Display.

- Source non intra-group users that were camped on to a DN will receive a NOTIFY message with a Notification indicator information element specifying "call information/event", and the CLLI of the AC using the feature Name and Reason Display.

6.33.3 Feature Interactions and Limitations

6.33.3.1 Name and Reason Display

The feature Name and Reason Display is used to deliver the CLLI of the AC to both source and destination ISDN users. Generic procedure G10 is used for Name and Reason Display when the Nofitication indicator information element specifies "connected to Attendant Console", and as indicated in the procedures when it specifies "call information/event".

6.33.3.2 Camp On

The AC can only camp on to a DN that is call-reference busy.

6.33.3.3 Busy Verify Line

The AC will only see busy on a DN that is call-reference busy. The AC is only allowed to barge in to an active Speech or 3.1 Khz Audio call.

6.33.3.4 Busy Verify Trunk

The AC is only allowed to barge in to an active Speech or 3.1 Khz Audio call.

6.34 DISPLAY PROCEDURES

This section describes feature operation and procedures for the invocation of supplementary services involving display procedures.

6.34.1 Name and Reason Display

6.34.1.1 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 information elements which 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) will be delivered when it is available. If name text for a party is not available, default text will be substituted (i.e., "OUTSIDE CALL").

If a user has not subscribed to Name and Reason Display, then provided the user has subscribed to the particular number delivery, the address of the parties (calling party, redirecting party, redirection party, and connected party) involved in the call will be delivered in the Display Text information element when the address information is available.

Reason text supplements information which may already be present in other information elements, such as Notification indicator and Progress indicator information elements. Use of the network-provided reason text frees the terminal from having to translate indicators relating to supplementary services operations (for example, Call Pickup) into appropriate text for display.

6.34.2 Procedures

If available, name and reason text is delivered to the user, for all originating and terminating calls, using the generic procedure

G11. If the text is available when the network offers a terminating call to the user, the information is included in the SETUP message. In all other cases, for both originating and terminating calls, the text will follow in a subsequent INFOrmation or other message.

The name and reason text is sent in the Display Text information element as specified in section D

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), and Connected Number (CON).

Of the mandatory tags: Skip and Blank; only the Blank tag is currently used with this service.

The Display Text information element will be 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 will be contained in the next 40 characters of the Display Text information element. The information will be formatted such that terminals with a minimum display size of 2X20 characters can post meaningful information on the display without neccessarily comprehending the otional display tags. All information will be tagged, thus allowing terminals which comprehend the optional display tags to manage the presentation of display information.

6.34.2.1 Name/Address

If the information is available and Name and Reason Display is subscribed to, name text will be 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 Display Text information element display tags. Refer to section D of this specification for description of the Display Text information element.

If a party is outside the customer group or customer group family, the name text delivered will be "OUTSIDE CALL", or substitute text can be programmed on a customer group basis.

Default Text	Reason
CONFERENCE	Conferences: multi-party call, such as Flexible Calling
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

Figure 82. Default Reason Text

6.34.2.2 Reason Text

Reason text can be programmed on a customer group basis or can be allowed to default. Figure 82 on page E-238 lists the reasons which are supported and the default text with which they are associated.

6.34.3 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 (EKTS-GIC)
- Electronic Key Telephone Service Shared DN
- Flexible Calling
- 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.

6.35 SCREEN LIST EDITING

This section provides a description of the screen list editing service as reflected in BCS 34 design intent.

6.35.1 Definition

Call Screening services allow subscribers to screen out certain incoming calls for special treatment. Such screening services include:

- Selective Call Rejection (SCRJ)
- Selective Call Acceptance (SCA)
- Selective Call Forwarding (SCF)
- Customer Originated Trace (COT)

For each call screening feature, a list of DNs identifying incoming calls for special treatment is maintianed by the switch. These lists can be created and modified by the subscriber. The subscriber also has the ability to activate and deactivate the service which uses the associated screening list.

Screening List Editing (SLE) provides the interface to the subscriber for carrying out these activities.

6.35.2 Feature Description

A brief description of each feature assignable to ISDN sets by the SLE service follows:

Selective Call Forwarding (SCF). This service allows a subscriber to define a special list of Directory Numbers (DNs) and a destination Directory Number (DN). Incoming calls from the subscriber's list of DNs will be forwarded to the destination DN.

Selective Call Rejection (SCRJ). This service allows a subscriber to define a list of DNs, such that incoming calls fromt those DNs will be prevented from terminating to the subscriber.

Selective Call Acceptance (SCA). This service allows the subscriber to define a list of DNs such that only calls that are on the list of DNs will be allowed to terminate to the subcriber's

line. All other calls (e.g., those numbers not on the DN list, will not terminate on the subscriber's line).

Customer Originated Trace (COT). This service 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.

6.35.3 Procedures

Screen List Editing is accessed by dialing an access code, as supported by Generic Procedures 8 - Interactive Dail Access (Call Initiation Phase). A call proceeding message will be returned, followed by an INFO (IRQ=prompt), prompting the user/terminal to return D-channel keypad in response to in-band audio prompts.

SECTION F: ISDN BASIC RATE INTERFACE - DATA SERVICES

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1.0 INTRODUCTION

This section of the document describes Integrated Services Digital Network (ISDN) Data services offered by Northern Telecom ISDN switch, from the point of view of any basic rate (2B+D) user-network interface. Data services encompass both circuit mode and packet mode data services as set forth in the 1988 CCITT I-Series of Recommendations. The Packet Mode Data (PMD) services described in this section are provided by the DMS Packet Handler (DMS PH).

The DMS Packet Handler (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. The DMS PH is an integral component of the Northern Telecom ISDN switch capable of providing Bellcor 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.

In describing data services, this section uses the principles and terminology of CCITT Recommendations X.200 and X.210 - the reference model for Open Systems Interconnection.

This section includes the specification of :

- Packet mode data services on semi-permanent (provisioned at subscription time) B-channel(s).
- Packet mode data services Provisioned on the D-channel.
- Circuit mode data services available on-demand to user-network B-channel(s).

Northern Telecom 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 packet mode data services to be offered:

- D-channel packet mode access for X.25 terminal equipment using CCITT LAPD (per Section C 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 kbit/s connection on a B-channel.

Packet terminals which support D-channel packet service (SAPI 16) must use static TEIs. In addition, two TEIs will be required for for integrated circuit switched - D-channel packet mode terminals (static TEI for packet access). However, in future, support will be provided to allow integrated circuit - D-channel packet terminals to share a single TEI.

Note that rate adaption for the circuit mode data 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 concensus. For circuit mode data 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 Northern Telecom T-link protocol, as implemented in Datapath equipment. Details on the T-link protocol specification and its implementation are available from Northern Telecom.

The ISDN packet mode data services, as described above, will be augmented by future enhancements to include additional capabilities and packet mode services:

- Packet mode data 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)

1.1 REFERENCES

1. Public Packet Switched Network Generic Requirements (PPSNGR), Bellcore TR-TSY-000301.

2. ISDN Access Call Control Switching and Signalling Requirements, Bellcore TR-TSY-000268.

3. ISDN X.25 Supplementary Services, Bellcore TR-TSY-000846.

4. CCITT Recommendation X.31.

5. CCITT Rec.E.164

6. CCITT Rec.X.121
7. CCITT V.110.
8. CCITT V.120.

2.0 PHYSICAL LAYER SPECIFICATION

This subsection 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 Section B of this document.

2.1 RATE ADAPTION

Rate adaption for B-channels is a process whereby bit streams having speeds less than 64 kbit/s are increased to 64 kbit/s at layer 1. Rate adaption is necessary for ISDN data services' access by terminal equipment operating at speeds less than 64 kbit/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.

In the case of 56 kbit/s terminal equipment accessing packet mode data services, the preferred method of rate adaption is to increase the clocking rate to 64 kbit/s.

Rate adaption for the circuit mode data services on B channels is the responsibility of CPE terminal adaptor (TA) equipment. For circuit mode data service on a B channel, the ISDN connection is effectively transparent to any rate adaption protocol adopted by TA equipment.

For circuit mode data service interworking with PSDS (see "Interworking with PSDS" section F), rate adaption as specified in CCITT V.110 (see reference 7) for 56 kbit/s terminals shall be used for compatibility with the 56 kbit/s bearer capability of PSDS.

3.0 DATA LINK LAYER SPECIFICATION

The Data Link Layer specifications for both B- and D-channel data services are described in this subsection.

3.1 DATA LINK LAYER SPECIFICATION - B-CHANNEL

The Layer 2 protocol for X.25 packet mode data on the B-channel shall be based 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.

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 TR-TSY-000301.

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 Northern Telecom's ISDN Packet Handler which are in compliance with as defined in TR-TSY-000301.

1. Timer T1 specifies the period after which transmission of any frame may be repeated; the default value for T1 shall be 2 seconds; adjustment range from 1 second to 20 seconds; adjustment increment = 0.5 second.

2. Timer T2 indicates the amount of time available before the acknowledging frame must be initiated in order to ensure its receipt by the DTE or DCE. The parameter T2 range lies between 0 and 0.4 seconds.

3. Idle channel Timer T3, 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

to 30 seconds in 1 second increments with a default value of 5 seconds.

4. The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency) is specified by parameter N1, and set at 2120 bits for a maximum packet size of 256 octets.

5. The maximum number of attempts to complete a successful transmission is specified by parameter N2 and shall default to 3; adjustment range from 2 to 15; adjustment increment = 1.

6. 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 to 7 (modulo 8) and 8 to 127 (modulo 128) ; adjustment increment = 1. The default value would be modulo 8 with a link level window size of 7.

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 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 Section C of this document together with the following provisions :

1. Multiple frame operation shall be used on packet (SAPI=16) links.

2. Initially, pre-assigned TEIs (manually established at subscription time) shall be supported for one or multiple packet mode data terminals on the subscriber D-channel, for both SVCs and PVCs. It shall be 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.

3. Link layer parameters shall be determined at subscription time. Parameters will use the ranges and defaults specified in Section C.

4. A separate, longer timer (T200 in Section C) shall be provided for packet data links, since signaling links will have priority status.

5. Unacknowledged information (UI) transfer procedure will not be supported for packet links.

6. Terminals shall be viewed 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 will attempt to establish a logical link to the terminal by transmitting SABME. When the terminal is attached to the loop, the terminal 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) will be cleared by the network.

4.0 NETWORK LAYER X.25 PACKET MODE DATA SERVICES

This subsection describes the X.25 packet mode data transport service offered by Northern Telecom's ISDN switch. The service is available for both B- and D-channels at the basic rate user-network interface.

4.1 GENERAL CONSIDERATIONS

The network layer procedures implemented by Northern Telecom's ISDN Packet Handler conform to CCITT Recommendation X.25 and Bellcore technical recommendations as defined in TR-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 shall have access to the same packet mode services as dedicated X.25 users in a Public Packet Switching Network (PPSN).

Initially, both B and D-channel X.25 packet mode data services shall be provisioned (semi-permanent) at subscription time. Thus for packet mode data transfer across the DTE/DCE interface, there must exist a logical link on the desired channel. Should an incoming call arrive at the Packet Handler (PH), destined for a loop with no logical links established between Terminal and PH, the Packet Handler will clear 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 will be processed.

The Northern Telecom ISDN switch supports a very comprehensive set of packet level facilities. The facilities supported include most of the 1988 X.25 optional facilities.

4.2 TYPES OF CALLS

There are two types of packet mode data calls available to users on the user-network interface, namely Switched Virtual Call (SVC) and Permanent Virtual Circuit (PVC) calls.

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. A virtual circuit is the bidirectional 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.

4.2.1 Switched Virtual Call

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, and when communications are complete, the call clearing procedures are initiated to disconnect the virtual connection.

4.2.2 Permanent Virtual Circuit call

Permanent Virtual Circuit (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.

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 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.

4.3.1 Logical Channel Range

Four types of logical channels and their ranges must be chosen at subscription time. This selection should be based 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-utilized.

The four types of logical channels are :

1. Permanent Virtual Circuit logical channels.

2. One-way incoming logical channels for Switched Virtual Calls.

3. Two-way logical channels for Switched Virtual Calls.

4. One-way outgoing logical channels for Switched Virtual Calls.

   DMS PH will support 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 which affect the entire interface (restart and diagnostic packets).

- Note that while the logical channel range defined at subscription time varies :

  - 1 to 63 on D-Channel

  - 1 to 511 on B-Channel.

  The logical channel range defined may reside anywhere between 1 to 4095 for both B and D-channels, and the range must be continuos.

When initiating a call, the DTE shall select the highest numbered free logical channel for an outgoing call, while the DCE will select the lowest numbered free channel for an incoming call. This procedure is defined to minimize call collision probability.

4.4 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.

4.5 X.25 FACILITIES

The following is a list of the X.25 facilities (or 'services') that are available at the user-network 2B+D interface as defined in the Optional User Facilities (section 3.2.6) of the TR-TSY-000301 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 Annex A of this document.

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

4.5.1 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

4.5.2 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

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 shall be 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 will be 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 will be the mechanism for interworking between X.121 and E.164 numbering plans. The following provides address formats for different interworking configurations:

1. ISDN --> ISDN

   For calls between ISDN users, the calling user specifies the called address as : <subscriber number>. This address format will require prefixes to distinguish local, 10-digit and international calls.

2. ISDN --> PPSN

   For calls originating from one ISDN user that are destined for a user in a PPSN, the calling user specifies the called address as : <escape code 0> <DNIC of PPSN> <Network Terminal Number>.

3. PPSN --> 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:

- double escape code sequence allowed
- double escape code sequence not allowed
- double escape code allowed but "ignored".

Initially, DMS-PH will support the first two options.

4.7 USER MAINTENANCE CAPABILITY

This capability will be supported on DMS-PH in a future release as described below.

1. User Self-Testing Capability

   A user may be able to place a virtual call to its own address on basic rate interface (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.

5.0 CIRCUIT MODE DATA SERVICES

Transparent circuit switched service provides a point to point, 64 kbit/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 Section D.

5.1 INTERWORKING WITH PSDS

Public Switched Digital Service (PSDS) is the generic name for 56 kbit/s circuit switched data. Service on non-ISDN networks has a restricted bearer capability, i.e. can only support connections up to 56 kbit/s.

An ISDN user wishing to interwork with this service must arrange a unique Directory Number (DN) for this capability with the ISDN network administrator. The ISDN switch will associate the restricted bearer capability with this DN for both outgoing and incoming calls.

To support interworking with PSDS, CPE rate adaption shall be implemented by setting the least significant bit of the B-channel byte to ONE, as specified by CCITT recommendation V.110.

6.0 ANNEX A - X.25 SUBSCRIPTION PARAMETER VALUES

ISDN X.25 features are provided through the provisioning of ISDN X.25 service parameters as identified in TR301 and TR846. 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 Permanent Virtual Circuit (PVC) basis.

Call Type refers to circuit-mode, packet-mode. or voice-band services. Parameters provisioned against these Call Types are termed circuit-mode data (CMD), packet-mode data (PMD), or voice-band (VI) information.

Channel type refers to the B or D-channel, and is a refinement of the packet-mode (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 (i.e. DN/Call type, DN/Channel type), range of values and defaults are provided.

Following table defines the layer 2 (i.e. Link level) parameters:

PARAMETER	PROVISIONING	RANGE	DEFAULT
Link Level Frame Sequencing	DN/Channel	MOD8 or MOD 128	MOD8
Link Level Window Size	DN/Channel	1 to 7 or 1 to 127	7
Acknowledgement Timer (T1)	DN/Channel	1 to 20 sec	2 secs.
Response Timer (T2)	DN/Channel	0 to 4	2 of 100 millisec.
Idle Channel Timer (T3)	DN/Channel	1 to 30 sec.	5 sec.
Max. re-transmissions (N2)	DN/Channel	2 to 15	3

Figure 1. X.25 Layer 2 parameters-LAPB only

Figure 2 lists the packet level parameters. This table also defines the logical channel assignment sub-parameters, i.e. assigned logical channels for each type of service at the time of subscription.

PARAMETER	PROVISIONING	RANGE	DEFAULT
Packet Level Sequencing	DN/Calltype	MOD8 or MOD 128	MOD8
Start Logical Channel Number	DN/Channel	1 to 4095	1
Number of Permanent Virtual Circuit	DN/Channel	0-511 B-chn 0-63 D-chnl1	0
Num. of One-way Incoming logical chnl.	DN/Channel	0-511 B-chn 0-63 D-chnl	0
Num. of non-restricted channel	DN/Channel	1-511 B-chn 1-63 D-chnl	1
Num. of One-way Outgoing logical Chnl.	DN/Channel	0-511 B-chn 0-63 D-chnl	0

Figure 2. X.25 Layer 3 parameters

X.25 optional user facilities and their values are defined in the figures 3, 4 and 5.

PARAMETER	PROVISIONING	RANGE	DEFAULT
Incoming calls barred	DN/Calltype	Yes or No	No
Outgoing 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 chnl	128
Outgoing Maximum Packet size	DN/Channel	16,32,64, 128,256 for B/D chnl	128

Figure 3. X.25 - Optional User Facilities

PARAMETER	PROVISIONING	RANGE	DEFAULT
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	upto 64kb/s on B-chnl upto9.6kb/s on D-chnl	none
Outgoing Default TC Assignment	DN/Channel	upto 64kb/s on B-chnl upto9.6kb/s on D-chnl	none
Flow Control parameter Negotiation	DN/Calltype	Yes or No	No
Throughput Class Negotiation	DN/Calltype	Yes or No	No
Closed User Group Subscription	DN/Calltype	Yes or No	No
Fast Select Acceptance	DN/Calltype	Yes or No	No

Figure 4. X.25 - Optional User Facilities (Contd-)

PARAMETER	PROVISIONING	RANGE	DEFAULT
Reverse Charging Acceptance	DN/Calltype	Yes or No	No
Local charging Prevention	DN/Calltype	Yes or No	No
RPOA Selection Barred	DN/Calltype	Yes or No	No
IC Preselection	DN/Calltype	Yes or No	No

Figure 5. X.25 - Optional User Facilities (Contd-)

7.0 GLOSSARY

BRA	Basic Rate Access
CCN	Credit Card Number
CLAMN	Called Line Address Modification Notification
CPE	Customer Premises Equipment
CUG	Closed User Group
CUGI	Closed User Group Indication
CUGOAI	Closed User Group/Outgoing Access Indication
DMS-PH	DMS Packet Handler
DN	Directory Number
DTE	Data Terminal Equipment
ISDN	Integrated Services Digital Network
LAPB	Link Access Procedure - Balanced
LAPD	Link Access Procedure on the D-channel
LCA	Logical Channel Assignment
N1	Maximum Packet Size
N2	Maximum Retransmissions
NUI	Network User Identification
PPSN	Public Packet Switched Network
PVC	Permanent Virtual Circuit
OAM	Operations, Administration and Maintenance
SVC	Switched Virtual Circuit
SPAPH	Semi-Permanent Access to the Packet Handler
T1	Acknowledgement Timer
T2	Response Timer

T3	Idle Channel Timer
XSG	X.25/X.75 Services Group

SECTION G: ISDN BASIC RATE INTERFACE - SUBSCRIPTION PARAMETERS

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1.0 INTRODUCTION

This section provides a list of some of the subscription parameters which are required to be supported for the functional ISDN basic rate interface.[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 basic rate interface. These parameters provide for the characterization of an ISDN basic interface arrangement on the DMS-100. The parameters are categorized into the following groups:

Note: A directory number may be associated with one or more service service profiles and a service profile may be associated with one or more directory numbers (see section E for a description of directory number assignments).

Section 2 summarizes the ISDN office parameters.

Section 3 summarizes the Protocol version control parameters.

Section 4 provides a list of interface parameters which are specified per basic rate interface.

Section 5 summarizes the parameters that are assigned to a terminal service profile.

Section 6 summarizes the parameters for Feature Activator/ Indicator assignments

Section 7 summarizes the parameters per DN.

Section 8 summarizes the parameters per DN/BC.

Section 9 summarizes the parameters per group of DNs.

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[1] For information on subscription parameters for stimulus applications contact Northern Telecom.

1.1 REFERENCES

1. "ISDN Basic Rate Interface Call Control Switching and Signaling Requirements", Bellcore TR-TSY-000268, Issue 2."

2. "ISDN Layer 3 Protocol Details for the Support of Supplementary Services, Bellcore TR-TSY-000861, Issue 1."

1.2 ABBREVIATIONS AND ACRONYMS

BC	Bearer Capability
CGN	Calling party number
CMD	Circuit-Mode Data
DN	Directory number
TEI	Terminal Endpoint identifier
V	Voice
VBD	Voice-Band Data

2.0 DMS OFFICE PARAMETERS

- Layer 2 system parameters
- Q.931 layer 3 timer values
- Network-provided tones

- Layer 2 System Parameters

  A list of layer 2 system parameters (LAPD) such as protocol timers and retransmission counters etc. are specified in section C of this interface specification.

- Q.931 Layer 3 Timer Values

  A list of Layer 3 timers and their default values are given in section D of this Interface Specification.

- Network-provided tones

  This parameter applies to voice or Voice-band data (VBD) calls only. It indicates whether the network should apply normal call processing tones and announcements in-band over a connected B-channel for Voice and Voice-band data calls originated by the user when treatment is required. The network will still provide information regarding the status of the call in the Cause information element of the appropriate D-channel message. Currently, the network always provides in-band tones for V and VBD call types.

3.0 PROTOCOL VERSION CONTROL PARAMETERS

This feature provides a protocol version control mechanism for Northern Telecom ISDN switches. The protocol version and issue of a particular ISDN Basic Rate Interface terminal is chosen at subscription time.

Note: The current version and code values supported and the relevant NT specifications that apply to each version and issue code are as follows:

Version	Issue Number	Specification
NT Stimulus	0	NIS S208-2
NT Meridian Feature Transparency	0	NIS S208-5 Issue 1.0 Sections A,B,C,I
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 Australia	0	to be determined

4.0 INTERFACE PARAMETERS/CHARACTERISTICS

The following parameters specify the characteristics of the ISDN basic rate interface. These parameters are not changeable by switch administration.

- configuration
- number of B-channels
- maximum number of service profiles
- maximum number of TEIs allowed
- D-channel data rate

- Configuration

  The interface configuration is always point-to-multipoint, i.e. the network will always send a broadcast SETUP.

- Number of B-channels

  This parameter defines the maximum number of B-channels supported by the interface. The value is 2.

- Maximum number of service profiles

  This parameter defines the maximum number of service profiles which may be associated with a basic rate interface.

  The value is 8.

- Maximum number of TEIs allowed

  This parameter defines the maximum number of TEIs allowed on the physical interface. Preassigned 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

  This parameter defines the D-channel data rate to be 16 kbps, and handles call control signaling and packet data.

5.0 TERMINAL SERVICE PROFILE PARAMETERS

The following subscription parameters are service related and are specified on a terminal service profile (TSP) on the interface.

- signaling type
- number of TEIs
- type of TEI
- list of valid fixed TEIs
- service profile identifier (SPID)
- autorized call types
- number of circuit switched B-channels
- number of provisioned B-channels
- directory numbers
- EKTS shared DN
- intercom groups
- calling number delivery service
- network resource selector
- message waiting
- hunting

- Signaling type

  This parameter defines the type of signaling capabilities which will be supported on the interface. The allowable parameters are defined in Section 3, Protocol Version Control Parameters.

- Number of TEIs

  This parameter defines the number of TEIs supported by the profile.

  Currently only 1 TEI is supported. Future plans include supporting up to 8 TEIs per service profile. The total number of TEIs for all profiles on the interface must be less than or equal to 8 (i.e. maximum supported by the interface).

- Type of TEI

  This parameter specifies whether each TEI is fixed or dynamic.

- List of valid fixed TEIs

  This parameter defines the list of valid fixed TEIs for the service profile. The values are selected in the range 0-63. The list size must be less than or equal to the number of TEIs supported by the service profile.

- Service Profile Identifier (SPID)

  This parameter defines the SPID that is used by dynamic TEI terminals during the initialization procedures (see section E). The value is the primary DN plus a suffix.

- Authorized call types

  This specifies the call types that can be requested, or to which calls may be terminated. The profile may support one or more of the following bearer capabilities. The allowed values are:

  1. V - voice (speech)

  2. VBD - voiceband data (3.1 kHz audio)

  3. CMD

     - circuit-mode data (64 kbit/s unrestricted) including circuit-mode 64 kbit/s rate adapted from 56 kbit/s
     - circuit-mode 64 kbit/s restricted

  4. PMD - packet mode data (note: switched B-channel access is currently supported with the circuit-mode call types at this time)

     Note: The V and VBD Bearer Capability parameters are both required when desiring a voice call type.

- Number of circuit switched B-channels

  This parameter defines the number of switched B-channels that may be assigned simultaneously to the service profile.

  The allowed range is 0-2.

  At this time the maximum number of B-channels supported per TSP is one. A physical terminal can support two B-channels provided two TSPs are subscribed to.

- Number of provisioned B-channels

  This parameter defines the maximum number of provisioned B-channels that may be simultaneously assigned to the service profile.

  The allowed range is 0-2.

  At this time the maximum number of B-channels supported per TSP is one. A physical terminal can support two B-channels provided two TSPs are subscribed to.

- Directory Numbers

  The maximum number of directory number appearances that may be supported per service profile is 64.

  A parameter specifies the primary DN associated with the service profile.

  The set of valid secondary DNs must be specified for the service profile.

  The maximum number of calls that can be associated with each DN specified for the service profile is also defined.

  A single default DN is specified for the service profile. The network will use the default DN in the event that a terminal does not provide a calling DN when initiating a call.

- EKTS shared DN

  This parameter specifies those DNs that are EKTS shared DNs, and therefore may be shared with other service profiles. Not all EKTS DNs are necessarily shared.

- Intercom groups

  This parameter defines any intercom group identifiers associated with the service profile. If the intercom group consists of more than two members then an intercom address is also specified for the particular group.

- Calling number delivery service

  This parameter defines whether the network will deliver calling party number, connected number, redirection number and/or redirecting number 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 Calling party number and Calling party subaddress information elements.

- Network resource selector

  This parameter is used in managing modem pools which 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.

  - Using "Prefix NRS Outbound"(PNO), a specific modem pool will be accessed. The modem pool to be used is stored in the network.

  - Using "Prefix NRS Default"(PND), allows a user to access the default modem pool group stored in the network.

- Message waiting

  This parameter allows messages to be forwarded and retrieved from a message center or to be queued up against the called party's terminal

  Only messages which are 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, which can be either an attendant or a store and forward message system.

- Hunting

This parameter enables a call to be routed to another station if the original station is currently busy. This increases the possibility of calls being completed.

Hunting is based on network-determined-user-busy, not user-determined-user-busy. Hunting 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.

- Directory Number Hunting (DNH)
- Multiline Hunting (MLH)
- Distributed Line Hunting (DLH)

Only Directory Number Hunting is supported by functional DNs.

6.0 FEATURE ACTIVATOR/INDICATOR ASSIGNMENTS

For each feature activator/indicator, the feature identifier must be specified. The allowed features are:

- conference
- conference drop
- conference transfer
- EKTS privacy
- EKTS privacy release
- release
- ring again
- hold service subscribed
- automatic dial
- call pickup
- flexible call
- drop
- transfer
- automatic callback
- speed calling
- call park
- leave message
- intercom
- executive busy override

- Conference

  This parameter allows a caller to include additional parties in the call.

- Conference drop

  This parameter allows a party to be dropped from the conference.

- Conference transfer

  This parameter allows a call to be transferred to another party using the conference keys.

- EKTS privacy

  This parameter allows the party connecting additional parties to a call to talk to those parties before adding them to a multiple party call.

- EKTS privacy release

  This parameter allows the party connecting additional parties to a call to connect those parties.

- release

  This feature allows a user to abandon a feature programming sequence. The user may then originate or receive other calls.

- ring again

  This parameter 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.

- Hold service subscribed

  This parameter defines if the user has subscribed to the Hold service. If the user has subscribed, he will be allowed to 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.

- Automatic dial

  This parameter allows a user to automatically terminate to a pre-determined destination without having to supply the address of the destination for each call.

- Call pickup

  This parameter 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 feature activator/ indicator or code access.

- 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.

When the first call of the conference has been established, subsequent calls (maximum of 1 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 can be 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.

- Drop

  This parameter allows a controller of a conference call, that has been established using the Flexible call service, to send a drop request to have the network clear the last call added to the conference, when there are more than two users in conference.

  If the conference has only two users the network will interpret a drop request as a request to release the conference facilities, and the two users will revert to a normal two-way connection.

- Transfer

  This parameter allows a controller of a conference call, that has been established using the flexible call service, to send a transfer request to cause the network to disconnect the controller from the conference, but maintain the connection between the conferees. A transfer request can be issued while the conference is held or active.

- Automatic callback

  This parameter is the same as the ring again parameter.

- Speed calling

  This parameter allows a subscriber to store frequently dialed numbers and to make calls to destinations with 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 which consists of a maximum of 10 stored numbers.

- A long list which has 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 and these 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 and are accessed by a two digit code.

- Call park

This parameter allow terminals the capability of holding a call against a directory number (that of the terminal call appearance issuing the feature request). The call may later be retrieved by the same or another terminal.

The feature may be divided into two components.

- The Call Park Store feature enables a subscriber to park calls against their own directory number.

- The Call Park Retrieve feature enables a subscriber to retrieve parked calls from any call appearance.

- Leave message

This parameter is used to perform the Call Request Activation (CRA) function in the Message Waiting/Call Request feature.

If a user receives a ringing no answer or busy treatment, the user can depress the Leave Message (LVM) feature activator. If the request is accepted, it will be enqueued on the call request queue against the called set and the message waiting indicator on the called set will be turned on.

If the request is completed, the LVM indicator of the requestor will be turned on and confirmation tone heard. The indicator is turned off when the call is taken down.

If the request cannot be completed, no visual or audible feedback is given in order to allow the user to activate another feature (eg. Ring Again).

- Intercom

This parameter introduces two intercom calling services 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, will 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 Meridian Digital Centrex features may be applied to an ICM appearance, although a call on an ICM appearance may be held and retrieved.

- Group Intercom (GIC) may be used 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 and 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 then 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 Meridian Digital Centrex features are supported for GIC calling.

- Executive Busy Override

  This parameter allows a user access to a busy terminal. When a busy indication is received, the calling terminal may choose to invoke the Executive Busy Override (EBO) feature. Once invoked, the called terminal and the party connected to the called terminal receive a custom warning tone after which the calling terminal will enter a 3-way call connection with them.

  Once a 3-way connection is established, the user receiving the busy indication can force the third party out of the call by activating EBO again, thus completing the call.

7.0 PARAMETERS PER DIRECTORY NUMBER

- preferred interLATA carrier (PIC)
- calling party number presentation
- calling party subaddress information transfer
- called party subaddress information transfer
- low layer compatibility information transfer
- high layer compatibility information transfer
- automatic line
- block delivery of calling number
- block delivery of called number
- number to be used if CGN not present
- generate AMA record
- name to be sent to called party
- multiple appearance DN
- last number redial
- terminal will not ring

- Preferred interLATA Carrier (PIC)

  This parameter indicates the interLATA carrier to which interLATA calls originated from this DN should be routed. The IEC code will be in the range 0-999. The IEC codes are designated by Bellcore.

  The PIC will be 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".

- Calling party number presentation

  This parameter indicates whether the switch should allow presentation or restrict presentation of the DN of the calling party.

- 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. The default is No.

  The called user does not directly subscribe to this capability in order to receive this information. But the called user must not subscribe to the parameter Block delivery of calling number to be able to receive a calling party subaddress.

- Called party subaddress information transfer

  This parameter indicates whether the network should accept and transfer called party subaddress information from the calling user on call origination.

  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 a Called party number information element accompanied by a Called party subaddress information element.

- Low Layer Compatibility information transfer

  This parameter indicates whether the network should accept and transfer Low Layer Compatibility information from the calling user on call origination.

  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 and sends a Low layer compatibility information element on call origination.

- High Layer Compatibility information transfer

  This parameter indicates whether the network should accept and transfer High layer Compatibility information from the calling user on call origination.

  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 and sends a High layer compatibility information element on call origination.

- Automatic line

  This parameter, Automatic Line (AUL), allows a calling user to automatically terminate on a pre-determined destination without having to supply the address of the destination for each call.

- Block delivery of calling number

  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.

- Block delivery of called number

  This parameter allows a called user that does not wish to subscribe to the delivery of the Called Party Number (CDN) information element, to block the delivery of the CDN element.

- Number to be used if CGN not present

  This parameter allows a charge number (CHG), if available, to be delivered in the Calling Party Number (CGN) information element when there is no calling number present. The charging number and option must be set for that DN. The charging number will be delivered when the following conditions are met.

  - No calling number available
  - A charge number (either the ISUP charge number, or ANI is available)
  - Interworking has occured (for ISUP originations)
  - The CHG option on the BRI DN has been set

  For a POTS trunk (with Automatic Number Identification (ANI)) the ANI will be delivered in the CGN information element whenever ANI is available and the above conditions are met. However, the ANI will not be 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:

- Type of Number (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

- Generate AMA record

  This parameter allows the Telephone Operating Company (OC) the ability to optionally generate an Automatic Message Accounting (AMA) record when a call terminates to a line or through a Virtual Facilities Group (VFG).

  This feature will allow the OCs to have access charges per termination and to assign up to 200 unique call codes and optionally 200 unique service feature codes.

- 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.

- Multiple appearance DN

  This parameter 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 Multiple Appearance Directory Number, Multiple Call Arrangement (MADN MCA) group.

- Last number redial

  This parameter allows the last number dialed by the calling user to be redialed using a single key. The last number di-

aled is stored as the Last Number Dialed (LNR) number for that DN.

- Terminal will not ring

  This parameter prevents the terminal from ringing on incoming calls.

8.0 PARAMETERS PER DIRECTORY NUMBER/BEARER CAPABILITY

- Preferred InterLATA carrrier (PIC)

  This parameter allows a different PIC to be assigned to each bearer capability supported by the user. However, the PIC is not assignable to a BC of 64 kbit/s restricted.

  This parameter may also be used on a per directory number basis. The PIC for the bearer capability equal to 64 kbit/s restricted is supported on a DN basis only.

9.0 PARAMETERS PER GROUP OF DIRECTORY NUMBERS

- make set busy
- last number redial associated with set
- prevent barge-in on existing calls
- do not disturb
- call forward busy (exclude intergroup calls)
- call forward busy (exclude intragroup calls)
- call forward busy unrestricted
- call forward don't answer (exclude intergroup calls)
- call forward don't answer (exclude intragroup calls)
- call forward don't answer unrestricted
- call forward busy
- call forward don't answer
- call forward don't answer variable timer
- call forward intragroup
- call forward remote access
- call forward universal

- Make set busy

  This parameter allows a terminal to be made busy to incoming calls. While this feature is active on a set, all incoming calls will receive either a busy tone or some other treatment (tone or announcement).

  For intragroup calls blocked by the Make Set Busy (MSB) feature, the calling party will always receive a busy tone. Also the made busy set will 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 will still appear busy to incoming calls even when the set is involved in one or more calls.

- Last number redial associated with set

  This parameter allows a subscriber to redial 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 directory number.

- Prevent barge-in on existing calls

  This parameter allows the network to store information that will not allow a second call to the same DN, thus blocking an incoming Executive Busy Override feature.

- Do not disturb

  This parameter is an existing Meridian Digital Centrex feature that allows 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

  This parameter is an option available, from within the Call Forward Busy feature that prevents calls being forwarded to a remote terminal outside the customer group.

- Call forward busy exclude intragroup calls

  This parameter is an option available, from within the Call Forward Busy feature, that allows the prevention of the forwarding of incoming intragroup calls.

- Call forward busy unrestricted

  This parameter is an option available, from within the Call Forward Busy feature, that allows calls to be forwarded to a remote terminal either inside or outside the customer group.

- Call forward don't answer exclude intergroup calls

  This parameter is an option available, from within the Call Forward Don't Answer feature, that prevents calls being forwarded to remote terminals outside the customer group.

- Call forward don't answer exclude intragroup calls

  This parameter is an option available, from within the Call Forward Don't Answer feature, that allows the prevention of the forwarding of intragroup calls to a remote terminal.

- call forward don't answer unrestricted

  This parameter is an option available, from within the Call Forward Don't Answer feature, that allows the calls to be forwarded to a remote terminal inside or outside the customer group.

- Call forward busy

  This parameter 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 the Call Forward Busy 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

  This parameter 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 Call Forward Don't Answer is 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

  This parameter provides the ability to store in the network a Call Forward Don't Answer time. 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

  This parameter allows a terminal that has been assigned Call Forward capability to forward calls to a user-defined remote terminal within the customer group.

- Call forward remote access

  This parameter allows a user, from a remote terminal, to program Call Forwarding for their own base DN.

- Call forward universal

  This parameter allows a terminal that has been assigned Call Forward capability to forward calls to a user-defined remote terminal inside or outside the customer group.

SECTION H: ISDN BASIC RATE INTERFACE - MANAGEMENT SERVICES

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1.0 INTRODUCTION

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.

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.

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.

Other management services will be added in future releases of this document, as they become available.

1.1 ABBREVIATIONS

ASN.1	Abstract Syntax Notation One
BC	Bearer Capability
CAP	Call Appearance Key
CCITT	International Telegraph and Telephone Consultative Committee
CMIP	Common Management Information Protocol
CPE	Customer Premises Equipment
CRn	Call Reference with value = n
DN	Directory Number
ET	Exchange Termination
FA	Feature Activator
FIE	Facility information element
FAC	FACility message
ID	Identification
IE	Information Element
ISDN	Integrated Services Digital Network
MIT	Management Information Tree
REG	REGister message
REL COM	RELease COMplete message
RO	Remote Operations
RR	Return result component
SPM	Service Profile Management
TE	Terminal Equipment

1.2 REFERENCES

1. Draft Recommendation X.208 – Specification of Abstract Syntax Notation One (ASN.1), CCITT, 1988.

2. Draft Recommendation X.209 – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1), CCITT, 1988.

1.3 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 Section D 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 D, Appendix C, 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

2.0 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 Section D.

3.0 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".

3.1 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.

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.

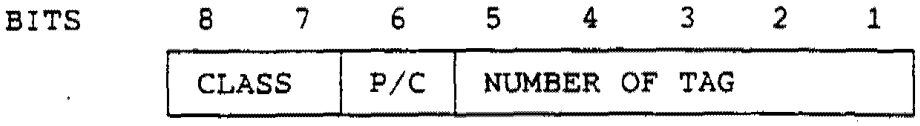
ERROR VALUES

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 D of this specification.

The following are the encodings for the operation specific tags. The coding rules for these tags are as follows.



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.

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

NOTES:

1. The contents of the DN Tag are coded using IA5 characters.

2. The contents of the Number of Calls tag are coded as an unsigned binary integer.

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 D of this specification.

4. The contents of the FA Value and CAP Value are coded as unsigned binary integers.

The following are the 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)

4.0 SERVICE PROFILE MANAGEMENT (SPM) PROCEDURES

4.1 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 D).
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: 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 Section E).

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 1 on page H-9 shows the information flow for the SPM protocol.

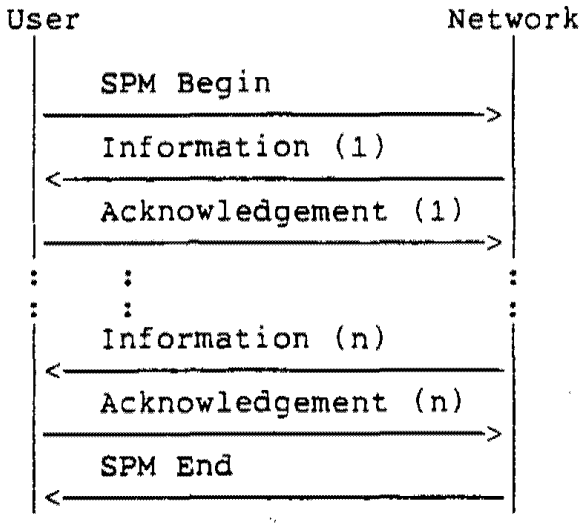


Figure 1. Information flow for SPM: This figure shows the basic message flow.

4.2 NORMAL PROCEDURES

Figure 2 on page H-10 show the message exchange between the network and the user in order to perform the SPM service.

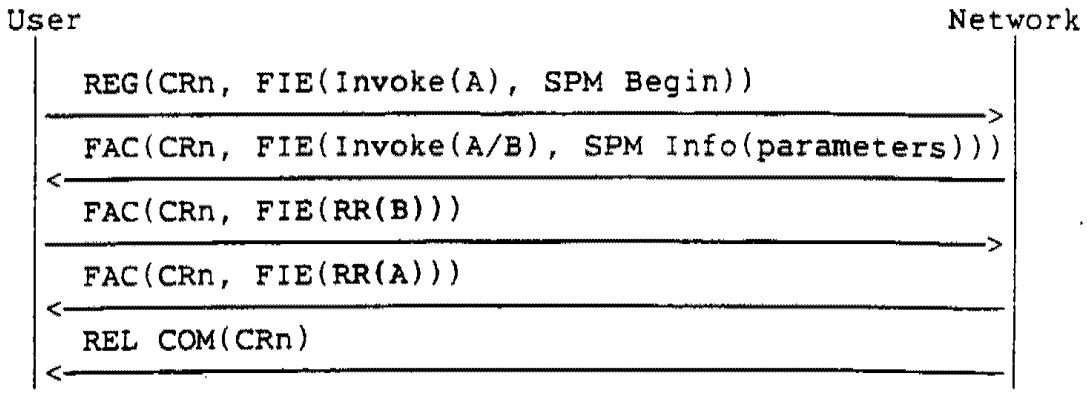


Figure 2. SPM Protocol: This is the message exchange for the normal case.

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 4.3.

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 4.7.

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.

4.3 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.

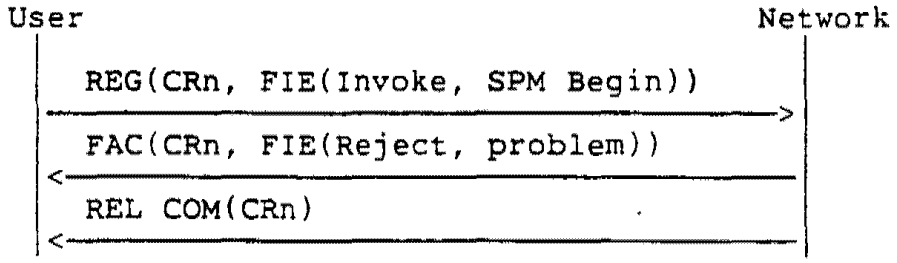


Figure 3. Reject Transaction: The Reject component is used to respond to components with a procedural or syntactical error.

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.

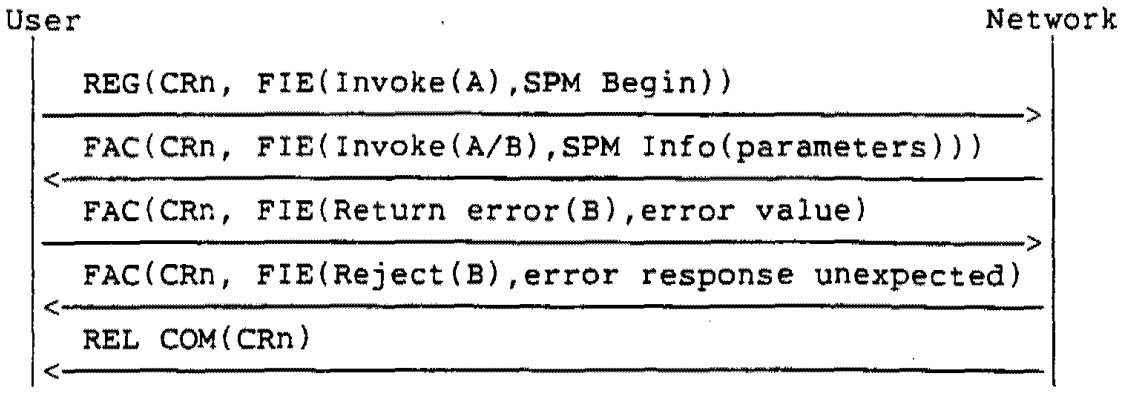


Figure 4. Error Transaction: The Return error component is used when an application problem occurs.

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.

4.4 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.

4.5 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.

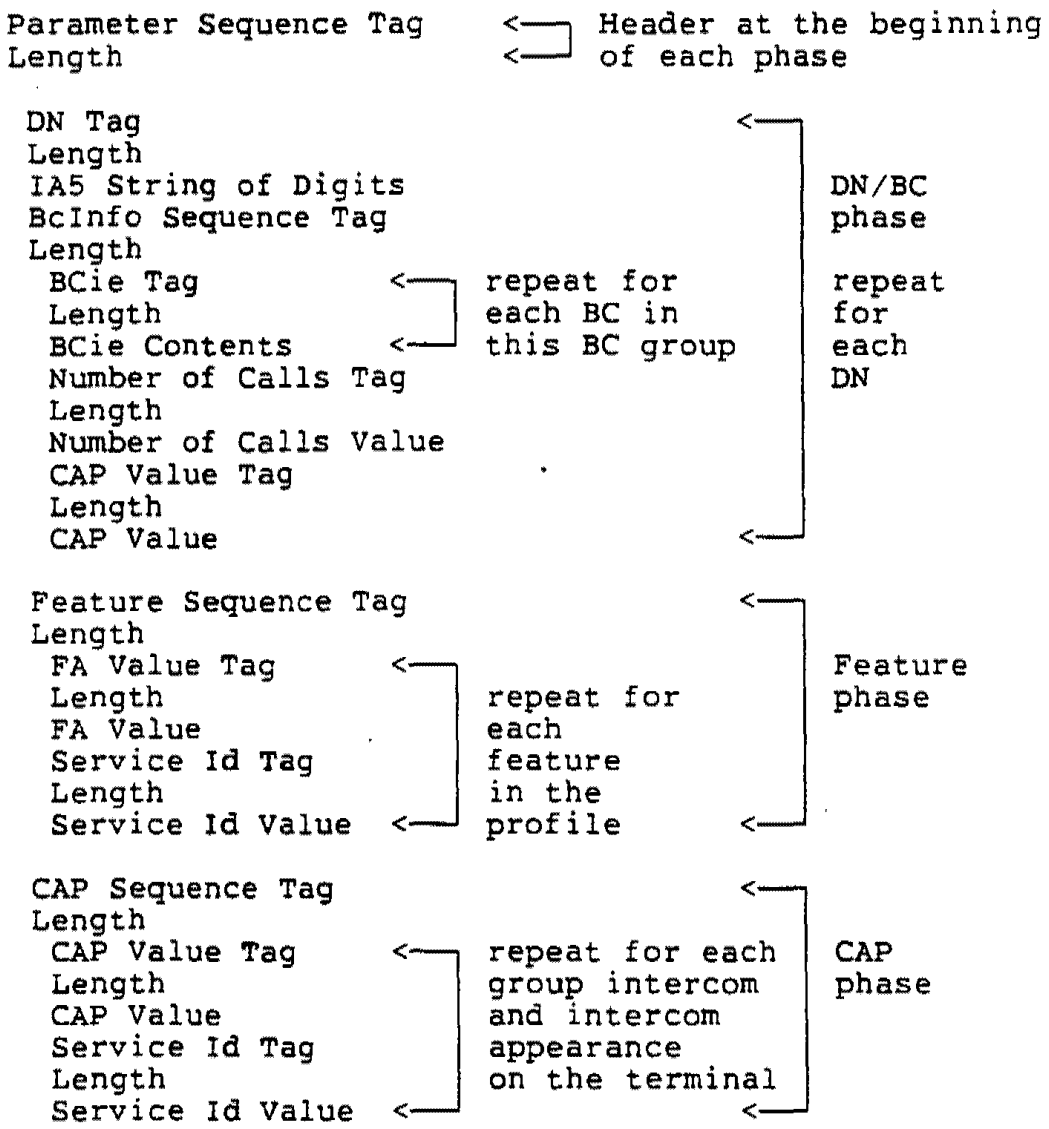
NSPM1 Timer on the network side (ET) which is started after a FACility message is sent to the user. The timer will be stopped on receipt of a FACility or a RELease COMplete message from the user, with the same call reference. If the timer expires, the network sends the user a RELease COMplete message, with the appropriate call reference. DURATION: 4 seconds.

4.6 SPM COMPONENT STRUCTURE

The following are the structures for the various components introduced above for this application.

4.7 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. The following chart shows the contents of the parameter portion of the linked Invoke component.



NOTES:

1. If the Number of calls is missing, the default is 1.
2. The CAP specifies a place holder for the DN.
3. Each new phase may be contained within one or more linked Invoke components.

This method is compatible with the view that Feature Activator assignments can be provisioned on a DN/BC pair.

4.8 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 Appendix C of Section D for further information on Remote Operations, macros, and ASN.1 notation.

```
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}

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
                    }
```

ADDENDUM A: ISDN BASIC RATE INTERFACE - DPN PACKET MODE DATA SERVICES

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1.0 INTRODUCTION

This section of the document describes Integrated Services Digital Network (ISDN) data services offered by Northern Telecom ISDN over the basic rate (2B+D) user-network interface when utilizing the DPN (Data Packet Network) based packet handler.

In describing the packet mode data services, this section uses the principles and terminology of CCITT Recommendations X.200 and X.210 - the reference model for Open Systems Interconnection.

This section 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.

Northern Telecom 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 data services to be offered:

- D-channel packet mode access for X.25 terminal equipment using CCITT LAPD (per Section C 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, will be augmented by future enhancements to include additional capabilities and packet mode services:

- Packet mode data services available On-Demand to user-network B-channels (CCITT Recommendation X.31 Case B).

1.1 REFERENCES

1. Northern Telecom Practice NTP 241-1001-184, LAPB/X.25 Specification.

2. CCITT Recommendation X.31 (1988)

3. IBM Synchronous Data Link Control - General Information, IBM GA 27-3093-3.

4. Northern Telecom Practice NTP 241-1001-193, SDLC Specification.

5. Northern Telecom Practice NTP 241-1001-196, SNA Multihost TPAD specification.

6. Northern Telecom Practice NTP 241-1001-194, LAPD/X.25 Specification.

7. Northern Telecom Practice NTP 241-2001-340, Service Data Specification.

8. Northern Telecom Practice NTP 241-1001-303, AM/RM operator Commands.

9. CCITT Rec.E.164 (1988)

10. CCITT Rec.X.121 (1988)

11. CCITT Rec.X.122 (1988).

2.0 PHYSICAL LAYER SPECIFICATION

This subsection 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 Section B of this document.

2.1 RATE ADAPTION

Rate adaption for B-channels is a process whereby bit streams having speeds less than 64 kbit/s are increased to 64 kbit/s at layer 1. Rate adaption is necessary for ISDN data services' access by terminal equipment operating at speeds less than 64 kbit/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 kbit/s terminal equipment accessing packet mode data services, the preferred method of rate adaption is to increase the clocking rate to 64 kbit/s.

3.0 DATA LINK LAYER SPECIFICATION

The Data Link Layer specifications for both B- and D-channel data services are described in this subsection.

3.1 DATA LINK LAYER SPECIFICATION - B-CHANNEL

The Layer 2 protocol for X.25 packet mode data on the B-channel shall be 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 shall be based on IBM SDLC as defined in appendix C of "IBM SDLC and Data Link Control Standards" IBM GA 27-3093-3 (reference 2.).

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.

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 Northern Telecom's ISDN Packet Handler :

1. Timer T1 specifies the period after which transmission of any frame may be repeated; the default value for T1 shall be 3 seconds; adjustment range from 1 second to 655 seconds; adjustment increment = 1 second.

2. Timer T2 indicates the amount of time available before the acknowledging frame must be initiated; the default value shall be 200 milliseconds; adjustment range from 100 milliseconds to 1000 milliseconds; adjustment increment = 100 milliseconds.

3. The maximum number of bits in an information frame (excluding flags and 0 bits inserted for transparency) is specified by parameter N1, and shall default to 16,440 bits; adjustment range from 1 bit to 16,440 bits; adjustment increment = 1 bit.

4. The maximum number of times that a command is sent before a station enters the disconnected mode is specified by parameter N2, and shall default to 10; adjustment range from 1 to 15; adjustment increment = 1.

5. The default 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 to 7 (modulo 8) and 8 to 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 Packet Handler (PH) has not received frames from a DTE for interval T (i.e. T203 for LAPD, T2 for LAPB) the PH will force a DTE response with RR or RNR. The value for T defaults to the value specified for timer T1; adjustment range from 1 second to 655 seconds; adjustment increment = 1 second.

Refer to NTP 241-1001-184 "LAPB/X.25 Specification" for exact details of Northern Telecom's implementation of the CCITT LAPB recommendation (reference 1.).

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. A subset of LAPD shall be used as defined by Section C of this document together with the following provisions :

1. Multiple frame operation shall be used on packet (SAPI=16) links.

2. Initially, pre-assigned TEIs (manually established at subscription time) shall be supported for one or multiple packet mode data terminals on the subscriber D-channel, for both SVCs and PVCs. It shall be 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.

3. Link layer parameters shall be determined at subscription time. Parameters will use the ranges and defaults specified in Section C.

4. A separate, longer timer (T200 in Section C) shall be provided for packet data links, since signaling links will have priority status.

5. Unacknowledged information (UI) transfer procedure will not be supported for packet links.

6. Only the extended (modulo 128) control field format shall be supported.

7. Terminals shall be viewed 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 will attempt to establish a logical link to the terminal by transmitting SABME. When the terminal is attached to the loop, the terminal 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) will be cleared by the network.

   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 will the incoming call be cleared.

Refer to NTP 241-1001-194 "LAPD/X.25 Specification" for exact details of Northern Telecom's implementation of CCITT LAPD/X.25 Recommendation (Reference 7.).

4.0 NETWORK LAYER X.25 PACKET MODE DATA SERVICES

This subsection describes the X.25 packet mode data transport service offered by Northern Telecom's ISDN switch. The service is available for both B- and D-channels at the basic rate user-network interface.

4.1 GENERAL CONSIDERATIONS

The network layer procedures implemented by Northern Telecom's ISDN Packet Handler 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.

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 shall have access to the same packet mode services as dedicated X.25 users in a Public Packet Switching Network (PPSN).

Initially, both B- and D-channel X.25 packet mode data services shall be provisioned (dedicated) at subscription time. Thus for packet mode data transfer across the DTE/DCE interface, there must exist a logical link (as specified in "DATA LINK LAYER SPECIFICATION" on page DPN-4) on the desired channel. Should an incoming call arrive at the Packet Handler (PH), destined for a loop with no logical links established between Terminal and PH, the Packet Handler will clear 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 will be processed.

The Northern Telecom ISDN switch supports a very comprehensive set of packet level facilities. The facilities supported include most of the 1984 and 1988 X.25 optional facilities as well as additional facilities not defined by X.25.

Refer to NTP 241-1001-184 "LAPB/X.25 Specification" for exact details of Northern Telecom's implementation of the CCITT X.25 recommendation (reference 1.).

4.2 TYPES OF CALLS

There are three types of packet mode data calls available to users on the user-network interface, namely Switched Virtual Calls, Permanent Virtual Calls, and Direct Calls.

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. A virtual circuit is the bidirectional 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.

4.2.1 Switched Virtual Call

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, and when communications are complete, the call clearing procedures are initiated to disconnect the virtual connection.

4.2.2 Permanent Virtual Call

Permanent Virtual Call (PVC), in contrast, is a permanent association between two DTEs. Each end has a logical channel preassigned 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.

4.2.3 Direct Call

Direct Call provides the flexibility of a SVC with the convenience of a PVC. With Direct Call service, call request information is defined at subscription time and is associated with a particular logical channel. Users do not have to specify the called terminal address when a call request is initiated on that logical channel number. An X.25 outgoing call which provides no destination address will cause a search for a direct call envel-

ope (within the PH) associated with its logical channel. If it exists, the direct call envelope will provide a destination address, facility data, and user data.

A DTE may override direct call data by inserting a destination address in the call request packet. In this case, the DCE ignores all information it has for the Direct Call option. If a user wishes to restrict where a DTE can call, an additional feature may be specified at subscription time to prevent override.

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 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.

4.3.1 Logical Channel Range

Four types of logical channels and their ranges must be chosen at subscription time. This selection should be based 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-utilized.

The four types of logical channels are :

1. Permanent Virtual Call logical channels.

2. One-way incoming logical channels for Switched Virtual Calls.

3. Two-way logical channels for Switched Virtual Calls.

4. One-way outgoing logical channels for Switched Virtual Calls.

For LAPB/X.25 service, logical channels are identified by a four bit logical group number and an eight bit logical channel number. This allows for the capability to address 4096 discrete logical channels. Logical channel 0, however, is reserved for control packets which 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 to 511. Channel 0, is again reserved for control packets which affect the

entire interface (restart and diagnostic packets), so only 510 channels are available for assignment.

- Note that while the logical channel range defined at subscription time may reside anywhere from 1 to 511 for D-channels or 1 to 4095 for B-channels, the range must be continuous.

When initiating a call, the DTE shall select the highest numbered free logical channel for an outgoing call, while the DCE will select 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.

4.4 SEQUENCED AND EXPEDITED 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. Modulo 8 packet sequence numbering is supported.

Expedited data transfer refers to the ability to send a limited amount of data on the virtual circuit, which will not be 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.

4.5 X.25 FACILITIES

The following is a list of the X.25 (1984/88) facilities (or 'services') that are available at the user-network 2B+D interface. All facilities are available for both B- and D-channel access.

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.

4.5.1 Additional Facilities

In addition to the X.25 defined facilities the following facilities are also provided.

- Direct Call
- Interexchange Carrier Preselect
- Protocol Conversion Screening
- Traffic Class

The following is a brief description of the additional packet facilities listed above.

4.5.1.1 Direct Call

This facility requires registration at subscription time and can be defined for any non-PVC logical channel with outgoing calls allowed. With this service, call request information is defined at subscription time and allows 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 "Types of Calls" on page DPN-8 for details.

4.5.1.2 Interexchange Carrier Preselect

This service 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.

4.5.1.3 Protocol Conversion Screening

This facility 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.

4.5.1.4 Traffic Class

This service 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: a) Priority and b) Normal. Priority packets usually have a lower delay than normal packets over the same virtual circuit.

4.5.2 Facilities not implemented

The following 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

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 shall be 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 will be 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 will be the mechanism for interworking between X.121 and E.164 numbering plans. The following provides address formats for different interworking configurations:

1. ISDN --> ISDN

   For calls between ISDN users, the calling user specifies the called address as : <subscriber number>. This address format will require 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 will eliminate the need for dialing prefixes.

2. ISDN --> PPSN

   For calls originating from one ISDN user that are destined for a user in a PPSN, the calling user specifies the called address as : <escape code 0> <DNIC of PPSN> <Network Terminal Number>.

3. PPSN --> ISDN

   For calls originating from a PPSN user that are destined for an ISDN user, the calling user specifies the called address as : <prefix> <escape code 0 > < country code><subscriber number>.

For North American ISDN trial purposes the pseudo-DNIC <9001> can be used to distinguish those users on the ISDN from those on the public packet switching network for intra-LATA calls.

4.7 ADMINISTRATIVE PROCEDURES

- To be added later.

4.8 USER MAINTENANCE CAPABILITIES

There are five capabilities which are available to aid both users and network operators in the operations and maintenance of ISDN Packet Handler X.25 access. These capabilities are described below.

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 are available to the users.

   Unconditional Takedown - If the unconditional takedown procedure is invoked, the PH will take the X.25 service on that channel out of service by initiating the link layer disconnect procedure. It will also clear all virtual calls and reset all permanent virtual circuits towards the remote terminals.

   Conditional takedown - If the conditional takedown procedure is invoked, the PH will prevent any new virtual calls from being set up on the designated access channel.The PH will take down the service by initiating the link disconnection procedure when all switched virtual circuits have been terminated and there is no permanent virtual circuits.

2. User Self-Testing Capabilities

   A terminal may place a virtual call to its own address. Using this capability, users may 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 can be used for incoming calls.

3. Idle Line Probe

   This service provides a simple sanity test on the packet mode terminal of the user-network interface.

   Provided that there is at least one idle LCN available, this service will have 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, otherwise the network will disconnect the link layer. After that, the network will try 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 "LAPB System Parameters" on page DPN-4, an additional timer (T2) is defined at the data link layer to detect idle logical links.

   In general, the Packet Handler starts T2 if no frames are sent or received on a logical link, and resets the timer whenever there is activity on that link. In the event timer T2 expires, the PH will force 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, which are used to indicate error conditions under circumstances when the usual methods of indication (i.e. reset, clear and restart with cause and diagnostic codes) are not adequate.

5.0 NETWORK LAYER 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.

5.1 GENERAL CONSIDERATIONS

Synchronous Data Link Control (SDLC) service is offered as a network layer packet mode data service by Northern Telecom's ISDN switch. The SDLC service conforms to "IBM Synchronous Data Link Control - General Information" GA27-3093-3 (reference 3).

Two SDLC services are currently offered: SNA Single Host and SNA Multihost.

SNA Single Host service implements the SDLC Single Host Terminal PAD (TPAD) function and the SDLC Host PAD (HPAD) function, to provide transparent communication (i.e. private line replacement) to SNA hosts using the QLLC protocol.

The SNA Multihost service implements the SDLC Multihost Terminal PAD (TPAD), to provide communication to multiple SNA X.25 hosts (i.e. 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 the course of this subsection:

Station	SDLC cluster controller + terminals
PAD	Packet Assembler and Disassembler
SNA X.25 Host	Host equipped with a NPSI or other X.25 front end
SNA SDLC Host	Host which talks to the network on an SDLC link through the HPAD
DTE	Data Terminating Equipment. An SNA Host or SNA controller connected to a PAD is referred to as a DTE.

Station State / Station Mode NRM or NDM

NRM	Normal Response Mode
NDM	Normal Disconnect Mode
SDLC	Synchronous Data Link Control
QLLC	Qualified Logical Link Control
SNA	System Network Architecture
NCP	Network Control Program
NPSI	NCP Packet Switch Interface

5.2 SERVICE SPECIFICATION

5.2.1 SNA Single Host

The SNA Single Host service is offered on the Northern Telecom ISDN switch in the following two configurations selectable at service subscription time:

- Both the SDLC 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 via permanent virtual circuits.

- 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 permanent virtual circuits 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.

5.2.2 SNA Multihost

The SNA Multihost service offered on the Northern Telecom 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, the SDLC protocol is used between the SDLC stations and the network, and X.25 protocol is used between SNA X.25 Hosts and the network. Only switched virtual circuits are supported between the terminal PAD and the SNA X.25 Hosts. Note that the host must implement its own PAD for QLLC, for example, by installing the Network Control Packet Switching Interface (NPSI) from IBM.

Refer to NTP 241-1001-193 "SDLC Specification" (reference 4.) and NTP 241-1001-196 "SNA Multihost TPAD Specification" (reference 5.) for exact details of Northern Telecom's implementation of the SNA single and Multihost services.

5.2.3 B-Channel Rate Adaption

B-channel rate adaption shall be implemented as specified for X.25 based data services. See "Rate Adaption" on page DPN-3.

5.2.4 Classes of Traffic Priority

The traffic priority class is specified at subscription time and can be specified as 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.

5.2.5 Maximum Frame Size

The maximum frame size allowed is 521 bytes.

5.2.6 SDLC Frame Level Overview

The SDLC frame level specifications are compatible with the "IBM Synchronous Data Link Control - General Information, GA27-3093-3 (reference 3) with the following restrictions:

The SDLC service supports only two way alternate transmission, nonswitched, per station.

The following SDLC features are not supported :

1. SDLC Loop Configuration

2. NRZI (non-return to zero inverted)

3. A station mode of "initialization"

4. SDLC frame types:

   - UI (unnumbered information frame)
   - RIM (request initialization mode)
   - SIM (set initialization mode)
   - BCN (beacon)
   - CFGR (configure)
   - UP (unnumbered poll)

5. Group addresses.

5.2.6.1 Data Link Configuration

The SDLC service supports point-to-point or multipoint. Communication is via a duplex channel but logically half duplex. In the case of 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.

5.2.6.2 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 can transmit 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.

5.2.6.3 Station Mode Definitions

The following station modes of operation are supported:

- Normal Response Mode (NRM): A Station in NRM can exchange data and flow control supervisory commands with other stations on the link.
- Normal Disconnected Mode (NDM): A Station in NDM can exchange only mode setting and other control commands.

5.2.6.4 SDLC Frame Format

The SDLC frame format is identical to the HDLC frame format of X.25.

5.2.7 Qualified Logical Link Control (QLLC)

The information path between the SNA X.25 Host or SNA SDLC Host and the SDLC stations are supported by physical and logical paths. 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 via 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 Manual" - GA27-3345-1.

ISDN BASIC RATE INTERFACE SPECIFICATION
NIS S208-6 ISSUE 1.1

ADDENDUM B OVERVIEW

Issue 1.1 of the ISDN Basic Rate Interface Specification NIS S208-6 describes the Bulk Change Supplement in the (BCS) 34 software level of the DMS-100 ISDN Basic Rate Interface product. Addendum B contains the call control signaling specification for Meridian Feature Transparency (MFT) product in BCS 34. This issue covers all changes and corrections to the DMS-100 MFT product specified in NIS S208-6, Issue 1.0 since its release in April 1991.

Terminal equipment which conforms to Section I of NIS S208-5 will continue to function on a DMS-100 switch with the BCS 34 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.

This overview describes in general the technical changes between NIS S208-6 Issue 1.0 Addendum B and NIS S208-6 Issue 1.1 Addendum B. Minor editorial and technical changes are not discussed, but all changes are marked with change bars in the left-hand margin.

Addendum B - MFT Call Control Signaling

1. A Call Timer field has been added to the list of network managed local display fields. This field would be used by the terminal to display a call timer to the user. The network will indicate the initial timer value to the terminal.

2. Terminals working with the current issue of MFT (Version=MFT, Issue=1) should not respond to the handsfree on and handsfree off instructions from the network. That is, terminals should not respond with offhook or onhook indications to the network when receiving one of these instructions.

3. Further detail on the operation of local fields has been provided.

Addendum B: ISDN Meridian Feature Transparency Call Control Signaling Specification

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1.0 INTRODUCTION

1.1 GENERAL

This section contains the layer 3 specification for the Integrated Services Digital Network (ISDN) basic rate user-network interface between the Northern Telecom 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 statisfy 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 Section A for a description of the contents of all sections of this document.

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, handsfree, 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 Sections A through H 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.

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 section are based on the concept of the abstract terminal as described in Section A of this document.

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.

2.0 OVERVIEW OF CALL CONTROL

This section is intentionally left blank to maintain consistency in section numbering with Section D of this specification. Section D–2.0 specifies the call states appropriate to functional signaling procedures.

3.0 MESSAGE FUNCTIONAL DEFINITIONS

3.1 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.

3.2 MESSAGES FOR CIRCUIT-MODE CONNECTIONS

The messages for circuit-mode connections follow.

3.2.1 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

Information Element	Reference	Direct	Type	Length
Protocol Discriminator	4.2	both	M	1
Call Reference	4.3	both	M	1 – 2
Message Type	4.4	both	M	1
Cause	4.5.4	n—>u	O	4 – 6
Date/time	4.5.10	n—>u	O	8
Keypad	4.5.5	u—>n	O	3
Information Request	4.5.11	n—>u	O	3
Feature Activation	4.5.6	u—>n	O	3 – 4
Feature Indication	4.5.7	n—>u	O	3 – 5
Service Profile Identification	4.5.8	u—>n	O	3 – 22
Endpoint Identifier	4.5.9	n—>u	O	3 – 4
Locking Shift	4.5.3	both	O	1
Display Text	4.6.5	n—>u	O	3 – n
B-channel Control	4.6.1	both	O	3
Meridian Transparency	4.6.2	both	O	3 – n
Sequence	4.6.3	both	O	3
Protocol Version	4.6.4	both	O	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 currect 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 Shift is only included if any Codeset 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.

4.0 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.

4.1 OVERVIEW

Within this protocol, every message may consist of the following parts:

a. Protocol Discriminator;

b. Call Reference;

c. Message Type;

d. 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 1 on page MFT-9.

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.

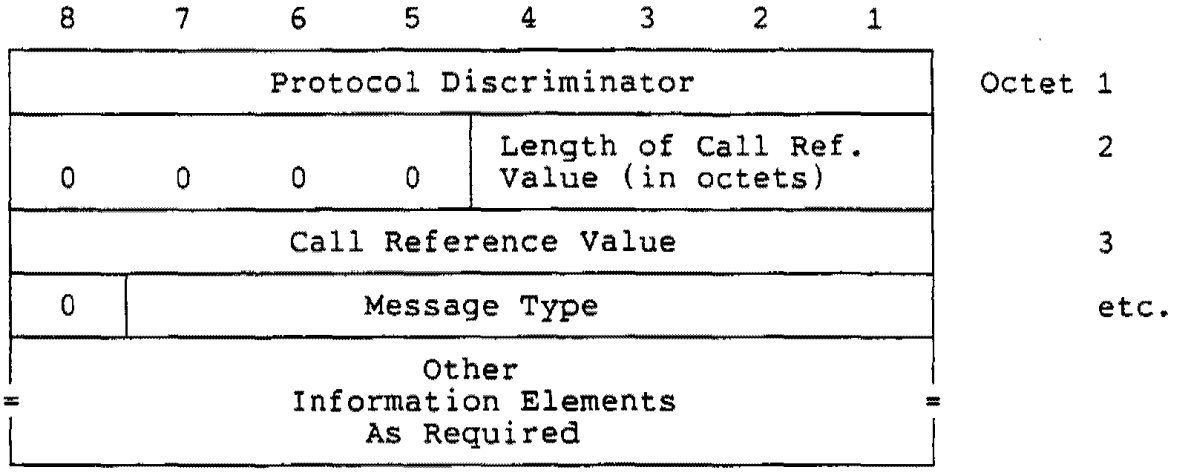


Figure 1. General Message Organization Example

4.2 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 2 on page MFT–10.

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								

Figure 2. Protocol discriminator

8	7	6	5	4	3	2	1	
0	0	0	0	1	0	0	0	Q.931(I.451) user-network call control messages

4.3 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.

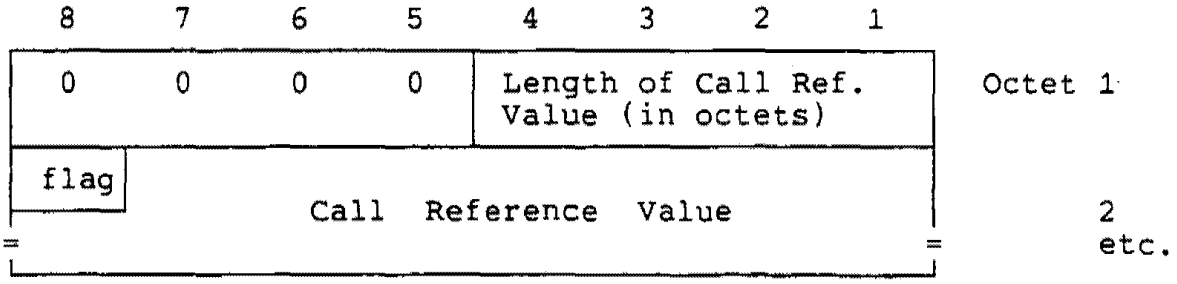
The call reference is the second part of every message. The length of the call reference value is indicated in octet 1, bits 1-4 of Figure 3 on page MFT-11.

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.

The call reference information element containing a dummy or null call reference is one octet long and is coded "0000 0000", as shown in Figure 4 on page MFT-11. The dummy call reference is the only type of call reference used in this specification.



Call Reference Flag (octet 2)

Bit
8

0 The message is sent from the side that originates the call reference.
1 The message is sent to the side that originates the call reference.

Figure 3. Call Reference information element

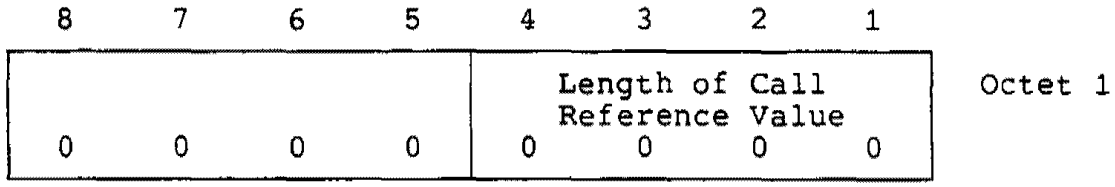


Figure 4. Dummy Call Reference

4.4 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. The message type is coded as shown below.

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

4.5 OTHER INFORMATION ELEMENTS (CODESET 0)

4.5.1 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 5 on page MFT–14 :

a. Single Octet Information Elements

b. Variable Length Information Elements

For the information elements described below, the coding of the information element identifier bits is summarized in Figure 6 on page MFT–15.

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.

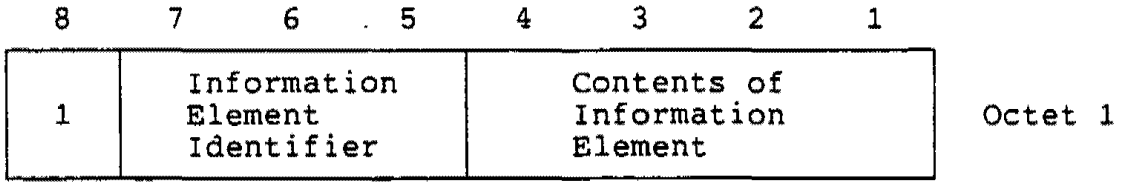
There is no length field in the single octet information element structure.

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.

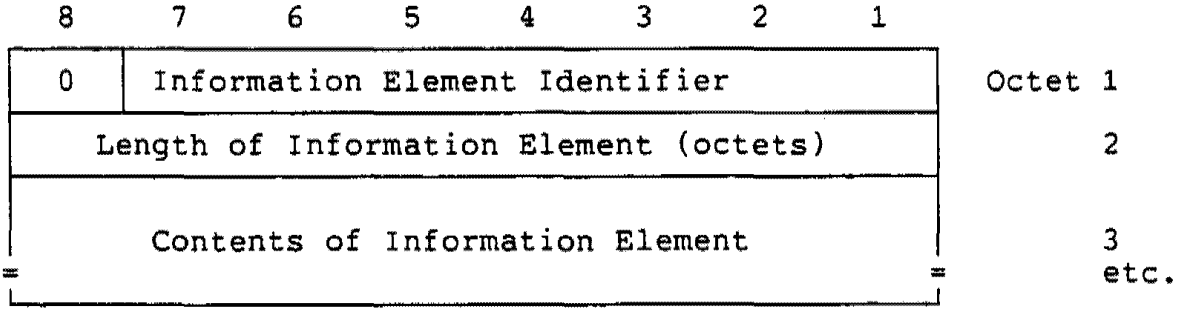
The following rules apply for the coding of variable length information elements in the format descriptions appearing in sections 4.5.4 etc.

a. 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.

b. Optional octets are marked with asterisks.



(a) Single Octet Information Element Format



(b) Variable Length Information Element Format

Note: Bit 8 is used to distinguish short (single octet) and long (multiple octet) format.

Figure 5. Formats of Information Elements

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

Figure 6. Information Element Identifier Encoding

4.5.2 Extensions of Codesets

There are 136 possible information element identifier values using the formatting described in Section 4.5.1, 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 "Coding Rules" on page MFT-12 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.

4.5.3 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 7 on page MFT-17.

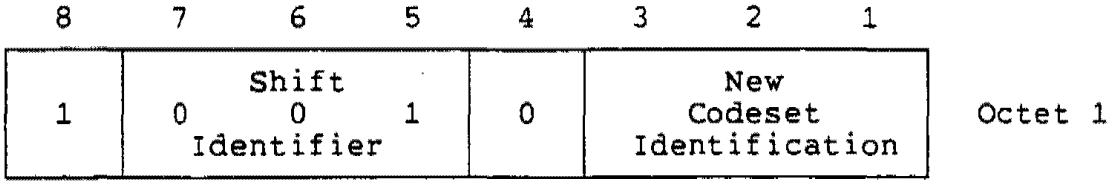


Figure 7. Locking shift information element

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)

4.5.4 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 below. 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 4.

The Cause information element and diagnostic may be repeated in a message, to report multiple errors.

8	7	6	5	4	3	2	1	
0	Cause 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

Cause information element

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

Cause value		Cause Number	Cause	Diagnostics
Class 7 6 5	Value 4 3 2 1			
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 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 preceeded by a Locking shift information element which specifies the appropriate codeset.

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

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.

4.5.5 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 below.

8	7	6	5	4	3	2	1	
0	Keypad Information Element Identifier							Octet 1
0	Length of Keypad Information							2
	0	0	0	0	0	0	1	
	Keypad information (IA5 character)							3

Keypad information element

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	#

4.5.6 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 below.

8	7	6	5	4	3	2	1	
0	Feature Activation 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 activation information element

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.

4.5.7 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.

The Feature indication information element is coded as shown below.

8	7	6	5	4	3	2	1	
0	Feature Indication 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						Status Indicator		4
0	0	0	0					

* this octet may be omitted.

Feature indication information element

Feature Identifier Number (octets 3 and 3a)

This field is coded as described for the Feature activation information element.

Status Indicator (octet 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)

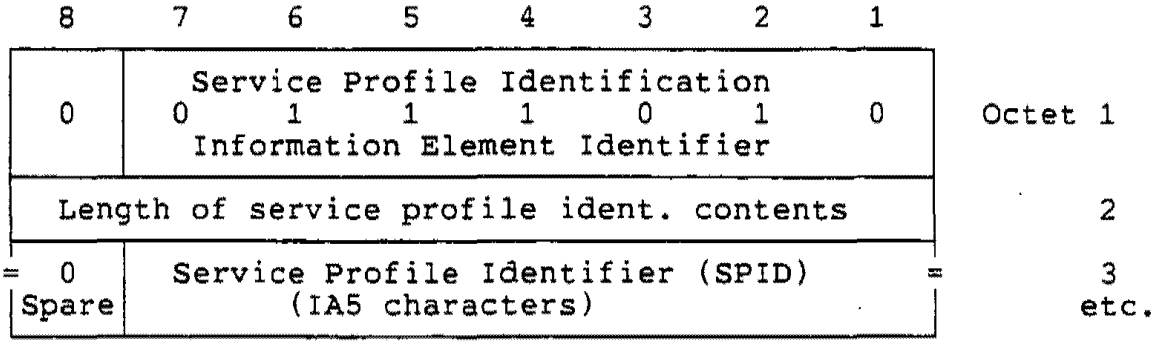
Note 1. The recommended indicator state is flash (50% on, 50% off, at 60 cycles per minute)

Note 2. The recommended indicator state is wink (67% on, 33% off, at twice the flash rate - 120 cycles per minute)

4.5.8 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 the following figure.



Service profile identification information element

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.

4.5.9 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.

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 Identifer							3
1 Ext.	Int.	Terminal Identifier						4*

* This octet may be omitted.

Endpoint identifier information element

User Service Identifer (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 termi-

nals 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

4.5.10 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 below. Octets 3 – 8 are binary coded (bit 1 being the least significant bit).

8	7	6	5	4	3	2	1	
0	Date/time Information Element Identifier							Octet 1
Length of Date/time Information								2
year								3
month								4
day								5
hour								6
minute								7
second								8

Date/time information element

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.

4.5.11 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 the following figure.

8	7	6	5	4	3	2	1	
0	Information Request Information Element Identifier							Octet 1
	0	1	1	0	0	1	0	
Length of information request contents								2
1 Ext.	Info. Req. Ind	Type of Information						3

Information request information element

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.

4.6 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.

4.6.1 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 below.

8	7	6	5	4	3	2	1	
0	B-Channel Control Information Element Identifier							Octet 1
0	Length of Control Information							2
	B-channel Control Parameter							3

B-channel control information element

B-channel Control Parameter (octet 3)

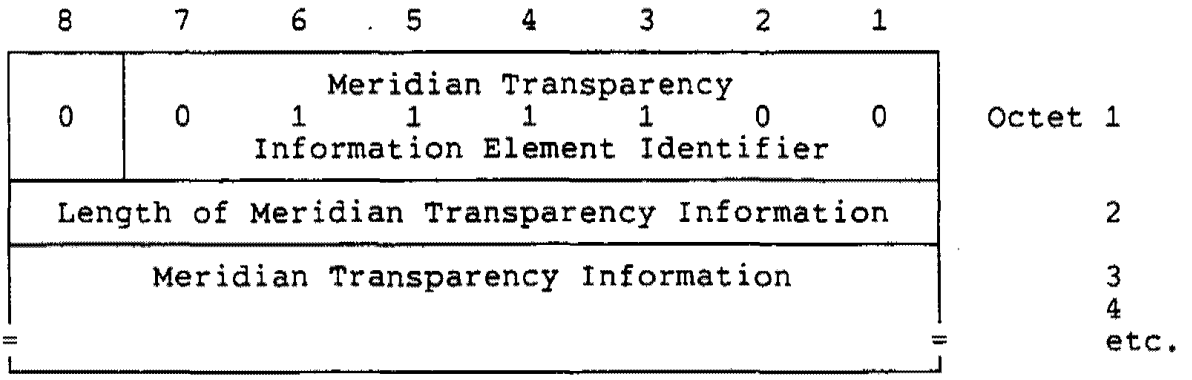
8	7	6	5	4	3	2	1	Meaning
0	0	0	0	0	0	0	0	Release B1
0	0	0	0	0	0	0	1	Release B2
0	0	0	0	0	0	1	0	Connect B1
0	0	0	0	0	0	1	1	Connect B2

All other values are reserved.

4.6.2 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 below.



Meridian transparency information element

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 "Meridian Transparency Procedures" on page MFT–56 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 follow.

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

8	7	6	5	4	3	2	1	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 "Transmit Status Message": no powerfail since last asked
0	0	1	1	0	1	0	0	Response to "Transmit Status Message": powerfail since last asked

All other values are reserved.

Network-to-User Meridian Transparency Information

All Meridian transparency information in the network to user direction has octet 3 coded 00000000.

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

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

4.6.3 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 below.

8	7	6	5	4	3	2	1	
0	Sequence Information Element Identifier							Octet 1
0	Length of Sequence Information							2
1 Ext.	Req. Ind.	Sequence Number						3

Sequence information element

Sequence Request Indicator (Octet 3)

Bits 7	Meaning
0	Sequence number provided
1	Sequence number request

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.

4.6.4 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.

8	7	6	5	4	3	2	1	
0	Protocol Version 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.

Protocol version information element

Note 1 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.

Note 2 Octet 3 – the spare bits may be used as a Coding Standard field, at a later date.

Note 3 Octet 4 – the MSB is bit 7 of octet 4. The LSB is bit 1 of the last occurence of octet 4a.

Note 4 Octet 5 – the MSB is bit 7 of octet 5. The LSB is bit 1 of the last occurence of octet 5a.

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.

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.

Issue Code (Octet 5)

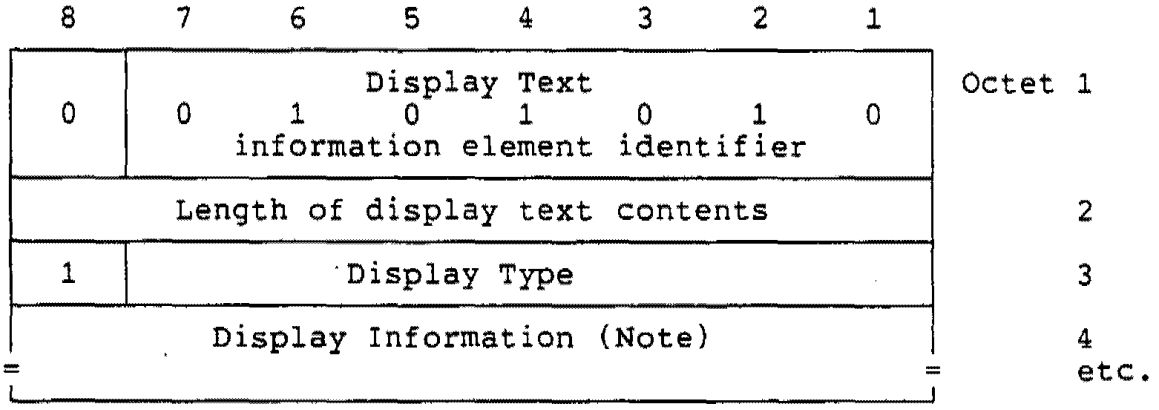
Bits 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0	issue number 0
0 0 0 0 0 0 1	issue number 1
0 0 0 0 0 1 0	issue number 2
0 0 0 0 0 1 1	issue number 3
to	
1 1 1 1 1 1 1	issue number 127

Note: the MFT version and issue codes supported and the relevant NT specifications that apply to each version and issue code follow. Refer to Section D of this specification for information on other supported protocol version and issue codes.

Version Meaning	Issue Code Value	Specification
NT Meridian Feature Transparency	0	NIS S208-5, Sections A,B,C,I
NT Meridian Feature Transparency	1	NIS S208-6, Sections A,B,C,I

4.6.5 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.



Display Text Information Element

Note: One or more groups of display information may be included depending on specific service requirements.

Display type

Bits 8	7 6 5 4 3 2 1	Meaning
1	0 0 0 0 0 0 0	Normal

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 D, Appendix C 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 table below.

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 0 1 0 0 0 1 0 1	Local field	::= [69]... (see below)

C: primitive = 0, constructor = 1.

All other values are reserved.

The table below shows the 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 D, Appendix C). 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.

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.

The following 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 preceeding display text tag. It is never the first tag in a Display text information element, and can not immediately follow another continuation tag.

The following example codes the ASCII text string "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.

The following example codes the ASCII text string "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. The ASN.1 definition of this data element is shown below.

```
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. The data element would be coded as follows:

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.

The data element specifying a date local field might be coded as follows:

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:

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 follows:

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)

5.0 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:

a) When a message is received that is less than three octets long, that message shall be ignored;

b) When a message is received with a protocol discriminator not in accordance with Section 4.2, that message shall be ignored;

c) 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";

d) When a truncated message is received (end of message occurs before the end of the message type) that message shall be ignored;

e) 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;

f) 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;

g) When the user or network receives a message containing information elements which are not ordered according to the rules specified in section 4.5.1, that message shall be ignored;

h) 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;

i) 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.

j) 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 A) shall be in state "active" (active call) at any one time. The Call Ap-

pearance 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.

5.1 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 12 on page MFT-69 to Figure 16 on page MFT-74.

5.1.1 Procedures for Call Establishment at the Origination Exchange

5.1.1.1 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.

5.1.1.2 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.

5.1.2 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 to).

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.

5.1.3 Procedure for Call Clearing

5.1.3.1 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 15 on page MFT-73).

5.1.3.2 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 16 on page MFT-74).

5.1.4 Interworking with Existing Networks

5.1.4.1 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.

5.1.4.2 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.

5.1.5 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.

5.1.6 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 "Meridian Transparency Procedures" on page MFT-56 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 "Terminal Identification" and "Protocol Version Control" on page MFT-55.

Note: The initialization procedure applies only to calls related to a specific logical link, that is, a specific abstract terminal.

5.1.7 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 acknowledgement 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.

5.1.8 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 Proto-

col 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.

5.1.9 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 "event" 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 "Meridian Transparency" on page MFT-34 for a description of Meridian transparency information.

5.1.9.1 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 "Terminal Initialization" on page MFT-53). 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 "Terminal Initialization" on page MFT-53), 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.

5.1.9.2 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.

5.1.9.3 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.

	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 refered 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 "Meridian Transparency" on page MFT-34).

To support the display option, the user shall support the mandatory control tags and display text tags described in "Display Text" on page MFT-41 and the display option instructions described in "Meridian Transparency" on page MFT-34. 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 preceeded 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 "Display Text" on page MFT-41 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 "Display Examples" on page MFT-61 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 refering to this option. Display low power mode is exited when the terminal receives any display update information from the network.

5.1.9.4 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 "Display Option" on page MFT-58. The terminal shall act on local field tags in Display text information elements which are preceeded by a locking shift to codeset 6. See "Display Text" on page MFT-41 for coding details, and "Display Examples" on page MFT-61 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.

5.1.9.5 Display Examples

In Figure 8 on page MFT-62 through Figure 11 on page MFT-64 are examples of how to code the display information field of the Display text information element. Please refer to "Display Text" on page MFT-41 for the descriptions of the different types of display text supported, and to Section D Appendix C 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.

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

Figure 8. Date, Time, and Call Timer Local Fields: 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 seconds.

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

Figure 9. Feature Display: 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.

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

Figure 10. Local Fields Overwritten: All previously displayed text is blanked and the local fields are overwritten. Unmodified portions of the local fields are blanked by the terminal.

TAG	LENGTH	CONTENTS	ASN.1 Reference
80	01	50	blank [0] IMPLICIT OCTET STRING=80

THU MAR 14 02:36
21:50

Figure 11. Clearing a 2x40 Display: 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.

5.1.9.6 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 accomodate a softkey label width of 8 display positions for each softkey on the bottom line of the display.

5.1.9.7 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 occured most recently.

5.1.10 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 "Keypad" on page MFT-22). The duration of the generated DTMF tone shall be no less than 100 milliseconds.

5.1.11 Exception Handling Procedure

Exception conditions may arise during or outside the lifetime of a call and these are handled as follows.

5.1.11.1 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'.

5.1.11.2 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".

5.1.11.3 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.

5.1.11.4 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 "Message Sequencing" on page MFT-52.

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.

5.1.11.5 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:

a. If any timer is running, it shall be cancelled. Timer T309S is started.

b. 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 "Message Sequencing" on page MFT-52.

c. 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 "Mandatory Procedures" on page MFT-56).

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 12 on page MFT-69 to Figure 16 on page MFT-74

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

Notes:

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.

2. The notation "FA=z" represents a Feature activation information element with feature value=z where z ranges from 1 to 64.

   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 MFT-25).

3. "MT=#nnnn" represents a Meridian transparency information element with a Meridian transparency information octet pair shown in hexadecimal. See "Meridian Transparency" on page MFT-34 for further information the coding of this information element.

4. 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.

5. 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 "Meridian Transparency Procedures" on page MFT-56 for further information).

Scenario: Terminal is idle. The user initiates a call on activator #1, to address 4335, using overlap sending.

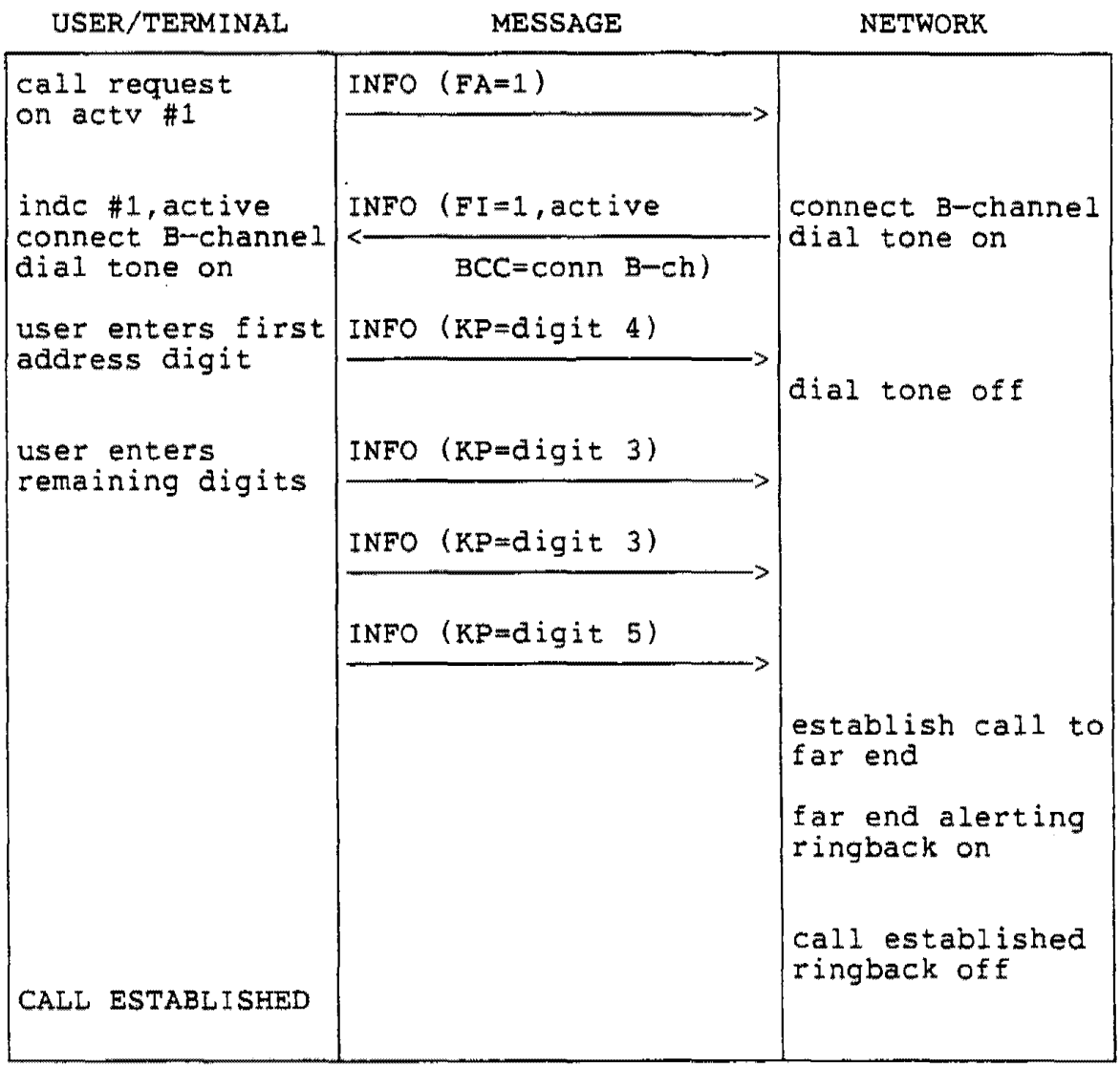


Figure 12. Call Setup

Scenario: While a call to 4335 is active on 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 13. Nested Call

Scenario: An incoming call is offered to 2 idle terminals. First terminal to request connection is awarded the call. The incoming call address is 5824.

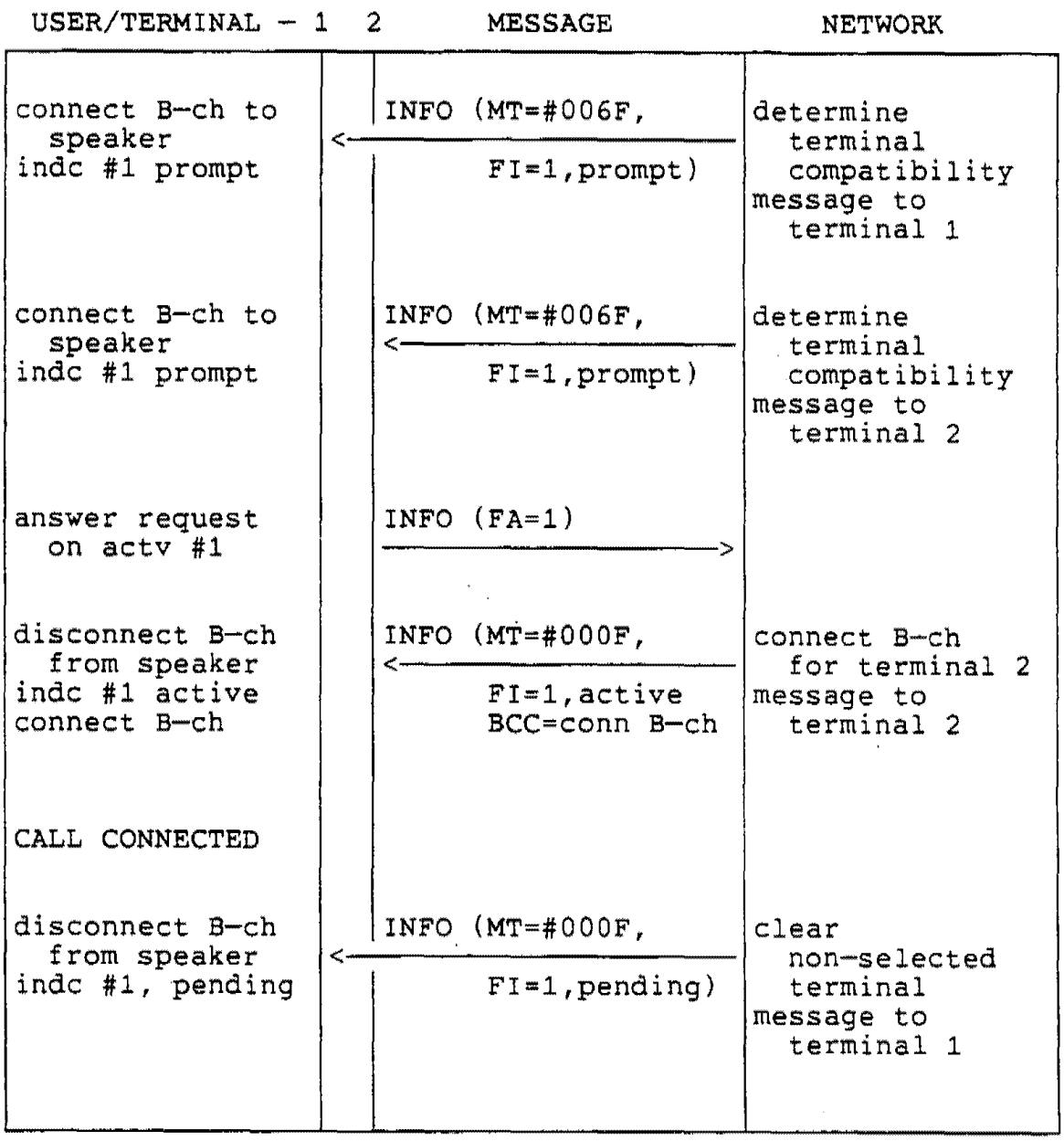


Figure 14. Incoming Call

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 activator.

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.

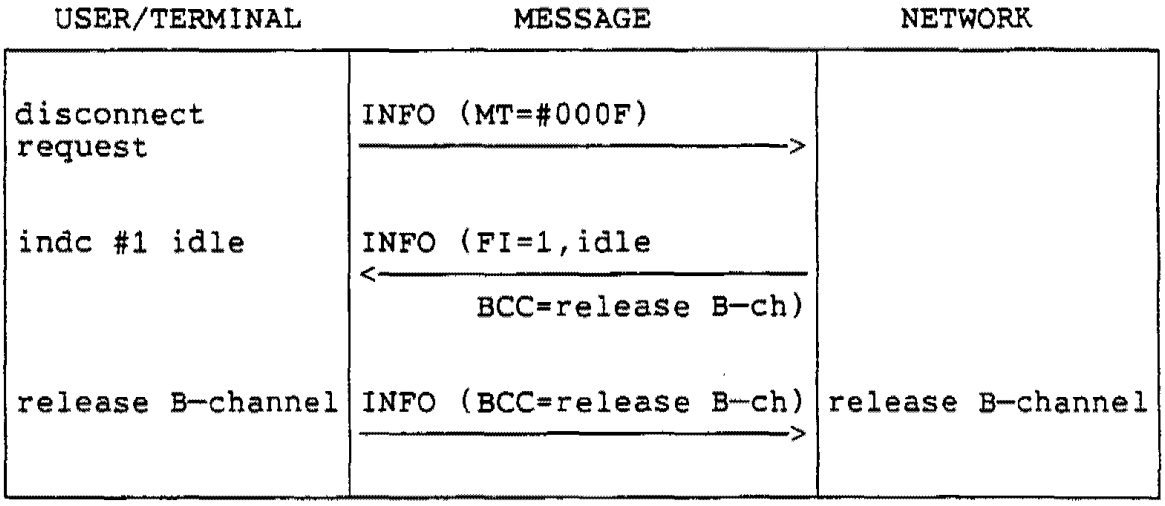


Figure 15. Call Clearing (User Initiated)

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.

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.

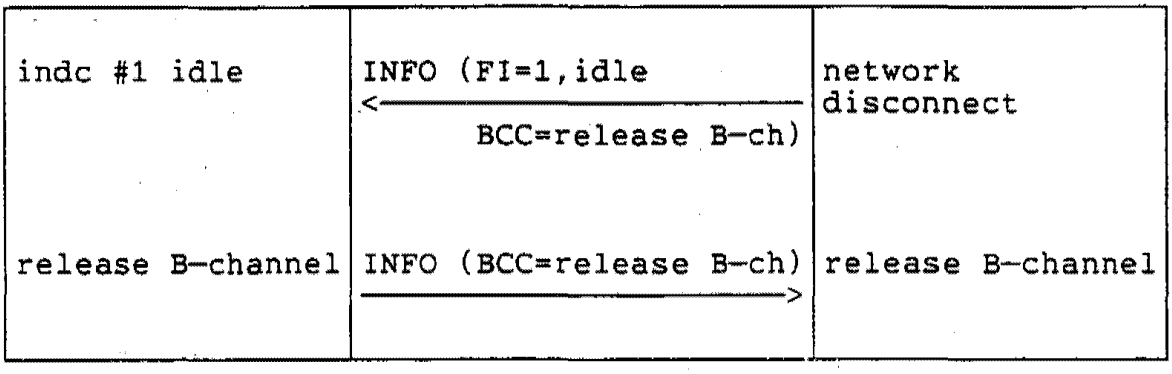


Figure 16. Call Clearing (Network Initiated)

Note: The B-channel control information elements are sent only if there are no outstanding calls at the terminal.

6.0 SYSTEM PARAMETERS

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.