TECHNICAL REFERENCE

AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface And Special Application Specification

User - Network Interface Description

July 1990

Director - Network Strategy

AT&T

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AT&T NETWORK INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PRIMARY RATE INTERFACE
AND
SPECIAL APPLICATIONS SPECIFICATION

USER-NETWORK INTERFACE DESCRIPTION

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AT&T INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PRIMARY RATE INTERFACE

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GLOSSARY

64C	64Kbps Clear
64R	64 Kbps Restricted
ANI	Automatic Number Identification
APS	ACCUNET® Packet Service
B8ZS	Bipolar with 8 Zero Substitution
BN	Billing Number
CATSC	Call Associated Temporary Signaling Connection
CBC	Call-By-Call
CCITT	International Telegraph and Telephone Consultative Committee
COLI	Connected Line Identification
CPE	Customer Premises Equipment
CPN	Calling Party Number
CPS	Calling Party Subaddress
DDS	Digital Data System
ESF	Extended SuperFrame
ILDS	International Long Distance Service
ISDN	Integrated Services Digital Network
LAPD	Link Access Protocol for the D-channel
MA UUI	Message Associated User-to-User Information
NANP	North America Numbering Plan
NCA TSC	Non-Call Associated Temporary Signaling Connection
PRI	Primary Rate Interface
SDI	Switched Digital International Service
SDN	Software Defined Network
SID	Station Identification
TG	Trunk Group
USBS	User Signaling Bearer Service

1. Introduction

This Technical Reference describes the service-related capabilities and features which will be supported by AT&T in its implementation of Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI). This issue of Technical Reference 41459 dated July, 1989 [1] includes TR 41459 Addenda[2] dated December 15, 1989, January 1990, and July 1990. A necessary companion Technical Reference is the AT&T ISDN Primary Rate Interface Specification[3] (TR 41449) and the TR 41449 Addendum[4] dated July, 1990. TR 41449 contains the ISDN PRI protocol specification for both the network and the user side ISDN PRI implementations of AT&T ISDN PRI products, without discussing carrier-specific or application-specific aspects of the interface. This interface is based on the International Telegraph and Telephone Consultative Committee (CCITT) Recommendations for the ISDN user-network Primary Rate Interface. The AT&T Primary Rate Interface is compatible, subject to feature set differences, with other announced or future AT&T products as specified in other external AT&T publications.

The key feature of the ISDN Primary Rate Interface is the use of out-of-band message-oriented signaling, carried in a separate digital channel on the access and/or egress facility. This feature will enable AT&T to provide end-to-end services, over service-independent access channels, at 64 Kbps and certain multiples of 64 Kbps. It also allows for a wide variety of vertical features on existing and planned services.

The ISDN Primary Rate Interface is capable of supporting the AT&T network features and services described in the following sections and serves as a foundation for many other special access services. Users with this ISDN Primary Rate Interface can communicate across the AT&T network with those users who do not use ISDN Primary Rate Interface, subject to the limitations of their network interfaces and premises equipment.

This document will be updated to specify future additional AT&T network features and/or to reflect future changes resulting from ongoing standards activities (e.g., CCITT, ANSI T1S1). A glossary of acronyms is provided at the beginning of Part I.

1.1 Introduction to this Issue of TR 41459

In this issue of TR 41459 modifications have been made to provide feature and service enhancements, changes in standards, and feature revisions. The implementation described herein is backward compatible, where possible, with the previously described implementation.

Note that the format of Layer 3 (Network Layer) in Part II of this issue aligns with the format in the CCITT Recommendations for the ISDN user-network PRI. The Layer 3 section adopts similar sectioning and layout mechanisms in presenting the protocol information as accepted in the standards community (e.g. CCITT). This continues to demonstrate AT&T's commitment and efforts in conforming with external standards.

Note also that differences between information elements in Part II of this document and TR 41449 are highlighted in **bold** face text.

There are four appendices in this issue: Appendix 1 — "Feature Control Interface Specification for AT&T Special Applications", Appendix 2 — "Capability for ISDN Tandem Interface", Appendix 3 — "Service Specific Capabilities", and Appendix 4 — "Alternate Destination Call Redirection".

Briefly, the new features supported via the AT&T Network ISDN PRI included in this document are:

□ Message-Associated User-to-User Information (MA UUI) Upgrade:

— Define the information element dropping algorithm upgrade.

□ Improvements on Calling Party Subaddress (CPS) which provides the following capabilities to the originating end:

— The ability to restrict, on a subscription or per call basis, the presentation of Calling Party Subaddress (see Section 4.11 in Part I and Section 3.11.7 in Part II).

□ Improvements in the Connected Line Identification (COLI) feature, which provides the following capabilities to the user:

— The ability for the network to provide a network-provided connected number to a calling user, on a subscription basis, if a connected number is not provided by the called user (see Section 4.12 in Part I and Section 3.11.8 in Part II).

— The ability of the called user to restrict, on a subscription basis, the presentation of the network-provided connected number to the calling user. (see Section 4.12 in Part I and Section 3.11.8 in Part II).

□ A summary of protocol upgrades is listed below:

● Messages:

— Improvement of message format, with addition of "*locking*" to the Shift information element descriptions.

● The following information element procedure has been changed:

— Non-Locking Shift (see Section 3.4.5.4 in Part II).

● Update the format of the Bearer capability information element:

— A change in octet numbers, octet 5 and extensions have been renamed to 5, 5a, 6, and 7. Some field names in octet 5 have also been renamed. Bit values are unchanged (see Section 3.4.5.5 in Part II).

● The following new network-specific Cause value is supported:

— Cause 47, "New destination" (see Section 3.4.5.12 of Part II, Table II-3-50).

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2. Physical Interface

The physical interface is based on CCITT Recommendations I.412 and I.431 and conforms to AT&T Technical Reference 62411[5]. The Primary Rate Interface (PRI) is one or more 1.544 Mbps DS1 facilities, each organized into 24 time slots of 64 Kbps each. Details of the physical interface are given in Part II of this document. Note that a customer location may have multiple DS1 facilities and multiple PRIs.

As a customer option, the full information bearing capacity of an interface need not be provisioned. For example, a customer can have one ISDN PRI access limited to the use of only 13 time slots for calls plus at least one time slot for out-of-band signaling. Remaining time slots on the DS1 could be used for other purposes, such as dedicated special access to Digital Data System (DDS), ACCUNET® Packet Service (APS), or other inband signaled network services. Note that this option is not explicitly mentioned in other sections of this Technical Reference.

2.1 Channel Structure

Single time slots used for signaling are referred to as D-channels. When a D-channel is present in a DS1 interface, it must be in time slot 24. An ISDN customer location must have at least one D-channel. When multiple DS1s are provided to a given customer location, the ratio of B-channels to D-channels will be engineered. The number of D-channels in a multi-DS1 arrangement can be tailored to meet a given customer's cost/performance requirements. Furthermore, to reduce the risk of possible facility failure with non-facility associated signaling, the customer can optionally provision one or more D-channels, and each D-channel can have one backup D-channel associated with it.

Single time slots used for voice or data (circuit or packet mode) are referred to as B-channels.

Groupings of time slots 1-6, 7-12, 13-18 or 19-24 (provided that time slot 24 has not been provisioned as a D-channel) within a single interface are referred to as H_0 channels and are used to carry calls at a data rate of 384 Kbps. A grouping of the entire twenty-four time slots within a single interface (without a D-channel) is referred to as an H_{11} channel and it can be used to carry calls at a data rate of 1.536 Mbps.

2.2 Channel Overlay

While the time slots comprising an H_0 or H_{11} channel are fixed, these time slots may alternatively serve as time slots of other channel types. For example, if all the time slots of an H_0 channel are idle, the time slots can be used as six individual B-channels to carry a call or, if all time slots of an H_{11} channel are idle, the time slots can be used as four individual H_0 channels or 24 individual B-channels or any combination of the above. This scheme is referred to as a channel overlay structure, or an overlaid interface.

Channel overlay is optional. Any time slot grouping serving as an H_0 or H_{11} channel may be dedicated to carrying calls of that bandwidth if the customer so chooses through service provisioning. The channel overlay structure may only be employed on those time slots which correspond to public circuit-switched channels.

3. Signaling Capabilities

Signaling for the AT&T Primary Rate Interface (PRI) is provided over the D-channel using

CCITT Recommendation Q.921 (I.441, or LAPD), Q.931 (I.451) and Q.932 protocols. Part II of this document provides details regarding the implementation of the protocols for this interface. The protocols are fully described in sections III and IV of TR 41449. These protocols allow calls to be placed on B, H_0, and H_{11} channels and to support vertical features on those calls.

These capabilities are possible because the protocols are message-oriented. Signaling information related to the call, such as calling/called party identification and channel number and type, is carried in specific "information elements" within a flexible message format.

4. Feature Descriptions

The following sections describe the features of the AT&T Network ISDN PRI.

4.1 64 Kbps Clear/Restricted

Switched end-to-end digital connections will be supported at a data rate of 64 Kbps Restricted (64R) or at 64 Kbps Clear (64C) as described in TR 41449. With 64R the customer is responsible for ensuring that the all-zero octet is not transmitted in any time slot. If the all-zero octet *is* transmitted, one of the bits will be changed to a one, thereby corrupting user information. 64C channel connections will be supported where Bipolar with 8 Zero Substitution (B8ZS) coding and the Extended SuperFrame (ESF) format are available end-to-end. 64C allows the entire 64 Kbps of a time slot to be used for user information with no restrictions on the time slot content.

If the call SETUP message specifies 64C in the Bearer capability information element and the network cannot provide end-to-end 64C connectivity, the call will be rejected. A call reattempt with 64R specified will be required to set up the call.

4.2 Wideband Switching

The capability to switch calls at 384 Kbps and 1.536 Mbps rates across the network will be supported, subject to appropriate end-to-end connectivity.

An H_0 channel must be designated in the Channel identification information element via the slot map (see Section 3.4.5.13 in Part II). For a B or H_{11} channel the slot map is not used. For an H_{11} channel, the interface identifier must be designated in the Channel identification information element. Clear or Restricted versions[7] of 384 Kbps and 1.536 Mbps switched end-to-end digital connections will be supported. As with 64C Kbps connections, 384 Kbps and 1.536 Mbps clear channel connections will be subject to the availability of the B8ZS coding and the ESF format end-to-end.

If the call SETUP message specifies 384C or 1536C and the network cannot provide the appropriate clear channel connectivity, the call will be rejected. A call reattempt with 384R or 1536R specified will be required to set up the call.

The network will support RESTART, RESTART ACKNOWLEDGE, SERVICE, and SERVICE

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7. See Section 6 in Part II of TR 41449 for definitions of restricted and clear channels.

ACKNOWLEDGE messages for all channel types (B, H_0, and H_{11}, overlaid or non-overlaid) on an individual B-channel basis only. Wideband channel maintenance is done by sending the appropriate messages for the individual B-channels which comprise the wideband channel.

4.3 Call-by-Call (CBC) Service Selection

By using various information elements in the SETUP message for a given channel, the user can designate to the network, on a Call-by-Call (CBC) basis, which service is desired. Similarly, when offering a call to a user, the network will indicate on a call-by-call basis the service type of the incoming call. CBC will eliminate the need for dedicated channels for each service. If desired by the customer, however, dedicated channels could be provided.

The CBC Service Selection feature applies to H_0 and H_{11} channels as well as B-channels. For example, an H_0 channel could carry a 384 Kbps call associated with one of several services. Note that when channel overlay is employed, the underlying B-channels must be a call-by-call group.

4.3.1 Service Provisioning Options

The customer may specify, at service provisioning, that all or some of the (switched) channels will be CBC channels (service-independent channels). Additionally, the customer may specify that one or more subsets of the channels to be dedicated channels, that are allocated to particular switched services. A "service configuration" designates which channels are to be allocated to which services. The service configuration may be changed via service order.
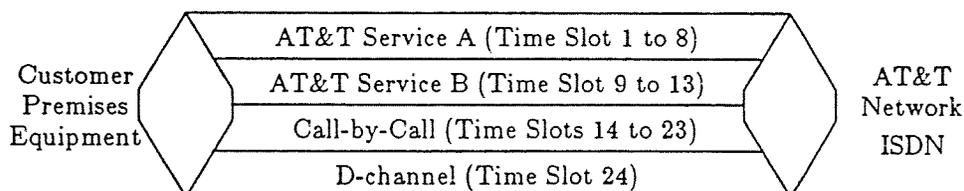

	AT&T Service A (Time Slot 1 to 8)	
Customer Premises Equipment	AT&T Service B (Time Slot 9 to 13)	AT&T Network ISDN
	Call-by-Call (Time Slots 14 to 23)	
	D-channel (Time Slot 24)	

Figure I-1. Sample Service Configuration of a DS1 between Customer Premises and AT&T Network ISDN

Figure I-1 shows a sample configuration that a customer, who has a single DS1 access, might choose. This customer has chosen to dedicate 13 time slots to specific AT&T services and 10 time slots (labeled call-by-call) can be used to carry calls of any service that the customer subscribes to. Note that this customer cannot place or receive an H_0 call on time slots 7 to 12 or 13 to 18 since a single call cannot cut across time slots dedicated to different services. Similarly, this customer cannot place or receive an H_{11} call on this DS1.

4.3.2 CPE Management of a CBC Pool of Channels

Instead of dedicating specific time slots to specific services, the customer may choose to treat all time slots as belonging to the call-by-call pool. The Customer Premises Equipment (CPE) can choose to limit the maximum number of simultaneous calls of each type on the call-by-call pool. By choosing suitable limits for each call type, the CPE can ensure that no individual call type can adversely affect the traffic volume of other call types. This can be done transparently to the network by CPE with appropriate development. It could be used to achieve the same effect as dedicating time slots for a particular call type without the need to reconfigure (e.g., via a

service order), while still gaining some traffic efficiency.

4.3.3 Subscription Screening

For each service subscribed to by the customer, the customer must have either a pool of channels dedicated to that service, or the CBC pool of channels must be provisioned to carry calls of that service, *or both*. The network will screen every call that is initiated by the customer. The call will be rejected if the customer is not provisioned to carry calls of the requested service on the pool of channels on which the call arrives. See Sections 5 and 6 in Part I for the possible AT&T domestic and international switched services that are supported via ISDN PRI.

4.4 Service Identification

4.4.1 Service Identification on Access

When the Network-specific facilities information element indicates unrecognized facilities, the network may either send a RELEASE COMPLETE message if the call is on a CBC TG or send a FACILITY REJECT message if the call is on a dedicated TG.

For calls on CBC TGs, services are identified by using the Network-specific facilities, Bearer capability, Channel identification, and Called party number information elements. If the contents of the Network-specific facilities, Called party number, Channel identification and Bearer capability information elements are inconsistent, the call will be rejected. Table II-3-54 in Part II, illustrates information element codings for nodal services.

There will be no default treatment of calls when a Network-specific facilities service coding is absent in a SETUP message on a CBC TG. In this case, the network returns a RELEASE COMPLETE message with cause 96, "mandatory information element missing".

4.4.2 Service Identification on Egress

On egress, the network will choose a channel to the user based on the terminating customer's service configuration[2]. The associated service may be specified using the Network-specific facilities, Bearer capability, Channel identification, and Called party number information elements in the SETUP message to the terminating user. CPE may use this information for the purposes of generating traffic reports, TG sizing on the user-network interface, and customized call handling by services on CBC TGs.

4.5 Service Screening

4.5.1 Screening on CBC TG

See Section 4.3.3 above.

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2. See Section 4.3.1 in Part I.

4.5.2 Screening on Single Service TG

For calls on dedicated TGs, the Network-specific facilities information element, if present, must indicate the same service to which the TG belongs. If a Network-specific facilities information element with invalid contents is included in the SETUP message, a call attempt on a dedicated TG will be rejected with cause 50, "requested facility not subscribed",

4.6 Channel Hunt Algorithm

In order to increase the efficiency and utilization of an access interface the network will employ the following channel-hunt algorithm.

1. The network will attempt to hunt an idle channel beginning with the first non-overlaid interface, if the customer has any. If no channel of the appropriate bandwidth is available on any non-overlaid interface, the network will make a second pass over all the customer's interfaces, overlaid and non-overlaid, in order, for an idle channel. This strategy also applies to hunts for H0 and H11 channels. The hunt order will always be in the forward direction[3] (i.e., from the lowest numbered available channel to the highest numbered channel).

2. On an overlaid interface, when hunting an idle B-channel, the network will first search for an idle time slot in an already partially occupied H_0 time slot grouping. This method is used in order to keep totally unoccupied H_0 time slot groupings open as long as possible for 384 Kbps calls. A similar strategy is employed to retain H11 channels uncontaminated, when hunting H0 channels in an overlaid interface. Again, the hunt order will always be in the forward direction[3].

It is recommended that customer premises equipment employ a complementary channel-hunt strategy so as to maximize the fill and minimize glare on a PRI or group of interfaces.

As with a CBC pool of channels, the customer may wish to manage call flow on overlaid channels according to bandwidth as well as service. Again, this can be done, transparently to the network, by CPE with appropriate development.

4.7 Calling Party Number (CPN) to the Network

For ISDN PRI customers originating calls to the AT&T Network, Calling Party Number (CPN) is the number provided by a user in the number digits field of the Calling party number information element in the SETUP message. The availability of CPN to the network makes it feasible to offer new network services. Also, this feature, combined with the "CPN/BN Privacy Optioning" feature (Section 4.8) and the "CPN/BN to the Terminating End" feature (Section 4.9) makes new user and terminal-based services feasible.

The customer or the originating local network can provide a CPN of 13 or fewer digits. The network may pad the CPN by inserting zeroes for unused digits, if the number of digits is less than 13. The network will not make any attempt to check whether the CPN will be meaningful for the terminating user. If the CPE sends a CPN of longer than 13 digits, the CPN may be discarded. For outgoing international calls, if the type of number is "national" and the numbering plan is "ISDN/telephony" the total length of the CPN must be 10 digits and the first digit must not be 0. This restriction does not apply if the CPN is a private number. Note that a private number is indicated by the

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3. Note that the numbering of channels can be decided at service provisioning and may not always correspond to the numbering of the time slots on a DS1.

"subscriber number" in the type of number field and the "private numbering plan" in the numbering plan identification field.

4.8 CPN/BN Privacy Optioning

As stated above in Section 4.7, CPN is the number provided by the user in the Calling party number information element within the SETUP message. BN is a customer billing number stored at the originating AT&T Network Switch.

With the CPN/BN privacy Optioning feature, AT&T PRI callers can control the presentation of either CPN or BN to the called users (including international endpoints). At service provisioning, an AT&T PRI customer chooses on a per TG basis the privacy setting which applies to both BN and CPN (if sent in the SETUP message). One of two values may be provisioned:

    i. CPN/BN Presentation Allowed (default value), and

    ii. CPN/BN Presentation Restricted.

Either provisioned values may be over-ridden on a per call basis by the originating PRI customer (with or without sending digits in the Calling party number information element). This is done by specifying the desired codepoint in the Presentation Indicator field of the Calling party number information element in the SETUP message. The user specified value in the Presentation Indicator field over-rides the network stored default value for that call.

4.9 CPN/BN to Terminating End

With this feature the terminating user may be provided with the caller's CPN or BN. The CPN or BN will be delivered to the terminating user via either the SETUP or the FACILITY ACKNOWLEDGE message.

The customer will choose, at service provisioning, whether to subscribe to this feature or not. For those who do subscribe, there are two service alternatives:

    1. CPN/BN provided on every call when available; or

    2. CPN/BN provided per call upon request.

If the customer wishes to receive CPN/BN for every call, then for each Trunk Group (TG), the customer must specify one of the following:

    a. *BN only*. If BN is available, it will be sent to the terminating customer and CPN, although it may be available, will never be delivered.

    b. *CPN only*. If CPN is available, it will be sent to the terminating customer and BN, although it may be available, will never be delivered.

    c. *BN preferred*. If BN is available, it will be sent to the customer and CPN, although it may be available, will not be delivered. If BN is not available then CPN, if available, will be delivered to the customer.

    d. *CPN preferred*. If CPN is available, it will be sent to the customer and BN, although it may be available, will not be delivered. If CPN is not available then BN, if available, will be delivered to the customer.

If CPN/BN is desired on all calls by the terminating user, and it is available, the number is

placed in the SETUP message to the terminating user. The number is delivered in the Calling party number information element.

To request CPN/BN on a per-call basis, the terminating user sends a FACILITY message containing a Network-specific facilities information element specifying CPN/BN preferred/only. CPN/BN, if available, will be returned in a FACILITY ACKNOWLEDGE message. In some cases, the CPN/BN may be unavailable, e.g., a call which has originated in a local network that does not support Equal Access. The network will then inform the user by sending a FACILITY REJECT message with an appropriate cause value.

On a CBC pool of channels, the network has the capability to handle CPN treatment individually for (a) MEGACOM® 800 and (b) all other services over that pool of channels.

See Section 3.11.3 in Part II of this document for additional information.

4.10 Delivery of the Dialed Number for AT&T ISDN Direct Egress Services

On calls terminating to AT&T PRI locations, the Called party number information element can be populated with the dialed number (typically 10 digits), if so chosen at service provisioning[4].

4.11 Calling Party Subaddress (CPS) Presentation and Restriction

For ISDN PRI customers originating calls to the AT&T Network, Calling Party Subaddress (CPS) is an optional number that may be provided (presented) by the calling user in the subaddress information field of the Calling party subaddress information element in a SETUP message. The contents of the Calling party subaddress information element are not interpreted by the network, and are passed transparently to the terminating user.

With presentation restriction of CPS, the AT&T PRI callers can control the presentation of CPS to the called users on a per call or subscription basis, including international endpoints. Per call control consists of applying the presentation restriction indication contained within the Calling party number information element to the contents of the Calling party subaddress information element. At service provisioning for CPN/BN, an AT&T PRI customer may choose on a per TG basis the requested privacy value settings for CPN/BN Privacy Optioning. These privacy settings would also apply to presentation restriction of CPS on a subscription basis (see Section 4.8 of Part I).

This feature does not remove CPS from inclusion in MA UUI. No notification is sent to the calling user if CPS is not presented to the called user due to presentation restriction of the CPN. See Section 3.11.7 in Part II for additional information.

4.12 Connected Line Identification (COLI) Presentation and Restriction

COnnected Line Identification (COLI) Presentation is a feature offered as a subscription option to a calling user on a per service basis. When available, COLI provides the calling subscriber of this capability with a user-provided connected number from the called user. In this case, the connected number is not verified. If the called user does not provide a connected number, the

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4. The ability to choose at service provisioning, that an abbreviated version of the dialed number (e.g., Dialed Number Identification Service [DNIS]) be delivered, will continue to be available.

network will provide a network-provided connected number to the calling subscriber. The |
connected number, coded as a national number, is passed in the Connected number information |
element in the CONNECT message sent to the calling user. |

An AT&T PRI user who subscribes to the Connected Line Identification Presentation feature |
may also subscribe to Connected Line Identification Restriction. The called user, on a |
subscription basis, may specify "presentation restricted" to prevent the network-provided |
connected number from being passed across the interface to the calling user. At service |
provisioning, the called user would elect to have the connected line information be provisioned |
to be "presentation restricted" on a per service basis. |

This capability does not apply to NCA-TSC (see Section 4.13.3 of Part I), and can only be used |
by calls that have end-to-end ISDN connectivity. The network will not notify the calling user if |
the Connected number is not available. See Section 3.11.8 in Part II for additional information. |

4.13 User-to-User Information (UUI) Exchange |

User-to-User Information exchange is an ISDN network capability to support virtual packet-oriented D-channel data connections between two ISDN users. The types of UUI capabilities planned are:

1. Message Associated User-to-User Information (MA UUI),

2. Call Associated Temporary Signaling Connection (CA TSC), and

3. Non-Call Associated Temporary Signaling Connection (NCA TSC).

For full details refer to Section 3.7.1 of Part II. A brief description of the concepts is given here.

4.13.1 Message-Associated User-to-User Information (MA UUI)

Message-Associated User-to-User Information (MA UUI) refers to the user-to-user information that may be placed in the User-user information element in the SETUP, ALERTING, CONNECT or DISCONNECT[5] messages. MA UUI can also be included in the first expected clearing message for a Non-Call Associated Temporary Signaling Connection (NCA TSC) which could be RELEASE[5] or RELEASE COMPLETE[5]. MA UUI also refers to the end-to-end transport of the user data information elements (i.e. Called party subaddress, Calling party subaddress, Connected number, High layer compatibility, Low layer compatibility, Redirecting number, Locking shifts and Codesets 6 and 7 information elements) in the call control messages where they may appear. Up to 131 octets of MA UUI can be carried by any of the above |
messages. The individual information elements which comprise MA UUI will be screened for |
valid information lengths. Any user data information element with an invalid length will be |
dropped. The total length of all user data information elements, except the User-user |
information element, is checked for compliance with the 129 octet limit. If the length is |
exceeded, the information elements will be dropped according to an information element |
dropping algorithm specified in Section 3.7.1 of Part II. |

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5. In the situation where both users disconnect nearly simultaneously, delivery of MA UUI in a clearing message is not guaranteed.

See Section 3.7.1 in Part II for detailed criteria. Note that as indicated in all cases described above, MA UUI refers to the user-to-user information exchange within Q.931 call control messages.

For international calls, the MA UUI information elements are defined as Calling party subaddress, Called party subaddress, Low layer compatibility, High layer compatibility and User-user information elements.

In these cases, initially the support of MA UUI on a call depends on the availability of appropriate network resources and the capabilities of the Terminating Equipment (TE). When network resources are not available to support the MA UUI feature on a call, or the terminating user is non-ISDN, any MA UUI in the message will be dropped but the network will still attempt to complete the call. The sending user will know that delivery of MA UUI is not possible on a requested call by receiving a STATUS message with Cause 43, "access information discarded". However, the network will not notify the sending user that MA-UUI was dropped by the receiving user even though a STATUS message with Cause value 43, "access information discarded", was sent by that user. Higher layer protocols must be used between users to guarantee the delivery and sequencing.

If the originating user desires MA UUI to be transported in the ALERTING, CONNECT, or DISCONNECT message on a call but has no MA UUI to be sent in the SETUP message, the originating user should still place an 'empty' UUI-type information element[6] in the SETUP message in order to obtain a suitable network connection to ensure MA UUI transport.

See Section 3.7 in Part II of this document for more detail.

4.13.2 Call Associated Temporary Signaling Connections (CA TSC)

A Call Associated Temporary Signaling Connection (CA TSC) refers to user-to-user information exchange that is associated with a circuit-switched connection. The Call Associated TSC can be established in two ways:

— a TSC is requested at call setup time, and

— a TSC is requested after call setup.

To request a CA TSC at call setup time, the user indicates this request using the SETUP message. If the request is accepted by the network and the terminating user, then the virtual D-channel connection is set up in addition to the circuit-switched connection. If the CA TSC request is successful, the user is notified explicitly through receipt of a FACILITY ACKNOWLEDGEMENT message. If, as the call progresses through the network, it is not possible to select facilities necessary to support the CA TSC, the network will still attempt to complete the call, but will drop the CA TSC request; it will also indicate to the originating user that the CA TSC request is rejected (see Section 3.7.2.2 in Part II for more detail).

After the CA TSC is established, the two users may exchange information transparently through the network. At disconnect time, the circuit-switched call and the CA TSC are released simultaneously.

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6. The User-user information element is recommended to be used for this purpose by CCITT.

To request a CA TSC after call setup, the user indicates this request by sending a FACILITY message after initiating the call with a SETUP message. If the network can support this capability (i.e., if the call was routed using compatible signaling facilities) and if the distant user accepts the CA TSC request, then the CA TSC is established identically to the description above. If the CA TSC request is successful, the user is notified explicitly through receipt of a FACILITY ACKNOWLEDGEMENT message.

See Section 3.7.2 in Part II for more information.

4.13.3 Non-Call Associated Temporary Signaling Connection (NCA TSC)

This feature allows the users to communicate by means of user-to-user signaling without setting up a circuit-switched connection. The user requests a Non-Call Associated Temporary Signaling Connection (NCA TSC)[7] by using the SETUP message. The called party number indicated in the SETUP message is translated the same way as for a circuit-switched call, except that no circuit switched connection is established. If the terminating user accepts the NCA TSC, a signaling connection is established when the requesting user receives a CONNECT message. Since no B-channel connection is involved, a NCA TSC is disconnected by the sending of a RELEASE message.

See Section 3.7.3 in Part II for more information.

4.14 B-Channel Negotiation (B-Channel Selection — Destination)

B-Channel Negotiation is a protocol feature that will enable a CPE to choose the B-channel upon which a incoming call will be received.

If the channel indicated by the network in the SETUP message is acceptable to the CPE, it can reserve it for the call. Otherwise, if the user subscribes to this feature, the CPE can search for another channel and indicate this to the network in the first response to the SETUP message (which, in this case, must be CALL PROCEEDING). If the alternate channel suggested by the CPE is available, and can be used to carry calls of the particular call type (e.g. voice), the network completes the call on the alternate channel. Otherwise the call is cleared.

Channel Negotiation is applicable only to the switched channels between the CPE and the AT&T service node which are controlled by the same D-channel (or D-channel Backup pair).

4.15 Causes and Diagnostics

This interface will support the set of Causes and associated Diagnostics listed in Section 3.4.5.12 of Part II.

For causes of local use generated by the network, the associated diagnostics will be sent to the user. When a call cannot complete, a relevant cause will be sent to the originating user from the network. Optionally, the network may choose to play an appropriate inband tone or announcement which corresponds to the cause. A PROGRESS message indicating that the user should cut through the B-channel connection will precede such a tone or announcement, if cut-through has not already occurred.

Causes of end to end significance will be supported in the following manner. A cause and its associated diagnostics generated by a user will be passed when the call is in a stable state and the call is cleared normally (via a DISCONNECT message). For calls at rates of 64R Kbps and

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7. The Non-Call Associated Temporary Signaling Connection (NCA-TSC) feature is also known as User Signaling Bearer Service (USBS) in CCITT International Standards.

lower (e.g 56 Kbps), a stable state is defined as waiting for answer (states 4 and 7) and answered (states 8 and 10). A stable state for calls at 64C Kbps and higher is defined as answered (state 10). The network does not screen user provided causes and diagnostics.

For calls at all transmission rates, when clearing is initiated other than as described above, the network may generate a cause to be contained in an appropriate message and/or the network may choose to play an appropriate tone or announcement on the corresponding information channel, depending upon the circumstances. See Part II, Section 3.4.5.10 for the cause values that initiate tones and announcements.

5. AT&T Domestic Switched Services Supported via ISDN PRI

The domestic switched services supported via AT&T Network ISDN PRI include the following:

1. Access to and egress from Software Defined Network (SDN),

2. Egress from MEGACOM® 800,

3. Access to MEGACOM®,

4. Access to and egress from ACCUNET® Switched Digital Service, and

5. Egress from AT&T MultiQuest®.

A brief description of each possible service is provided below:

SDN offers premises-to-premises voice and data transport, and a rich set of customer controllable call management and monitoring features.

MEGACOM® 800 is a service offering for customers that receive sufficient volumes of 800 calls to economically justify special-egress arrangements between the customer's location and an AT&T Service Node.

MEGACOM® is a high volume, outward calling service that uses the AT&T Switched Network to transmit voice and permissive voice-band data (up to 9.6 Kbps) communications. This service offers AT&T customers an outward calling capability similar to Outward Wide Area Telecommunications Service (OUTWATS).

ACCUNET® Switched Digital Service provides end-to-end full duplex circuit-switched digital capabilities. Switched 56/64 allows an AT&T PRI customer to send data at a rate of 56/64 Kbps. There are two types of Switched 64 service: Restricted (64R) and Clear (64C).

AT&T MultiQuest® is a terminating service that offers premium billed interactive voice service between callers and AT&T MultiQuest® service providers.

Note that when Switched Wideband service to 384/1536 is offered, it will allow an AT&T PRI customer to send data at a rate of 384/1536 Kbps. There may be two types of Switched Wideband 384/1536 service: Restricted (384/1536 R) and Clear (384/1536 C).

See Table II-3-54 in Part II for detailed information element codings for these services.

6. AT&T International Switched Services Supported via ISDN PRI

The international switched services supported via AT&T Network ISDN PRI include the

following:

1. Access to and egress from Switched Digital International Service (SDI)[8],

2. Access to and egress from Global Software Defined Network (GSDN),

3. Access to and egress from AT&T World Connect,

4. Egress from International 800 Service (Inbound I800), and

5. Access to International MEGACOM® Service.

A general description of each service is provided below:

SDI is an extension of the domestic ACCUNET® Switched Digital Service (i.e., an ACCUNET® Switched Digital Service customer will be able to initiate and receive international switched 56 and 64 Kbps clear calls). In addition, SDI calls can support exchange of both MA UUI and CPN/BN, subject to network connectivity. SDI will use the same Network-specific facilities codings as domestic ACCUNET® Switched Digital Service.

GSDN is targeted at meeting multinational customers' international virtual private networking needs. GSDN is a two-way voice, voice-grade data, and high speed data service implemented on the international Public Switched Telephone Network (PSTN) to some countries and on dedicated TGs to other countries. GSDN will use the same Network-specific facilities coding as domestic SDN.

AT&T World Connect is a direct access high volume, outbound calling service that uses the AT&T Switched Network to transmit voice and voice-grade data communication to destinations in dialable countries. It is identified by the Network-specific facilities service codepoint "LDS" in combination with the national/international indicator in the "type of number" field of the Called party number information element in the SETUP message. The type of number field should be set to "national" for World Zone 1 calls (i.e., North America Numbering Plan (NANP) numbers in Canada, the non-U.S. Caribbean, and Mexico[9]), and "international" for non-World Zone 1 international calls (according to the format CC+NN[10]).

Inbound I800 service allows callers at points within Canada, the Caribbean, and Non-World Zone 1 to reach AT&T subscribers in the U.S., usually at no cost to the caller (some foreign countries may charge the caller a local charge for this service). This service will be identified by the Network-specific facilities service codepoint "I800" in the SETUP message.

International MEGACOM® will be provided as an add-on to the inter-state MEGACOM® outward calling service to destinations in dialable countries. The Network-specific facilities service code point for "MEGACOM®" will be used. The "type of number" field of the Called party number information element will be either national or international. The type of number field should be set to "national" for World Zone 1 calls (i.e., North American Numbering Plan (NANP) numbers in Canada, the non-U.S. Caribbean, and Mexico[9]), and "international" for non-World Zone 1 international calls (according to the format CC+NN[10]).

See Table II-3-54 in Part II for detailed information element codings for these services.

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8. Switched Digital International (SDI) was previously known as International Switched Digital Services (ISDS).

9. The Mexican locations may also be dialed using the CC+NN format with CC=52. In this case, the type of number field will be coded "international".

10. "CC+NN" stands for Country Code appended with National Number.

7. Call Processing

7.1 Number Digits

For any call which terminates in the domestic United States (U.S.), seven or ten digits (depending on the service) are expected in the Called party number information element sent to the network. For calls originating in the U.S. but terminating internationally, the type of number digits field in the Called party number information element must be set to "international"; the "standard" inband "011" number prefix should not appear in the number field of that information element. The Country Code (CC) and the National Number (NN) (up to a maximum of 14 digits) should appear in the number digits field. More generally, no "pseudo" number digits[11], either prefixed or suffixed, will be permitted in the number field.

Number digits in the Calling party and Called party number information elements will be specified in the IA5 alphabet. Only characters 0 through 9 will be allowed for the calling or called number 'digits'. When a Calling party number information element is received with number digits/characters other than 0-9, that information element will be discarded by the network.

In the Called party subaddress and Calling party subaddress information elements, the user can specify a subaddress in any manner since this information is passed transparently by the network. Likewise, the Redirecting number and Connected number information elements may contain any characters in any alphabet.

7.2 Cut Through

For voice band calls, the network will cut through the circuit-switched connection upon receiving a PROGRESS, ALERTING or CONNECT message from a terminating ISDN PRI user, or upon outpulsing all number digits to a user who does not have ISDN PRI. The originating location should cut through the connection before or upon receipt of ALERTING or PROGRESS in order to hear inband ringing from the far end, other call progress tones from the network or end user, or network service announcements.

For all switched digital calls, the network will cut through the connection only when a CONNECT message has been received from the terminating user.

7.3 Call Progress Tones

The network will supply the usual inband call progress tones (e.g., network busy, reorder) in case of call attempt failures due to the network, no response from the terminating user, or based on causes received from the terminating user. The network or a terminating ISDN PRI user may supply a busy tone, depending on the indication the terminating user gives to the network. The terminating user is always expected to supply inband ringing (i.e., the network will not). As is presently done when the network delivers a call to an inband user, that user equipment (CPE) must supply any call progress tones.

Because the network or terminating CPE will maintain a connection on a failed call in order to supply call progress tones, the originating user may not receive any Cause information regarding

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11. Examples are "*", "#", etc.

the nature of the failure.

7.4 Message Length Constraints

The maximum length of any Layer 3 message shall be 255 octets. Any combination of user data information elements (i.e. User-user, Called party subaddress, Calling party subaddress, Connected number, High layer compatibility, Low layer compatibility, Redirecting number, locking Shift and Codeset 6 and 7 information elements) in the call control messages where they may appear[12], may not exceed 131 octets in total length. Otherwise, an information element dropping algorithm is employed to meet this requirement (see Section 4.13.1 in Part I and Section 3.7.1 of Part II for additional information). Call processing will continue. The user will be notified that user data was discarded only if all user data information elements are dropped, and the message is not a clearing message.

7.5 Glare Resolution

"Glare" occurs when the user and the network simultaneously attempt to seize the same channel. The call incoming to the user takes precedence in the glare condition. The network, upon recognizing the glare condition, shall send a RELEASE COMPLETE in response to the SETUP from the user and proceed normally with the setup of the call incoming to the user.

7.6 Fast Connect

The network will not support Fast Connect[13] on circuit-switched calls. If the terminating user sends a CONNECT not preceded by ALERTING in response to a SETUP, the network will send the originating user an ALERTING or PROGRESS followed by a CONNECT.

8. Operations, Administration and Maintenance

8.1 Failure Procedures and Maintenance

Network fault management techniques rely on several capabilities at the customer premises.

Performance monitoring and threshold exception reporting for DS1 facilities provide early, non-service disruptive indications of potential service impairment. DS1 monitoring is more effective if the ESF format is used and the termination at the customer premises complies with Technical Reference 54016[6].

The customer shall assign a line appearance in the CPE to a 64 Kbps (non-inverting) digital loopback. Such a loopback can be addressed from the network in the same manner as any other extension on the CPE. The customer shall make the address of the loopback available to AT&T personnel. This will permit operational and bit error rate tests from the network without the need for customer interaction. The loopback should preserve byte alignment, i.e., the most significant bit of the byte looped back corresponds to the most significant bit of the byte received, and so forth. The loopback could be provided as a stand-alone device or it may be integrated into the switching network of the CPE. Test calls will be established by the network analogously to a normal call, except that certain prespecified numbers will identify the call as a test call. Such test calls will also be accepted by the network from the user when the B-channel is in the In Service or Maintenance state (see Section 3.10 in Part II). Note that in order to

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12. Note that the total length of the user data information element in the USER INFORMATION message can be up to 251 octets.

13. Fast Connect means that if the terminating user generates a CONNECT without a prior ALERTING, the network would respond likewise to the originating user.

request a test call, the CPE needs to include in its SETUP message a valid Network-specific facilities information element for CBC TGs.

It is planned for the network to support customer test calls to a 64 Kbps (non-inverting) loopback described above.

If the CPE detects a DS1 alarm affecting B channels, and the D channel is still functioning, the CPE should remove the affected B channels from In Service status as described in Section 10 of TR 41449. (Note: Use of a digital crossconnect, in order to combine both ISDN and non-ISDN circuits on a given DS1 as described in Section 2 of Part I, may block the detection of DS1 alarms by the network). The CPE should return B channels to service, when the alarm clears, unless there are additional reasons for not returning the B channels to service. The network will follow a similar strategy, but service robustness is enhanced if the CPE behaves as described above.

Network sectionalization is improved if customer premises equipment has the capability to loop back the D channel for use in link checks. Link check involves transmission of specific frames by the network D channel termination which can be looped back at several different intermediate points.

If the D-channel is to be removed from service for maintenance purposes, use of the following procedure will ensure that the removal is a graceful one[14]. CPE should clear all calls under the control of the D-channel which are already established by sending Layer 3 DISCONNECT messages for those calls. After all the calls have been cleared, the D-channel may be removed from service by sending a DISC frame at Layer 2. This procedure will also avoid confusion on the part of the network as the network monitors Layer 2 protocol exceptions for D-channel maintenance. As long as the CPE is unable to re-establish the D channel, it should respond with a DM frame to any SABME frame received from the network. It is desirable that the CPE re-establish Layer 2, or allow it to be re-established as soon as possible as described in Part III of TR 41449.

Layer 3 messages and procedures exist that will be used for channel reinitialization in extreme failure situations and for identifying channels for maintenance or removal from service. These messages and procedures are described in Section 3.10 of Part II.

8.2 D-channel Backup

The D-channel backup feature permits a customer continued access to the AT&T network even if one of the D-channels were to fail by transferring most of the signaling information to a backup D-channel. D-channel Backup allows a customer to designate at provisioning a pair of D-channels in separate DS1 facilities as a mated pair.

In a typical D-channel failure scenario, both the CPE and the network must recognize failure of the active D-channel at Layer 2 for a backup to be initiated. In order to minimize switchover time, it is recommended that timer T203 at the CPE be set to 15 seconds. Once both ends have detected the failure, they can exchange messages recognizing the other D-channel as active for signaling messages. Detailed procedures concerning this feature are described in Annex F of TR 41449.

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14. The customer should coordinate shutdown of an ISDN CPE with the network work center to avoid causing network alarms. The customer should request the network work center to place the D-channel in the manual out-of-service state, prior to CPE shutdown. If the DS1 termination to the CPE is to be turned down, the customer should also loop the DS1 back toward the network at the point of interface.

REFERENCES

1. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459, July 1989.

2. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459 Addenda, December 15, 1989, January 1990 and July 1990.

3. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface Specification, TR 41449, July 1989.

4. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface Specification, TR 41449 Addendum, July 1990.

5. AT&T Technical Reference, ACCUNET® T1.5 Service Description and Interface Specifications", Technical Reference 62411, December 1988.

6. AT&T Technical Reference, Requirements for Interfacing Digital Terminal Equipment to Services Employing the Extended Superframe Format, Technical Reference 54016, September 1989.

PART II

AT&T NETWORK ISDN PRIMARY RATE INTERFACE

AND SPECIAL APPLICATIONS

SPECIFICATION

User-Network Interface Description

Protocol Implementation

PART II

AT&T NETWORK INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PRIMARY RATE INTERFACE

USER-NETWORK INTERFACE DESCRIPTION PROTOCOL IMPLEMENTATION

CONTENTS

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1. Layer 1 Implementation

1.1 Summary

The AT&T Network ISDN Primary Rate Interface conforms to the physical layer specification for DS1 interfaces, as given in TR 41449. While TR 41449 provides specifications for the ISDN reference points S, T and U, it is the U reference point, the CPE-network interface, which is the interface between the CPE and the AT&T network. This section contains information and clarification regarding the physical layer implementation.

1.2 Framing Format

Customers must use terminal equipment that complies with ESF or D4 format. ESF is preferred because it avoids the false framing and yellow alarm emulation problems which are possible when digital data services are transported with D4 format. If the ESF format is used, the enhanced maintenance capabilities described in Technical Reference 54016[1] are strongly recommended.

Framing patterns for both the D4 and the ESF formats are specified in Technical Reference 62411[2].

1.3 Channel Structure

The user-network "interface arrangement" supported by AT&T Network ISDN PRI consists of one or more DS1 interfaces. Within an interface arrangement, the capacity of each DS1 interface is structured into 24 eight-bit time slots, and can support D, B, H_0, and H_{11} channel types. Each interface arrangement must minimally have one D-channel.

A customer access arrangement consisting of multiple interfaces can be partitioned into groups of interfaces, each group having exactly one D-channel, as described below. The following interface arrangements will be supported:

- (23B+D) This configuration is the usual Primary Rate Interface. Up to three H_0 channels may be overlaid on top of the 23 B-channels, occupying slots 1-6, 7-12, and 13-18. A customer may provision multiple interfaces of this type.

- (47B+D) This configuration is the minimum interface arrangement (consisting of two DS1 facilities) which supports the use of an H_{11} channel. Up to seven H_0 channels may be overlaid on top of the 47 B-channels and H_{11} channel, occupying time slots 1-6, 7-12, 13-18, and/or 19-24 (if no D-channel is present on that DS1 interface). A single H_{11} channel may be defined on the DS1 interface which does not contain the D-channel; 24 B-channels and/or 4 H_0 channels may be overlaid as well.

- n(mB+D) This configuration is a generalized multi-interface arrangement. H_0 and/or H_{11} channels may also be overlaid as described above. A customer may provision multiple (mB+D) interfaces in order to meet availability or performance needs. A single D-channel may signal for as many as 20 DS1 interfaces (m<=479). Since one and only one D-channel is associated with a single interface arrangement, a Primary Rate ISDN customer may provision multiple interfaces (n=1, 2, 3...).

In order to increase the efficiency and utilization of an access interface, the network will employ the channel hunt algorithm described in Section 4.6 of Part I.

1.4 Line Coding and Pulse Density

Bipolar with 8-Zero Substitution (B8ZS) is the preferred line coding method, since it assures adequate pulse density without imposing any constraints on user data. However, B8ZS access

facilities may not be available from all access providers at this time.

If B8ZS access is not available, Alternate Mark Inversion (AMI) may be used instead. When AMI line coding is used, the CPE must enforce pulse density on a per-timeslot basis. This restriction is consistent with TR 41449 with regard to B, D, and H_0 channels. With regard to H_{11} channels, this restriction is the more constraining of the two methods described in TR 41449.

1.5 Idle Code

The physical layer idle code supported in this implementation is a pattern of contiguous ones. The physical layer idle code is not supported in either direction on restricted channels. For restricted D-channels, the following section regarding High-level Data Link Control (HDLC) coding applies.

1.6 HDLC Coding

In the interface configuration supported by AT&T, a D-channel is the only 64 Kbps data channel whose bit stream is subject to processing by the network. Thus, the HDLC encoding as described in Part II of TR 41449 is mandatory only for D-channels. The network places no further requirements on what can be carried on B-channels except that for restricted B-channels, the all-zero octet may not be sent.

Because LAPD, as specified in Part III of TR 41449, does not allow an HDLC idle pattern on a Primary Rate Interface, neither the network nor the user will send or receive the HDLC idle code on the D-channel.

TR 41449 describes two possible methods for implementing the HDLC abort pattern. Neither side of the user-network interface need inform the other of the method chosen, only success in passing the HDLC abort sequence is important. Regardless of which method is used to implement the HDLC abort signal, an abort sequence must be followed by a flag.

1.7 Alarms

Carrier Failure Alarms as described in TR 41449 will be supported.

Note that in the event of a DS1 facility failure, the user may receive a channel code of "11111110" on each time slot of that DS1 facility. This code may be interpreted as a series of HDLC aborts on D-channels whose bit stream is not subject to bit-inversion (i.e., Clear D-channels).

2. Layer 2 Implementation

2.1 Summary

The AT&T Network ISDN Primary Rate Interface is as described in the Layer 2 specification in TR 41449.

3. Layer 3 Implementation

3.1 General

This part of this Technical Reference defines the Layer 3 protocol options and service related procedures which will be supported by AT&T in its implementation of the ISDN Primary Rate Interface. The following sections will discuss the call states, messages, and information elements supported by this interface. Also detailed in the following sections will be any implementation options supported by AT&T which affect call control procedures and which are not described in TR 41449. These implementation options include, but are not limited to, procedures for accessing features and services supported by AT&T over an ISDN Primary Rate Interface.

3.1.1 Summary of Changes

Layer 3 aligns with the format in the CCITT Recommendations for the ISDN user-network PRI. | This Layer 3 section adopts the similar sectioning and layout mechanisms in presenting the protocol information as accepted in the standards community (e.g. CCITT).

The numbering scheme used for the section headers in Section 3 has the following characteristics:

a. the first digit, '3', represents Layer 3,

b. the following digits are the same[1] as those used for the analogous section in Part IV of TR 41449.

Note also that differences between information elements in Parts II of this document and TR 41449 are highlighted in bold.

This issue of TR 41459 contains many technical changes from the previous issue of April 1988. A summary of the update changes for the July 1990 issue can be found in Section 1.1 of Part I of | this document.

3.2 Overview of Call Control

Two call control configurations are described in TR 41449. The configuration supported by AT&T is that of two users connected via the intervening switched network connection provided by AT&T as shown in Figure II-3-1.
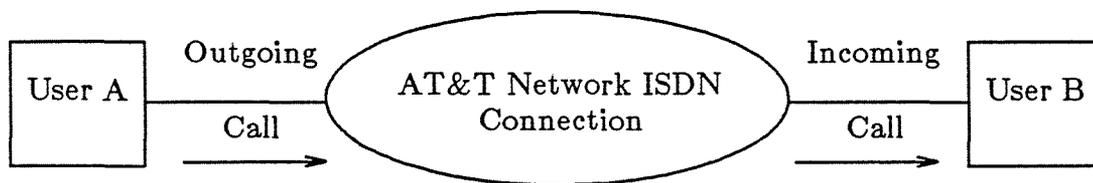
Figure II-3-1. Call from A to B via an ISDN Network Connection

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1. Note, however, characteristic (b) may not hold after Section 3.5.
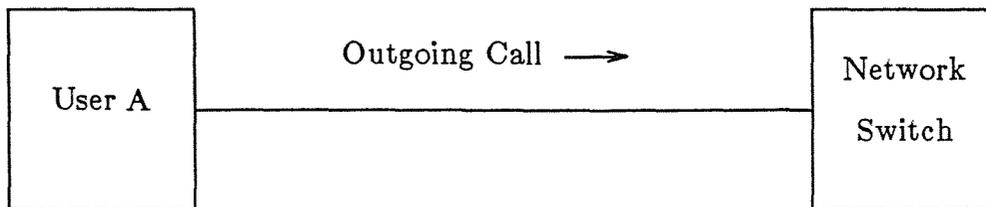
Figure II-3-2. ISDN Network Access for an Outgoing Call from A
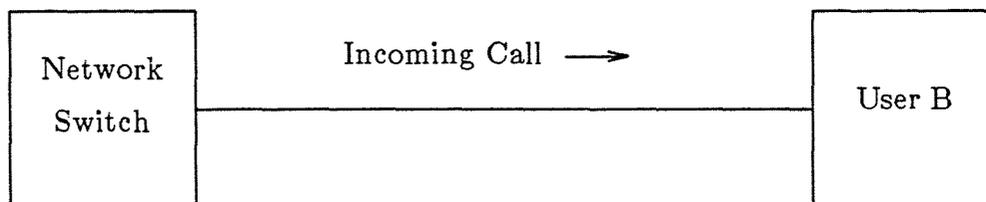
Figure II-3-3. ISDN Network Egress for an Incoming Call to B

The AT&T Network ISDN Primary Rate Interface supports switched network connections via the AT&T interexchange network. Complete call control procedures for various interface configurations are contained in TR 41449.

For the purposes of this discussion, the terms "public switched network connection", "switched network connection", and/or "the network" when they appear in TR 41449 should be interpreted as referring to the AT&T network. Likewise, the term "the network" when it appears in this TR is meant to be synonymous with the term "AT&T network".

In order to communicate properly over circuit-switched connections through the AT&T network, the switched network procedures, as defined in TR 41449, are the essential procedures that CPE must implement. Under the switched network procedures, the AT&T network assumes the burden of error recovery for the Layer 3 signaling procedures. CPE is not required to implement all Layer 3 user-side timers and need only perform limited state matching.

The complexity of CPE which follows the switched network connection procedures is less than that required for CPE which follows the private line connection procedures. The procedures for private line connections require that the CPE assume some of the burden of error recovery by implementing all Layer 3 timers, and performing complete state matching. These private line connection procedures, when enhanced with the procedures for the FACILITY messages, provide maximum compatibility with all AT&T ISDN products and services, including those services and features provided by the AT&T network.

3.2.1 Circuit Switched Call States

Individual calls on an interface may have any of the call states as defined in Section 2.1 of Part IV in TR 41449.

The network side states NS1, NS2, NS3, and NS4 as well as the user side states US1 and US2 are internal states for that side of the interface. Thus, no indication that the network or user is in one of these states would be returned in a STATUS message. The call state information element in the STATUS message will contain the call state from which the internal state was

entered.

3.2.2 Packet Mode Access Connection Control States — Not applicable.

3.2.3 Temporary Signaling Connections Call Control States

Individual calls on an interface may have any of the call states as defined in Section 2.3 of Part IV in TR 41449.

3.2.4 States Associated with the Global Call Reference

Individual calls on an interface may have any of the call states as defined in Section 2.4 of Part IV in TR 41449.

3.3 Message Functional Definitions and Content

This section provides an overview of the message structure, which highlights the functional definition and information content (i.e. semantics) of each message. Each definition follows the guidelines specified in Section 3 of Part IV in TR 41449.

3.3.1 Messages for Circuit Mode Connection Control

Table II-3-1 summarizes the messages for circuit-mode connection control. Please refer to Section 3.10.1.1.1 for maintenance messages.

TABLE II-3-1. Messages for Circuit-Mode Connection Control

Call Establishment Messages:	Reference
ALERTING	3.3.1.1
CALL PROCEEDING	3.3.1.2
CONNECT	3.3.1.4
CONNECT ACKNOWLEDGE	3.3.1.5
PROGRESS	3.3.1.10
SETUP	3.3.1.16

Call Information Phase Message:	
USER INFORMATION	3.3.1.23

Call Clearing Messages:	
DISCONNECT	3.3.1.6
RELEASE	3.3.1.11
RELEASE COMPLETE	3.3.1.12

Miscellaneous Messages:	
CONGESTION CONTROL	3.3.1.3
FACILITY	3.3.1.7
STATUS	3.3.1.18
STATUS ENQUIRY	3.3.1.19

3.3.1.1 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. See Table II-3-2.

TABLE II-3-2. ALERTING Message Content

Message type: ALERTING
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Channel identification	3.4.5.13	u→ n	O (Note 1)	4-8
Redirecting number	3.4.6.7	both	O (Note 2)	3-17
User-user	3.4.5.29	both	O (Note 3)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 3, 4)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 3, 4)	1-128

Note 1: Mandatory if this is the first message in response to a SETUP message.

Note 2: Used to identify address of redirection.

Note 3: Included in the user-to-network direction when an incoming call is offered and the called user wants to return user information to the calling user. Included in the network-to-user direction if the called user included user information in the ALERTING message.

Note 4: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.1.2 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. See Table II-3-3.

TABLE II-3-3. CALL PROCEEDING Message Content

Message type: CALL PROCEEDING
Significance: local
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Channel identification	3.4.5.13	both	M	4-8

3.3.1.3 Congestion Control

This message is sent by the network or the user to indicate the establishment or termination of flow control on the transmission of USER INFORMATION messages. This message may NOT be sent with the global call reference defined in Section 3.4.3. This message is implemented as described in TR 41449. See also Section 3.3.3.3 and Section 3.3.5.1 of Part II.

3.3.1.4 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. See Table II-3-5.

TABLE II-3-5. CONNECT Message Content

Message type: CONNECT
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Connected number	3.4.6.6	both	O	3-17
Channel identification	3.4.5.13	u→ n	O (Note 1)	4-8
Redirecting number	3.4.6.7	both	O (Note 2)	3-17
User-user	3.4.5.29	both	O (Note 3)	3-131
Shift to codeset 6,*(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 3, 4)	1-128
Shift to codeset 7,*(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 3, 4)	1-128

Note 1: Mandatory if this message is the first message in response to a SETUP message.

Note 2: Used to identify address of redirection.

Note 3: Included in the user-to-network direction when the answering user wants to return user information to the calling user. Included in the network-to-user direction if the user awarded the call included user information in the CONNECT message.

Note 4: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.1.5 Connect Acknowledge

This message is sent in response to a CONNECT message to indicate completion of the circuit-switched connection. This message is implemented as described in TR 41449.

3.3.1.6 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. See Table II-3-7.

TABLE II-3-7. DISCONNECT Message Content

Message type: DISCONNECT
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	M	4-22
User-user	3.4.5.29	both	O (Note 1)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 1, 2)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 1, 2)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 1, 2)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 1, 2)	1-128

Note 1: Included when the user initiates clearing and wants to pass user information to the remote user at call clearing time.

Note 2: - Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.1.7 Facility

This message is defined in Section 3.3.5.2.

3.3.1.8 Information — Not applicable.

3.3.1.9 Notify — Not applicable.

3.3.1.10 Progress

This message is sent to the user or the network to indicate the progress of a call in the event of interworking. The network may also send it to facilitate announcements before the call is cleared. The receipt of the message may be an indication that the information channel needs to be monitored for call progress information[2]. See Table II-3-8.

TABLE II-3-8. PROGRESS Content

Message type: PROGRESS
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	O (Note 1)	4-22
Channel identification	3.4.5.13	u→ n	O	4-8
Progress Indicator	3.4.5.22	both	M	4

Note 1: Included by the user or the network to provide additional information concerning the provision of in-band information/patterns.

Note 2: This information element is mandatory if this message is sent as the first response to SETUP.

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2. Data endpoints are not required to monitor the information channel for in-band tones.

3.3.1.11 Release

This message is sent by the user or the network to indicate that the equipment sending the message has disconnected the channel (if any) and intends to release the call reference, and that the receiving equipment shall release the channel (if any) and the call reference after sending the | RELEASE COMPLETE. See Table II-3-11.

TABLE II-3-11. RELEASE Message Content

Message type: RELEASE
Significance: local (Note 1)
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	O (Note 2)	4-22

Note 1: This message has local significance: however, it may carry information of global significance when used as the first call clearing message.

Note 2: Mandatory in the first call clearing message.

3.3.1.12 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 call reference. See Table II-3-12.

TABLE II-3-12. RELEASE COMPLETE Message Content

Message type: RELEASE COMPLETE
Significance: local (Note 1)
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	O (Note 2)	4-22

Note 1: This message has local significance: however, it may carry information of global significance when used as the first call clearing message.

Note 2: Mandatory in the first call clearing message.

3.3.1.13 Resume — Not applicable.

3.3.1.14 Resume Acknowledge — Not applicable.

3.3.1.15 Resume Reject — Not applicable.

3.3.1.16 Setup

This message is sent by the calling user to the network and by the network to the called user to initiate call establishment. See Table II-3-16.

TABLE II-3-16. SETUP Message Content

Message type: SETUP
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Bearer capability	3.4.5.5	both	M (Note 1)	4-8
Channel identification	3.4.5.13	both	M	4-8
Network-specific facilities	3.4.5.20	both	O (Note 2)	4-9
Calling party number	3.4.5.10	both	O (Note 3)	3-17
Calling party subaddress	3.4.5.11	both	O (Note 4)	3-23
Called party number	3.4.5.8	both	M	3-17
Called party subaddress	3.4.5.9	both	O (Note 5)	3-23
Redirecting number	3.4.6.7	both	O	3-17
Low layer compatibility	3.4.5.18	both	O (Note 6)	3-16
High layer compatibility	3.4.5.16	both	O (Note 7)	3-5
User-user	3.4.5.29	both	O (Note 8)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 8, 9)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 8, 9)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 8, 9)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 8, 9)	1-128

Note 1: The Bearer capability and High layer and Low layer compatibility information elements may be used to describe a CCITT telecommunications service, if appropriate.

Note 2: On call-by-call channels, the Network-specific facilities information element is mandatory in a SETUP message from an originating user and it must contain a valid binary service facility code point. On single service trunk groups, the Network-specific facilities information element is optional, but if it exists, it must contain a service coding which is valid for that trunk group.

Note 3: May be included by the calling user or the network to identify the calling user.

Note 4: Included in the user-to-network direction when the calling user wants to indicate the calling party subaddress. Included in the network-to-user direction if the calling user included a calling party subaddress in the SETUP message.

Note 5: Included in the user-to-network direction when the calling user wants to indicate the called party subaddress. Included in the network-to-user direction if the calling user included a called party subaddress in the SETUP message.

Note 6: Included in the user-to-network direction when the calling user wants to pass low layer compatibility information to the called user. Included in the network-to-user direction if the calling user included low layer compatibility information in the SETUP message.

Note 7: Included in the user-to-network direction when the calling user wants to pass high layer compatibility information to the called user. Included in the network-to-user direction if the calling user included high layer compatibility information in the SETUP message.

Note 8: Included in the user-to-network direction when the calling user wants to pass user information to the called user. Included in the network-to-user direction if the calling user included user information in the SETUP message.

Note 9: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.1.17 Setup Acknowledge — Not applicable.

3.3.1.18 Status

This message may be sent at any time during a call when an unexpected message is received. This message is also used to respond. to a STATUS ENQUIRY message. This message is implemented as described in TR 41449. Note that the Cause information element (See Section 3.4.5.12) may be repeated and the Call reference may use a global call reference value.

3.3.1.19 Status Enquiry

The STATUS ENQUIRY message may be sent at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory. This message is implemented as described in TR 41449. The global call reference value may not be used in this message.

3.3.1.20 Suspend — Not applicable.

3.3.1.21 Suspend Acknowledge— Not applicable.

3.3.1.22 Suspend Reject— Not applicable.

3.3.1.23 User Information

The USER INFORMATION message is sent by a user to the network to transfer information to the remote user. This message is also sent by the network to a user to deliver the information from the other user. See Table II-3-23.

TABLE II-3-23. USER INFORMATION Message Content

Message type: USER INFORMATION
Significance: access
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
More data	3.4.5.19	both	O (Note 1)	1
User-user	3.4.5.29	both	M	3-251
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Note 2)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Note 2)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Note 2)	1
User-specific (codeset 7)	3.4.5.3	both	O (Note 2)	1-128

Note 1: Included by the sending user to indicate that another USER INFORMATION message pertaining to the same message block will follow.

Note 2: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.2 Messages for Packet Mode Access Connection Control — Not applicable.

3.3.3 Messages for Non-Call Associated Temporary Signaling Connection

Table II-3-36 summarizes the messages for the control of Non-Call Associated Temporary Signaling (NCA TSC) connections and the transfer of user-user information. Please refer to Section 3.10.1.1.1 for maintenance messages.

TABLE II-3-36. Messages for Non-Call Associated Temporary Signaling Connection

Call Establishment Messages:	Reference
CALL PROCEEDING	3.3.3.2
CONNECT	3.3.3.4
CONNECT ACKNOWLEDGE	3.3.3.5
SETUP	3.3.3.9

Call Information Phase Message:	
USER INFORMATION	3.3.3.13

Call Clearing Messages:	
RELEASE	3.3.3.7
RELEASE COMPLETE	3.3.3.8

Miscellaneous Messages:	
CONGESTION CONTROL	3.3.3.3
STATUS	3.3.3.11
STATUS ENQUIRY	3.3.3.12

3.3.3.1 Alerting — Not applicable.

Note: For a NCA TSC, if the network receives this message in response to a SETUP message, this message will be ignored.

3.3.3.2 Call Proceeding

This message may be sent by the network to the calling user to indicate that the requested NCA-TSC establishment has been initiated, and no additional establishment information will be accepted. If the network receives this message in response to a SETUP message, this message will be ignored. See Table II-3-3.

3.3.3.3 Congestion Control

This message is sent by the network or the user to indicate the establishment or termination of flow control on the transmission of USER INFORMATION messages. This message may NOT be sent with the global call reference defined in Section 3.4.3. This message is implemented as described in Section 3.3.3 of TR 41449.

3.3.3.4 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. This message is implemented as described in Section 3.3.4 of TR 41449.

3.3.3.5 Connect Acknowledge

This message is sent in response to a CONNECT message to indicate completion of the circuit-switched connection. This message is implemented as described in Section 3.3.5 of TR 41449.

3.3.3.6 Information — Not applicable.

3.3.3.7 Release

This message is sent by the user or the network to indicate that the equipment sending the message intends to release the call reference, and that the receiving equipment shall release the call reference after sending the RELEASE COMPLETE. See Table II-3-37.

TABLE II-3-37. RELEASE Message Content

Message type: RELEASE
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	O (Note 1)	4-22
User-user	3.4.5.29	both	O (Note 2)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 2, 3)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 2, 3)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 2, 3)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 2, 3)	1-128

Note 1: Mandatory in the first call clearing message.

Note 2: Included when the RELEASE message is the first call clearing message for a NCA TSC and the user initiates call clearing and wants to pass user information to the remote user at call clearing time.

Note 3: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.3.8 Release Complete

This message is sent by the user or the network to indicate that the equipment sending the message has released the call reference and the receiving equipment shall release the call reference. See Table II-3-38.

TABLE II-3-38. RELEASE COMPLETE Message Content

Message type: RELEASE COMPLETE
Significance: local (Note 1)
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	O (Note 2)	4-22
User-user	3.4.5.29	both	O (Note 3)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 3, 4)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 3, 4)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 3, 4)	1-128

Note 1: This message has local significance: however, it may carry information of global significance when used as the first call clearing message.

Note 2: Mandatory in the first call clearing message.

Note 3: The user data information elements are allowed only when the RELEASE COMPLETE message is the first response to a SETUP message on a NCA TSC.

Note 4: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.3.9 Setup

This message is sent by the calling user to the network and by the network to the called user to initiate call establishment. See Table II-3-39.

TABLE II-3-39. SETUP Message Content

Message type: SETUP
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Bearer capability	3.4.5.5	both	M (Note 1)	4-8
Channel identification	3.4.5.13	both	M	3-4
Network-specific facilities	3.4.5.20	both	O (Note 2)	4-9
Calling party number	3.4.5.10	both	O (Note 3)	3-17
Calling party subaddress	3.4.5.11	both	O (Note 4)	3-23
Called party number	3.4.5.8	both	M	3-17
Called party subaddress	3.4.5.9	both	O (Note 5)	3-23
Redirecting number	3.4.6.7	both	O	3-17
Low layer compatibility	3.4.5.18	both	O (Note 6)	3-16
High layer compatibility	3.4.5.16	both	O (Note 7)	3-5
User-user	3.4.5.29	both	O (Note 8)	3-131
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Notes 8, 9)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Notes 8, 9)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Notes 8, 9)	1
User-specific (codeset 7)	3.4.5.3	both	O (Notes 8, 9)	1-128

Note 1: The Bearer capability and High layer and Low layer compatibility information elements may be used to describe a CCITT telecommunications service, if appropriate.

Note 2: On call-by-call channels, the Network-specific facilities information element is mandatory in a SETUP message from an originating user and it must contain a valid binary service facility code point. On single service trunk groups, the Network-specific facilities information element is optional, but if it exists, it must contain a service coding which is valid for that trunk group.

Note 3: May be included by the calling user or the network to identify the calling user.

Note 4: Included in the user-to-network direction when the calling user wants to indicate the calling party subaddress. Included in the network-to-user direction if the calling user included a calling party subaddress in the SETUP message.

Note 5: Included in the user-to-network direction when the calling user wants to indicate the called party subaddress. Included in the network-to-user direction if the calling user included a called party subaddress in the SETUP message.

Note 6: Included in the user-to-network direction when the calling user wants to pass low layer compatibility information to the called user. Included in the network-to-user direction if the calling user included low layer compatibility information in the SETUP message.

Note 7: Included in the user-to-network direction when the calling user wants to pass high layer compatibility information to the called user. Included in the network-to-user direction if the calling user included high layer compatibility information in the SETUP message.

Note 8: Included in the user-to-network direction when the calling user wants to pass user information to the called user. Included in the network-to-user direction if the calling user included user information in the SETUP message.

Note 9: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.3.10 Setup Acknowledge — Not applicable.

3.3.3.11 Status

This message may be sent at any time during a call when an unexpected message is received. This message is also used to respond to a STATUS ENQUIRY message. This message is implemented as described in Section 3.3.11 of TR 41449. Note that the Cause information element (See Section 3.4.5.12) may be repeated and the Call reference may use a global call reference value.

3.3.3.12 Status Enquiry

The STATUS ENQUIRY message may be sent at any time to solicit a STATUS message from the peer layer 3 entity. Sending a STATUS message in response to a STATUS ENQUIRY message is mandatory. This message is implemented as described in Section 3.3.11 of TR 41449. The global call reference value may not be used in this message.

3.3.3.13 User Information

The USER INFORMATION message is sent by a user to the network to transfer information to the remote user. This message is also sent by the network to a user to deliver the information from the other user. See Table II-3-40.

TABLE II-3-40. USER INFORMATION Message Content

Message type: USER INFORMATION
Significance: access
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
More data	3.4.5.19	both	O (Note 1)	1
User-user	3.4.5.29	both	M	3-251
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Note 2)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Note 2)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Note 2)	1
User-specific (codeset 7)	3.4.5.3	both	O (Note 2)	1-128

Note 1: Included by the sending user to indicate that another USER INFORMATION message pertaining to the same message block will follow.

Note 2: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.3.4 Messages Used with the Global Call Reference

Table II-3-41 summarizes the messages for circuit-mode connection control. Please refer to Section 3.10.1.1.1 for maintenance messages.

TABLE II-3-41. Messages Used with the Global Call Reference

Messages:	Reference
RESTART	3.3.4.1
RESTART ACKNOWLEDGE	3.3.4.2
STATUS	3.3.4.3

3.3.4.1 Restart

This message is sent by the user or the network to request the recipient to restart (i.e., return to an idle condition) the indicated channel. See Table II-3-42.

TABLE II-3-42. RESTART Message Content

Message type: RESTART
Significance: local (Note 1)
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M (Note 2)	2
Message type	3.4.4	both	M	1
Channel identification	3.4.5.13	both	M (Note 3)	5-6
Restart Indicator	3.4.5.24	both	M	3

Note 1: This message may have global significance if sent on a channel which is carrying an active call.

Note 2: This message is sent with the global call reference defined in 3.4.3.

Note 3: The network will support RESTART messages for individual B channels only. Thus the Channel identification information element is mandatory.

3.3.4.2 Restart Acknowledge

This message is sent to acknowledge the receipt of the RESTART message and to indicate that the requested restart is complete. See Table II-3-43.

TABLE II-3-43. RESTART ACKNOWLEDGE Message Content

Message type: RESTART ACKNOWLEDGE
Significance: local
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M (Note 1)	2
Message type	3.4.4	both	M	1
Channel identification	3.4.5.13	both	M (Note 2)	5-6
Restart Indicator	3.4.5.24	both	M	3

Note 1: This message is sent with the global call reference defined in 3.4.3.

Note 2: The network will support RESTART ACKNOWLEDGE messages for individual B-channels only. Thus the Channel identification information element is mandatory.

3.3.4.3 Status

This message may be sent at any time during a call when an unexpected message is received. This message is also used to respond to a STATUS ENQUIRY message. This message is implemented as described in Section 3.4.3 of TR 41449. Note that the Cause information element (See Section 3.4.5.12) may be repeated.

3.3.5 Messages for AT&T Supplementary Services

Table II-3-44 summarizes the messages for circuit-mode connection control. Please refer to Section 3.10.1.1.1 for maintenance messages.

TABLE II-3-44. Messages for AT&T Supplementary Services

Messages:	Reference
CONGESTION CONTROL	3.3.5.1
FACILITY	3.3.5.2
FACILITY ACKNOWLEDGE	3.3.5.3
FACILITY REJECT	3.3.5.4
REGISTER	3.3.5.5
USER INFORMATION	3.3.5.6

3.3.5.1 Congestion Control

This message is sent by the network or the user to indicate the establishment or termination of flow control on the transmission of USER INFORMATION messages. This message may NOT be sent with the global call reference defined in Section 3.4.3. This message is implemented as described in TR 41449.

3.3.5.2 Facility

This message is sent by a user to the network to request a facility or by the network to a user to request acceptance of an end-to-end facility (e.g., Call-Associated Temporary Signaling Connection). See Table II-3-45.

TABLE II-3-45. FACILITY Message Content

Message type: FACILITY
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Channel identification	3.4.5.13	both	O (Note 1)	4-8
Network-specific facilities	3.4.5.20	both	M (Note 2)	4-9

Note 1: The Channel identification information element is mandatory when the FACILITY is the first response to SETUP.

Note 2: The Network-specific facilities information element may appear up to two times.

Note 3: For a NCA TSC, if the network receives this message in response to a SETUP message, a FACILITY REJECT message will be sent to the user.

Note 4: Locking Shift to codeset 6 and codeset 6 information elements described in TR 41449 are supported by certain specialized applications developed by AT&T as described in the appendices.

3.3.5.3 Facility Acknowledge

This message is sent by either the network or the user to indicate the acceptance of a facility request. See Table II-3-46.

TABLE II-3-46. FACILITY ACKNOWLEDGE Message Content

Message Type: FACILITY ACKNOWLEDGE
Significance: dual
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Network-specific facilities	3.4.5.20	both	O (Note 1, 2)	4-9
Calling party number	3.4.5.10	both	O (Note 1)	3-17

Note 1: Either the Network-specific facilities information element or the Calling party number information element, or both, must be present.

Note 2: The Network-specific facilities information element may appear up to two times.

3.3.5.4 Facility Reject

This message is sent by either the network or the user to indicate the rejection or failure of a facility request. See Table II-3-47.

TABLE II-3-47. FACILITY REJECT Message Content

Message type: FACILITY REJECT
Significance: dual
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
Cause	3.4.5.12	both	M	4-22
Network-specific facilities	3.4.5.20	both	O (Note 1)	4-9

Note 1: The Network-specific facilities information element may appear up to two times.

3.3.5.5 Register

This message, which is described in TR 41449, is supported by certain specialized applications developed by AT&T as described in the appendices.

3.3.5.6 User Information

The USER INFORMATION message is sent by a user to the network to transfer information to the remote user. This message is also sent by the network to a user to deliver the information from the other user. See Table II-3-48.

TABLE II-3-48. USER INFORMATION Message Content

Message type: USER INFORMATION
Significance: access
Direction: both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	3.4.2	both	M	1
Call reference	3.4.3	both	M	2-3
Message type	3.4.4	both	M	1
More data	3.4.5.19	both	O (Note 1)	1
User-user	3.4.5.29	both	M	3-251
Shift to codeset 6 *(locking)*	3.4.5.3	both	O (Note 2)	1
Network-specific (codeset 6)	3.4.5.3	both	O (Note 2)	1-128
Shift to codeset 7 *(locking)*	3.4.5.3	both	O (Note 2)	1
User-specific (codeset 7)	3.4.5.3	both	O (Note 2)	1-128

Note 1: Included by the sending user to indicate that another USER INFORMATION message pertaining to the same message block will follow.

Note 2: Multiple codeset 6 and 7 information elements may be present. Any codeset 6 or 7 information elements must be preceded by an appropriate *locking* Shift information element.

3.4 General Message Format and Information Elements Coding

This section describes message contents, and provides a guide to information element contents recognized by the network. Details regarding specific codings for information elements are contained in TR 41449.

3.4.1 Overview

Every message must consist of the following parts:

a. protocol discriminator;

b. call reference;

c. message type;

d. mandatory information elements, as required;

and may consist of additional optional information elements, when required.

The protocol discriminator, call reference, and message type information elements, in that order, appear in every message. All other information elements present in a message follow the message type information element. These information elements follow in increasing octal order, independent of whether an information element is mandatory or optional in that message.

3.4.2 Protocol Discriminator

Two protocol discriminators will be supported in this implementation:

— Q.931 maintenance messages

— Q.931 user-network call control messages.

These values of the protocol discriminator will be sent on SAPI 0.

3.4.3 Call Reference

The two or three octets long global call reference value as described in Section 4.3 of TR 41449 will be supported in messages where it may properly appear. For this implementation, the allowed messages are RESTART, RESTART ACKNOWLEDGE, SERVICE, SERVICE ACKNOWLEDGE, and STATUS.

Note that consistent with the rules for processing of other call reference values, the flag bit on the global call reference value will be set to "1" when it is sent in response to a previously received message.

Other call reference values may be two or three octets long. CPE must be capable of receiving both two octet and three octet call reference values.

3.4.4 Message Type

The messages which shall be supported by CPE are listed in Tables II-3-1, II-3-36, II-3-41 and II-3-44 given earlier in this document. In addition, CPE must also support the SERVICE and SERVICE ACKNOWLEDGE messages described in Section 3.10.1.1.1 of this document. For each supported message, the coding for the message type is the same as described in TR 41449.

3.4.5 Other Information Elements

3.4.5.1 Coding Rules

The coding of other information elements follows the coding rules specified in TR 41449.

CPE is recommended to support both single octet information elements as well as variable length information elements as described in TR 41449 (including the information elements used with maintenance messages). This section describes the allowed values for fields within the information elements listed for circuit-mode connection control and some supplementary services.

The following sections outline which specific codings for those information elements will be recognized by the AT&T network for circuit-mode connection control. Please refer to Section 3.10.1.1.2 for specific codings for the information elements used with maintenance messages. Additional notes regarding the use of these information elements which pertain specifically to the AT&T implementation of the ISDN Primary Rate Interface are also provided. Procedures for handling information elements and information element codings which are not recognized by the network are described in TR 41449.

The information elements listed below will be supported for circuit-mode connection control.

TABLE II-3-49. Codeset 0 Information Element Identifier Coding

Single Octet Information Elements:	Reference
Congestion level	3.4.5.14
Shift	3.4.5.3
More data	3.4.5.19

Variable Length Information Elements:	Reference
Bearer capability	3.4.5.5
Call state	3.4.5.7
Called party number	3.4.5.8
Called party subaddress	3.4.5.9
Calling party number	3.4.5.10
Calling party subaddress	3.4.5.11
Cause	3.4.5.12
Channel identification	3.4.5.13
Connected number	3.4.6.6
High layer compatibility	3.4.5.16
Low layer compatibility	3.4.5.18
Network-specific facilities	3.4.5.20
Progress indicator	3.4.5.22
Redirecting number	3.4.6.7
Restart indicator	3.4.5.24
User-user	3.4.5.29

The AT&T Standardized facilities information element in codeset 6 is supported by some specialized applications developed by AT&T as described in the appendices to this document.

3.4.5.2 Extensions of codesets

3.4.5.3 Locking Shift Procedure

The network will recognize the *locking* Shift information element and be able to transport the *locking* Shift to codeset 6 and the *locking* Shift to codeset 7 information elements and the codeset 6 or 7 information elements that follow.

When a *locking* Shift to codesets 1, 2, 3, 4, or 5 is encountered, the *locking* Shift information element and all other information elements that follow that *locking* Shift until the next *locking* Shift, or the end of the message, whichever occurs first, are dropped.

The *locking* Shift information element and any subsequent codeset 6 and 7 information elements may appear in a message only after all codeset 0 information elements in that message have been presented.

For information of the coding of this information element refer to TR 41449.

3.4.5.4 Non-locking Shift Procedure

The network will recognize *non-locking* Shift (NLS) information element but the NLS procedure is not being supported. When the network receives a NLS information element in a Layer 3 message, the network will recognize the information element and discard both the NLS information element and the information element which follows the *non-locking* Shift information element. A *locking* Shift information element shall not follow directly on a *non-locking* Shift information element. If this combination is received, it shall be interpreted as though only a *locking* Shift information element was received.

Coding for the *non-locking* Shift information element is the same as the *locking* Shift information element, except bit 4 of the *non-locking* Shift information element is coded "1" to indicate *non-locking* Shift.
The *non-locking* Shift information element also supports Codeset 0, coded as "000", in bits 3 to 1 of the identification value field. For information on the coding of the *locking* Shift information element refer to TR 41449, Section 4.5.3 of Part IV.

3.4.5.5 Bearer Capability

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Coding standard	CCITT standardized in this Specification
	Information transfer capability	speech
		unrestricted digital information
		restricted digital information
		3.1 kHz audio (modem)
4	Extension	description is extended through next octet
		last octet of the description
	Transfer mode	packet mode
		circuit mode
	Information transfer Rate	packet transport mode
		64 kbit/s
		384 kbit/s
		1536 kbit/s
4a	Extension	description is extended through next octet
		last octet of the description
	Structure	default (i.e., 8 kHz integrity) (Note 1)
	Configuration	point-to-point (Note 1)
	Establishment	demand (Note 1)
4b	Extension	last octet of the description
	Symmetry	bidirectional symmetric (Note 2)
	Information transfer rate	same as in octet 4 (Note 2)
5 (Note 3)	Extension	description is extended through next octet
		last octet of description
	Layer 1 identification	layer 1 identification coding
	User information layer 1 protocol	rate adaption, octet 5a is required
5a (Note 3)	Extension	description is extended through next octet
		last octet of description
	Synch/Asynch	synchronous
	Negotiation	inband negotiation not possible
	User rate	56 kbit/s Recommendation I.463
6 (Note 3)	Extension	description is extended through next octet
		last octet of description
	Layer 2 identification	layer 2 identification coding
	User information layer 2 protocol	Recommendation Q.921 (I.441)
7 (Note 3)	Extension	description is extended through next octet
		last octet of description
	Layer 3 identification	layer 3 identification coding
	User information layer 3 protocol	Recommendation Q.931 (I.451)

Note 1: This is the default value if octet 4a is omitted.

Note 2: This is the default value if octet 4b is omitted.

Note 3: These octets may be omitted. The optional octet 5 and its extension, and octets 6 and 7 specify the layers 1, 2, and 3 protocol that will be used for the call.

3.4.5.6 Call Identity — Not applicable.

3.4.5.7 Call State

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Call state value	0 — Null
		1 — Call Initiated (user only)
		3 — Outgoing Call Proceeding
		4 — Call Delivered
		6 — Call Present (network only)
		7 — Call Received
		8 — Connect Request
		9 — Incoming Call Proceeding
		10 — Active
		11 — Disconnect Request
		12 — Disconnect Indication
		18 — Tone Active
		19 — Release Request

3.4.5.8 Called Party Number

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Type of number	international number
		national number
		subscriber number
	Numbering plan identification	unknown
		ISDN/telephony numbering plan (Recommendation E.164/E.163) (Note 1)
		private numbering plan
4, etc.	Number digits (Note 2)	0
		1
		2
		3
		4
		5
		6
		7
		8
		9

Note 1: The network will accept the codepoint for Telephony numbering plan (Rec. E.163). However, the user is encouraged to use this ISDN/telephony numbering plan codepoint.

Note 2: The maximum number of digits that will be supported is 14.

3.4.5.9 Called Party Subaddress

This information element is passed transparently by the network to the terminating entity. The network recognizes the information element identifier, and places no restrictions on the contents of the subaddress information. The contents of the called party subaddress is not interpreted by the network. The information element, when present in a message, may be from 3-23 octets in length. For information on the coding of this information element, refer to TR 41449.

3.4.5.10 Calling Party Number

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	description is extended through next octet
		last octet of the description
	Type of number	international number
		national number
		subscriber number
	Numbering plan identification	unknown
		ISDN/telephony numbering plan (Recommendation E.164/E.163) (Note 1)
		private numbering plan
3a	Extension	last octet of the description
	Presentation indicator (Note 2)	presentation allowed (Note 3)
		presentation restricted
	Screening indicator	user provided, not screened (Note 3)
		user provided, verified and passed
		user provided, verified and failed
		network provided
4, etc.	Number digits (Note 4)	0
		1
		2
		3
		4
		5
		6
		7
		8
		9

Note 1: The network will accept the codepoint for Telephony numbering plan (Rec. E.163). However, the user is encouraged to use this ISDN/telephony numbering plan codepoint.

Note 2: At the originating user-network interface, the presentation indicator is used for indicating the intention of the calling user for the presentation of the calling party number to the called user.

Note 3: This is the default value if octet 3a is omitted.

Note 4: The maximum number of digits that will be supported is 13. Prefix or escape digits shall not be included.

3.4.5.11 Calling Party Subaddress

This information element is passed transparently by the network to the terminating entity. The network recognizes the information element identifier, and places no restrictions on the contents of the subaddress information. The calling party subaddress information element is not interpreted by the network. The information element, when present in a message, may be from 3-23 octets in length. For information on the coding of this information element, refer to TR 41449.

3.4.5.12 Cause

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Coding standard	CCITT standardized for this specification
		standard specific to identified location (network specific)
	Location (Note 1)	user
		private network serving local user
		public network serving local user
		transit network
		public network serving remote local network
		private network serving remote user
		international network
		network beyond interworking point
4	Extension	last octet of the description
	Cause value	(Note 2)
5, etc.	Diagnostics (Note 3)	(Note 2)

Note 1: Depending on the location of the users, the local public network and remote public network may be the same network.

Note 2: See Table II-3-50.

Note 3: Diagnostics octets may be omitted.

TABLE II-3-50. A Summary of Cause Values

Cause Number	Cause	Diagnostics
01	Unassigned (unallocated) number	None
06	Channel unacceptable	None
16	Normal call clearing	None
17	User busy	None
18	No user responding	None
21	Call rejected	None
22	Number changed	New called party number
28	Invalid number format	Number information element
29	Facility rejected	Facility identification
30	Response to STATUS ENQUIRY	None
31	Normal, unspecified	None
34	No circuit or channel available	None
41	Temporary failure	None
42	Switching equipment congestion	None
43	Access information discarded	None
44	Requested circuit/channel not available	None
47	**New destination,(a network-specific Coding standard value only, see Appendix 4)**	**None**
50	Requested facility not subscribed	Facility
52	Outgoing calls barred	None
54	Incoming calls barred	None
58	Bearer capability not presently available	None
65	Bearer capability not implemented	None
66	Channel type not implemented	None
69	Requested facility not implemented	Facility
81	Invalid call reference	None
82	Identified channel does not exist	Channel identification
88	Incompatible destination	None
96	Mandatory information element is missing	Information element identifier
97	Message type non-existent or not implemented	Message type
98	Message not compatible with the call state	Message type
100	Invalid information element contents	Information element
102	Recovery on timer expiry	Timer 3XX that expired in IA5 characters

The above causes are those causes values which the network will recognize or generate and send to a user. However, the network may generate a tone or

announcement on the information channel that corresponds to a cause that has end-to-end significance. The tone and announcement treatment for those causes is given below.

Switch Tone or Announcement treatment	Cause number (s)
busy tone	17
no circuit announcement	34, 42 and 54
vacant code announcement	01, 22, 28, 65 and 66

Note: The default treatment for the other causes will be a reorder announcement.

3.4.5.13 Channel Identification

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of description
	Interface identifier present (Note 1)	interface implicitly identified
		interface explicitly identified
	Interface type	primary rate
	Preferred/Exclusive (Note 8)	indicated channel is preferred
		exclusive; only the indicated channel is acceptable
	D-channel indicator	the channel identified is not the D-channel
		the channel identified is the D-channel
	Information channel selection	no channel
		as indicated in the following octets
3.1	Extension	description is extended through next octet
		last octet of the description
	Interface identifier (Note 2)	binary code assigned to the interface (Note 3)
3.2 (Note 7)	Extension	last octet of description
	Coding standard	CCITT standardized for this specification
	Number/Map	channel is indicated by the number in following octet
		channel is indicated by the slot map in the following octet(s) (Note 4)
	Channel type/Map element type	B-channel units
		H_0 channel units
		H_{11} channel units
3.3 (Note 7) or 3.3 — 3.5	Channel number/Slot Map	binary number assigned to the channel (Note 5)
		bit positions in slot map corresponding to time slots used by the channel are set to 1. (Note 6)

Note 1: Explicit identification must be used for H_{11} channels or in signaling for non-associated

facilities.

Note 2: An interface arrangement may consist of more than one DS1 controlled by a single D-channel or two D-channels (in D-channel Backup configuration). In either case, when signaling for a channel on a DS1 other than the one on which the D-channel resides, the Interface Identifier in octet 3.1 is required. It is recommended that the interface identifier is always provided by the CPE. See Note 1. Additionally, CPE must accept the interface identifier.

Note 3: The range of interface identifiers supported will be 0-31.

Note 4: The slot map will be used only when H_0 channels are being requested.

Note 5: The range of channel numbers supported will be 1-24.

Note 6: The slot map in octet 3.3 through 3.5 will be supported for H_0 channels. For this implementation, H_0 channels are constrained to occupy time slots 1-6, 7-12, 13-18, and 19-24 (if time slot 24 is not the D-channel). The length of the slot map is 3 octets.

Note 7: Octets 3.2 and 3.3 will be absent for H_{11} channels and Non-Call Associated Temporary Signaling Connections.

Note 8: The network coding for this field value is Exclusive. This field value may be coded as Preferred during B-Channel Negotiation. For additional information see Section 3.5.1.1 of Part II.

3.4.5.14 Congestion Level

The purpose of the congestion level information element is to indicate the congestion status of the call. It is a single octet information element and can take one of two values: receiver ready or receiver not ready.

OCTET	FIELD	VALUE(S) RECOGNIZED
1	Congestion Level information element identifier	receiver ready
		receiver not ready

3.4.5.15 Display — Not applicable.

3.4.5.16 High Layer Compatibility

This information element is not interpreted by the network and is delivered to the distant user. Hence, the network only needs to recognize the information element identifier. For information on the coding of this information element refer to TR 41449.

3.4.5.17 Keypad Facility — Not applicable.

3.4.5.18 Low Layer Compatibility

This information element is not interpreted by the network and is delivered to the distant user. Hence, the network only needs to recognize the information element identifier. For information on the coding of this information element refer to TR 41449.

3.4.5.19 More Data

The More data information element is sent by the user to the network in a USER |
INFORMATION message and delivered by the network to the destination user in the
corresponding USER INFORMATION message. The purpose of this information element is to
inform the destination user that more USER INFORMATION messages may be expected. The
use of the More data information element is not supervised by the network. For information on |
the coding of this information element refer to TR 41449.

3.4.5.20 Network-Specific Facilities

The purpose of the Network-specific facilities information element is to indicate which network
facilities are being invoked.

Two binary facilities may be requested by encoding octet 4 twice. When multiple binary
facilities are present in a network-specific facilities information element, the facilities should be
presented in increasing octal order.

The following codings will be supported for this information element:

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Length of network identification (Note 1)	0 octets
		4 octets
3.1	Extension	last octet of description
	Type of network identification	unknown
		national network identification
	Network identification Plan	interexchange Carrier Identification Code
3.2 (+ extensions)	Network identification	IA5 characters corresponding to AT&T Network code: 288
4	Parameterized/Binary	There are parameters associated with the requested facility and they are specified in the following octets. (Note 2)
		The requested facility is a binary facility.
	Expansion	coding of facility is in the following 6 bits
	Feature/Service	the requested facility is a feature
		the requested facility is a service
	Facility coding value	(Note 3)

Note 1: This field contains the length, in octets, of the network identification found in Octets
3.1, 3.2 and the repetition of Octet 3.2.

Note 2: Presently there are no parameterized feature/service codepoints, the request will be
rejected if this code point is used.

Note 3: See Table II-3-51.

TABLE II-3-51. Binary Facility Coding Values for the Network-specific Facilities Information Element

Bits						
5	4	3	2	1	Feature (Bit 6=0)	
0	0	0	0	1	CPN (SID) preferred	
0	0	0	1	0	BN (ANI) preferred	
0	0	0	1	1	CPN (SID) only	
0	0	1	0	0	BN (ANI) only	
0	1	0	0	1	Call Associated TSC	

Bits						
5	4	3	2	1	Service (Bit 6=1)	Comment
0	0	0	0	1	SDN (including GSDN)	access and egress
0	0	0	1	0	MEGACOM® 800	egress only
0	0	0	1	1	MEGACOM®	access only
0	0	1	1	0	ACCUNET® Switched Digital Service (including Switched Digital International)	access and egress
0	0	1	1	1	Long Distance Service (including AT&T World Connect)	access and egress
0	1	0	0	0	International 800 (I800)	egress only
1	0	0	0	0	AT&T MultiQuest®	egress only

Note: In future implementations, new codings may be added to this information element to accommodate new features and services supported by the AT&T network.

3.4.5.21 Notification Indicator — Not applicable.

3.4.5.22 Progress Indicator

The purpose of the Progress indicator is to describe an event which has occurred during the life of a call.

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Coding standard	CCITT standard coding
	Location	transit network
4	Extension	last octet of the description
	Progress description	call is not end-to-end ISDN and/or further call progress information may be available in-band

3.4.5.23 Repeat Indicator — Not applicable.

3.4.5.24 Restart Indicator

The purpose of the Restart indicator is to identify the class of facility to be restarted.

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Class	Indicated Channel (Note 1)

Note 1: The Channel identification information element must be included in the RESTART and/or RESTART ACKNOWLEDGE messages to indicate which channel is to be restarted. The channel to be restarted must be a B-channel.

3.4.5.25 Segmented Message — Not applicable.

3.4.5.26 Sending Complete — Not applicable.

3.4.5.27 Signal — Not applicable.

3.4.5.28 Transit Network Selection — Not applicable.

3.4.5.29 User-user

The purpose of the user-user information element is to convey information between two users who have requested this facility. This information is not interpreted by the network, but rather is carried transparently and delivered to the remote user. The network restriction on the length of this information element is 131 or 251 octets depending on the message type. For the USER INFORMATION message it can be up to 251 octets and for all other message types for which it is permitted it can be up to 131 octets.

3.4.6 Supplementary Services Information Elements

3.4.6.1 Date/Time — Not applicable.

3.4.6.2 Facility — Not applicable.

3.4.6.3 Feature Activation — Not applicable.

3.4.6.4 Feature Indication — Not applicable.

3.4.6.5 Switchhook — Not applicable.

3.4.6.6 Connected Number

This information element, which is not interpreted by the network, indicates which address is connected to a call. The connected number may be different from the calling party or called party number because of facilities like transfer. The maximum length of this information element is **17** octets. For information on the coding of this information element refer to TR 41449.

3.4.6.7 Redirecting Number

This information element is not interpreted by the network and is delivered to the terminating entity. Hence, the network only needs to recognize the information element identifier. The maximum length of this information element is **17** octets. For information on the coding of this information element refer to TR 41449.

3.4.6.8 Codeset 6 Information Elements

Codeset 6 information elements are not interpreted by the network and are delivered to the terminating entity. Any codeset 6 information elements must be preceded by the *locking* Shift to codeset 6 information element. For information on the coding of codeset 6 information elements refer to TR 41449.

3.4.6.9 Codeset 7 Information Elements

Codeset 7 information elements are not interpreted by the network and are delivered to the terminating entity. Any codeset 7 information elements must be preceded by the *locking* Shift to codeset 7 information element. For information on the coding of codeset 7 information elements refer to TR 41449.

3.4.7 Information Elements for Data Communications — Not applicable.

3.5 Circuit-Switched Call Control Procedures

The complete description of the procedures for the flow of messages across an ISDN Primary Rate Interface is contained in TR 41449. This section specifies implementation options supported by AT&T Network in its implementation of the ISDN Primary Rate Interface, as well as any exceptions to the call control procedures as specified in TR 41449.

3.5.1 Call Establishment at the Destination Interface

3.5.1.1 B-Channel Negotiation (B-Channel Selection — Destination)

In the SETUP message, the network will indicate one of the following cases:

1. channel is indicated, no acceptable alternative,

2. channel is indicated, any alternative is acceptable;

The following clarifications to the B-Channel Negotiation procedure described in TR 41449 should be noted. In case 1 above, if the B-channel indicated in the first response message is not the channel offered by the network, it clears the call by sending a RELEASE message with cause value 6, "channel unacceptable" or a DISCONNECT message with cause value 100, "invalid information element contents". In case 2 above, if the channel indicated by the user in the CALL PROCEEDING message is unacceptable, the network clears the call towards the called user by either sending a RELEASE COMPLETE with cause value 34, "no circuit or channel available", or a RELEASE message with cause value 6, "channel unacceptable". Channel Negotiation does not apply to RESTART or SERVICE messages, which the network always defines and interprets as case 1 (exclusive) when received.

3.5.1.2 Call Confirmation

User equipment can respond to the SETUP message with an ALERTING, CALL PROCEEDING, CONNECT, FACILITY, RELEASE COMPLETE as well as the PROGRESS message. However, the network does not support "fast connect". If the terminating user responds to a SETUP message with a CONNECT message, the network will send an ALERTING message, followed by a CONNECT message to the originating exchange.

On the receipt of the ALERTING or PROGRESS message from a user, the network cancels the timer T303 or T310, depending on which timer is currently active, and also initiates procedures to send an ALERTING or PROGRESS message to the calling user for this call (if possible). The call then enters the Call received state. A CONNECT message is expected in this state. Note that on the receipt of any ALERTING or PROGRESS messages in this state, the network

responds with a STATUS message with cause value 98 "message not compatible with the call state".

Receipt of an ALERTING or CONNECT message in the case where no CALL PROCEEDING message has been received causes a corresponding message to be sent to the calling user and timer T303 to be canceled. In the case of an ALERTING message being received, the corresponding message delivered to the calling user may be either an ALERTING or PROGRESS message. The ALERTING message will always precede the CONNECT message.

3.5.1.2.1 Call Failure

The following call failure procedure will be implemented by the network. This procedure differs from that which is contained in TR 41449. The value of timer T303 as implemented by the network is 8 seconds (double the standard value for this timer). If no response to the SETUP message is received within a time interval T303, the network will send a RELEASE COMPLETE to the terminating user[3] at the first expiration of timer T303 and hunt a new channel. A SETUP message with a different call reference value is transmitted for this new channel, and timer T303 is reinitialized. If T303 expires a second time, then a RELEASE COMPLETE message is sent to the terminating user, the call is considered terminated, and the network sends a PROGRESS message and then plays an announcement to the originating user. This procedural difference does not affect compatibility with equipment following the procedures described in TR 41449. After the call failure procedure described above, maintenance procedures described in Section 3.10.1.2 are always initiated.

3.5.2 Call Clearing

The network supports the call clearing procedures as given in TR 41449. There is an additional exception to call clearing as follows:

— For some trunk maintenance test calls, only one side of the interface will be allowed to disconnect the call. In this situation, if a RELEASE message is received from the side of the interface without permission to disconnect, the other side of the interface will respond with a STATUS message. Call clearing will not be initiated.

3.5.3 In-Band Tones and Announcements

3.5.3.1 End-to-End ISDN Network Call - End User/Terminal Busy

When a call that originates from a PBX/network uses ISDN facilities, it will send a SETUP message and cut through to the designated B-channel. The call will proceed through the network and arrive at the terminating PBX as described in TR 41449. It is also possible for the response to a SETUP message to be RELEASE COMPLETE with a Cause Value 17, (User Busy). In this case, the switch that originates the SETUP request will propagate the message as far back as possible. Either the originating PBX/network or interworking[4] node will provide the

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3. The network puts the channel specified in the SETUP in Maintenance state and sends a RESTART message every 2 minutes on that channel until a response is received.

4. Situations which involve mixture of ISDN PRI and non-ISDN trunking facilities. For example, calls that enter a PBX over ISDN PRI facilities and are tandemed through that PBX over analog facilities, or calls that enter a PBX over analog trunking facilities and are tandemed through the PBX over ISDN PRI facilities are considered to be interworked. See TR 41449 for more detail.

user busy tone.

3.5.3.2 End-to-End ISDN Network Call - Congestion and Intercept Treatment

If a SETUP message is received from the user side of the interface for a busy B-channel (e.g., glare), the response is RELEASE COMPLETE. This means that the channel is not available but an alternate channel may be selected by the originating (user) end of the interface. The appropriate tone would not be provided until alternate choices for an idle B-channel are exhausted. A terminating node may, as an implementation option, choose to map other cause values to locally provided tones and disconnect the channel.

3.5.4 Restart Procedure

The restart procedure is used to return channels and interfaces to an idle condition (the null state). The procedure is usually invoked when the other side of the interface does not respond to other call control messages or a failure has occurred.

The network will support restart requests for individual B-channels only. Thus, the channel identification information element is mandatory in a RESTART message to the network. A request to restart a wideband channel is effected by sending RESTART messages for all underlying B-channels which comprise the wideband channel. Note that H_0 and H_{11} dedicated channels are always viewed as underlaid for the purposes of restarting them.

3.5.4.1 Sending RESTART

A RESTART message is sent by one side of the interface in order to return channels or interfaces to the null state. The Channel identification information element must be present in the RESTART message when a channel is to be returned to the null state.

All RESTART messages will specify individual B-channels only.

Upon transmitting the RESTART message, the sender initiates timer T316 and waits for a RESTART ACKNOWLEDGE message. Receipt of a RESTART ACKNOWLEDGE message cancels timer T316 and frees the channels for reuse.

If a RESTART ACKNOWLEDGE message is not received prior to expiry of T316, one or more subsequent RESTART message may be sent until a RESTART ACKNOWLEDGE message is returned. Meanwhile, no calls shall be placed over the channel or interface by the originator of the RESTART message.

If the network sends a RESTART and prior to receiving a RESTART ACKNOWLEDGE receives a SETUP message specifying the same channel and channel type, the SETUP message shall override, and the network will treat the receipt of a SETUP message as equivalent to the RESTART ACKNOWLEDGE message.

3.5.4.2 Receipt of RESTART

Upon receiving a RESTART message, the recipient shall return the specified channels and call references to the null state and send a RESTART ACKNOWLEDGE message to the originator.

When the RESTART message requests the restart of an entire interface (DS1 Facility), the network will return a STATUS message, which contains the global call reference, indicating "invalid information element contents".

3.5.5 Handling of Error Conditions

3.5.5.1 Call Reference Error

3.5.5.1.1 Call Reference Procedural Errors

a) Whenever one side of the ISDN interface receives any message except SETUP, RELEASE COMPLETE or STATUS ENQUIRY specifying a call reference that it does not recognize as in use, it shall: send a RELEASE COMPLETE message specifying the call reference used in the received message; and return to the *Null* state.

In all these clearing messages, the Cause information element shall specify the cause "invalid call reference value" (cause value 81), the location being the user or local network (as is appropriate) and the diagnostics field shall contain the received call reference value.

b) The receiver of a RELEASE COMPLETE message specifying a call reference that is not recognized as in use shall ignore the receipt of this message.

c) When any message except STATUS, RESTART, RESTART ACKNOWLEDGE, SERVICE, or SERVICE ACKNOWLEDGE is received specifying the global call reference, a STATUS message specifying the global call reference with cause 81 "invalid call reference" will be returned.

3.5.5.2 General Information Element Errors

3.5.5.2.1 Information Element Out of Sequence

An information element which has a code value lower than the code value of the information element preceding it shall be considered as an out of sequence information element.

If the network or user receives a message containing an out of sequence information element, it shall ignore this information element.

3.5.5.2.2 Duplicated Information Elements

If 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 handled and all subsequent repetitions of the information element shall be ignored. When repetition of information elements is permitted, only the contents of permitted information elements shall be handled. If the limit on repetition of information elements is exceeded, the contents of the information elements appearing first up to the limit of repetitions shall be handled and all subsequent repetitions of the information element shall be ignored.

Exception: If there are more than two Network-specific facilities information elements in the SETUP message to the network, the network will send a RELEASE COMPLETE.

3.5.5.3 Mandatory Information Element Errors

When a message other than SETUP, DISCONNECT, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements missing or with invalid contents, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause 96 "mandatory information element missing" or cause 100 "invalid information element contents" as appropriate.

When the Network-specific facilities information element indicates recognized facilities which are not subscribed by that user, the call is cleared. When the Network-specific facilities information element is mandatory and indicates unrecognized facilities, the network will send a RELEASE COMPLETE message.

When a clearing message (DISCONNECT, RELEASE or RELEASE COMPLETE) is received with the cause information element missing, it will be assumed the message was received with cause 31 "normal, unspecified".

3.5.5.4 Non-mandatory Information Element Errors

3.5.5.4.1 Non-mandatory Information Elements Not Implemented

When a message is received which has one or more non-mandatory information elements which are unrecognized, action shall be taken on the message and those information elements which are recognized and have valid content. The unrecognized information element(s) will be dropped and no STATUS message will be returned.

3.5.5.4.2 Non-mandatory Information Element Content Error

When a message is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which are recognized and have valid content. No STATUS message is returned.

When the Network-specific facilities information element indicates recognized facilities which are not subscribed by that user, the call is cleared. When the Network-specific facilities information element is not mandatory and indicates unrecognized facilities, the network will send a FACILITY REJECT message.

An information element with a length exceeding the maximum length will be treated as an information element with content error.

3.5.5.5 Data Link Failure

If layer 2 is disconnected, the calls are not immediately cleared, and attempts should be made to re-establish a data link connection. This shall continue for the duration of T309.

After a Layer 2 failure, Layer 3 will buffer messages for a maximum of three seconds. If the link has not been re-established by then, the buffer will be flushed.

Calls that are up at the time the Layer 2 failure occurs will remain up. It is the responsibility of the CPE to tear them down if so desired.

It is normally in the best interest of both the network and the user to re-establish the link as soon as possible. The network will attempt this by periodically sending SABME frames. As specified in TR 41449, the user should ordinarily respond with a UA frame, thereby agreeing to re-establishment of the link. The user is also encouraged to attempt to re-establish the link by periodically sending SABME frames. If the link is not automatically re-established within a few minutes, human intervention will eventually be prompted at both the network and user sides. This should be avoided unless there is actually a need for human intervention.

The SERVICE status of the B channels should be unchanged as a result of a temporary failure of Layer 2. A SERVICE audit may be conducted by either side of the interface in order to eliminate possible misalignment of the status across the interface.

3.5.5.6 Receiving a STATUS Message

On receipt of a STATUS message reporting an incompatible state, the network will take actions attempting to recover from a mismatch. See Section 5.8 in Part IV of TR 41449.

3.5.6 Layer 2 - Layer 3 Primitives

These primitives are implemented as described in TR 41449.

3.6 Packet Communication Procedures — Not applicable.

3.7 User-to-User Signaling Procedures

The complete description of the procedures for user-to-user signaling is contained in TR 41449. This section specifies implementation options supported by AT&T Network in its implementation of the user-to-user signaling.

3.7.1 Message-Associated User-to-User Information

The network will support user-to-user signaling in association with a circuit-switched connection as described in TR 41449. This capability is also referred to as Message-Associated User-to-User Information (MA UUI). User-to-user information may be placed in the SETUP, ALERTING, CONNECT and/or DISCONNECT[5] messages. MA UUI can also be included in the first expected clearing message for a Non-Call Associated Temporary Signaling Connection (NCA TSC) which could be RELEASE[5] or RELEASE COMPLETE[5].

In addition to the User-user information element, the network will treat the following information elements as user data information elements when present in the appropriate messages (listed with their MA UUI length restrictions):

— Called party subaddress (3-23 octets),

— Calling party subaddress (3-23 octets),

— Connected number (3-17 octets),

— High layer compatibility (3-5 octets),

— Low layer compatibility (3-16 octets),

— Redirecting number (3-17 octets),

— *Locking* Shift to Codeset 6 and any Codeset 6 information elements (1-129 octets), and

— *Locking* Shift to Codeset 7 and any Codeset 7 information elements (1-129 octets).

For international calls, in addition to the User-user information element only the following information elements will be treated as user data information elements:

— Calling party subaddress (3-23 octets),

— Called party subaddress (3-23 octets),

— Low layer compatibility (3-16 octets), and

— High layer compatibility (3-5 octets).

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5. In the situation where both users disconnect nearly simultaneously, delivery of MA UUI in a clearing message is not guaranteed.

The calling or called user should only send the above user data information elements for international ISDN.

All UUI-type information elements have significance to the end-user only and are not interpreted by the network.

Initially, the support of MA UUI on a call depends upon the availability of resources in the common channel signaling network. Thus, if the originating user potentially desires MA UUI to be transported in the ALERTING, CONNECT, or DISCONNECT messages, but has no MA UUI to send in the SETUP message, the originating user should place a User-user information element in the SETUP message with length=1.

The total length of user data information elements defined in Section 3.7.1 must also satisfy all of the following criteria:

1.   the length of the User-user information element shall be 3 to 131 octets; and

2.   the total length of all user data information elements except User-user, cannot exceed 129 octets; and

3.   the combined length of (1) and (2) above cannot exceed 131 octets.

The individual information elements which comprise MA UUI will be screened for valid information lengths. Any user data information element with an invalid length will be dropped. A STATUS message with cause 43, "access information discarded", is sent to the user only if all user data information elements are dropped, and the message is not a clearing message.

If the total MA UUI length is exceeded, the following information algorithm is employed. The total length of all user data information elements, except the User-user information element is checked for compliance with the 129 octet limit. If the length is greater than 129 octets, the *locking* Shift to Codeset 7 and the Codeset 7 information elements are dropped. If still too long, then the *locking* Shift to Codeset 6 and the Codeset 6 information elements are dropped. Then if the MA UUI total length is still greater than 131 octets, the User-user information element is dropped and the remaining user data information elements are passed by the network. This capability also applies to NCA-TSCs. It is the responsibility of the users to perform any verification of receipt of individual user data information elements.

3.7.2 Call Associated Temporary Signaling Connection (CA TSC)

3.7.2.1 Overview

Call associated TSCs can be requested during or after the call setup request. During call setup, the TSC request is included in the SETUP message. After call setup the TSC request is made with the FACILITY message. The Binary facility coding value field of the Network-specific facilities information element is coded to request a TSC in either case. Either the SETUP or the FACILITY message may request more than one of the facilities described in Section 3.11. Figure II-3-4 summarizes the CA TSC request by call state.

Call State	Requesting Entity	Message
0 — Null	Originating	SETUP
4 — Call Delivered	Originating	FACILITY
9 — Incoming Call Proceeding	Terminating	FACILITY
10 — Active	Either	FACILITY

Figure II-3-4. TSC Requests by Call State

More details on establishing a CA TSC at or after setup time are given in the next two sections. Transfer and flow control of USER INFORMATION messages is detailed in sections 3.7.2.5 and 3.7.2.6. Section 3.7.2.8 covers clearing a CA TSC.

3.7.2.2 CA TSC Requested at Setup Time

A CA TSC is requested during call setup by including the CA TSC code point in the Binary facility coding value field of the Network-specific facilities information element in the initial SETUP message. If resources are not available, the network will reject the CA TSC request by sending a FACILITY REJECT[6] to the user containing one of the cause information elements described in Section 3.7.2.4 and the Network-specific facilities information element encoded as above. Note that processing of the B-channel connection request is unaffected by the CA TSC rejection. If the CA TSC request is not rejected by the network, it is delivered to the terminating user in a similarly encoded SETUP message. Responses to the CA TSC request and subsequent actions are described in Sections 3.7.2.4 through 3.7.2.8.

3.7.2.3 CA TSC Requested After Call Setup

In this case the user first sets up a B-channel connection, then requests a CA TSC at some time after the initial SETUP message. The calling party can request a CA TSC anytime after receiving the ALERTING message because the called party has implicitly acknowledged the call setup. The called party can request a TSC anytime after sending the CALL PROCEEDING message that confirms the channel identity.

The user requests the feature in a FACILITY message by coding the Network-specific facilities information element for "CA TSC" as described in the previous section. If intervening switches are able to provide the CA TSC, the CA TSC request is delivered to the destination user in a similarly encoded FACILITY message. The destination user responds with either a FACILITY ACKNOWLEDGE or FACILITY REJECT message. From this point on, the procedure is exactly the same as that described for a CA TSC requested at setup time.

3.7.2.4 Acknowledgment of the CA TSC Request

An acknowledgement must be received from the distant user before USER INFORMATION messages may be transmitted in either direction. Note that a response to a CA TSC request can be made at any time after CALL PROCEEDING has been sent.

The positive acknowledgement is a FACILITY ACKNOWLEDGE message which includes the CA TSC coding in the Network-specific facilities information element.

A negative acknowledgement is needed because a rejected CA TSC *does not clear the call setup*. If the CA TSC request is rejected by a switch in the call path, the subsequent SETUP message continuing towards the terminating user will not include the CA TSC request in the Network-specific facilities information element. In this case, the call progresses without the CA TSC request. When a CA TSC request contained in a FACILITY message is rejected, the FACILITY message will not be tandemed past the switch rejecting the request.

The FACILITY REJECT message[7] shall include the following:

- An Network-specific facilities information element, encoded with the CA TSC code point in the Binary facility value field.

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6. Note that the network may respond with CALL PROCEEDING prior to sending FACILITY REJECT.
7. CPE implementing previous generics may return a STATUS message with a valid cause, since the FACILITY REJECT message may not be supported.

- A Cause information element with a cause value chosen from:

— 29 (facility rejected)

— 50 (requested facility not subscribed)

— 69 (requested facility not implemented)

Figure II-3-5 summarizes CA TSC acknowledgements. The acknowledgements have the following effect:

- A positive acknowledgement causes processing of the CA TSC request to proceed. Processing of the B-channel connection request is unaffected.

- A negative acknowledgement via the FACILITY REJECT message causes rejection of the CA TSC request, but allows processing of the B-channel connection request to continue normally.

- A negative acknowledgement via the DISCONNECT or RELEASE COMPLETE messages results in rejection of the CA TSC request and clearing of the B-channel connection.

Request Message	Positive Acknowledge	Negative Acknowledge
SETUP	FACILITY ACKNOWLEDGE	FACILITY REJECT DISCONNECT RELEASE COMPLETE
FACILITY	FACILITY ACKNOWLEDGE	FACILITY REJECT

Figure II-3-5. Responses to CA TSC Requests

3.7.2.5 Transfer of USER INFORMATION Messages

USER INFORMATION messages (Section 3.3.1.23) may be sent by either user provided a TSC has been successfully established. After interpreting the first three information elements (protocol discriminator, call reference value, and message type), the network will transport the USER INFORMATION messages intact. Any syntax errors contained within the message, after the message type information element, must be resolved by the end users. If a USER INFORMATION message exceeds the maximum allowable length, the message will not be transmitted across the network, and a STATUS message will be sent to the user with cause value 43 (access information discarded).

The sending of USER INFORMATION messages does not change the state of the call.

3.7.2.6 Flow Control of USER INFORMATION Messages

The network will flow-control, when needed, the transfer of USER INFORMATION messages from a user by means of a CONGESTION CONTROL message containing the Congestion level information element. Two indications of congestion level are specified: "receiver not ready" and "receiver ready". On receipt of the former, the user should suspend sending USER INFORMATION messages; on receipt of the latter, sending may recommence. After having sent a "receiver not ready" indication, the network may discard USER INFORMATION messages that are subsequently received.

The user can also send CONGESTION CONTROL messages to shut off the flow of USER INFORMATION messages from the network. In this event the network will immediately inform the remote user by sending a CONGESTION CONTROL message. Any USER INFORMATION

message received from the remote user will be discarded by the network.

The user or the network can resume flow by sending a CONGESTION CONTROL message indicating "receiver ready" across the user-network interface. This should only be done by the entity that sent the CONGESTION CONTROL message that initiated flow control.

A CONGESTION CONTROL message with the global call reference value will be interpreted as a message with an invalid call reference value.

3.7.2.7 Congestion Control Strategy for TSCs

Temporary Signaling Connections may encounter congestion from either the network or the user. AT&T's ISDN network will provide flow control to ensure that no single user is allowed to monopolize network resources, thus affecting service for other users.

AT&T's congestion control strategy addresses both network congestion and user congestion.

- User congestion — When a user indicates to the network that it is congested by sending a CONGESTION CONTROL (receiver not ready) message, the network will immediately forward the congestion indication to the other TSC user.

- While a network element is congested, neither the near end or far end of a TSC will be notified until an attempt is made to transfer user to user data, in which case, the user initiating the transfer will be notified of the congestion. The USER INFORMATION message will be discarded.

The network assumes no responsibility for recovery of lost messages. Rather, it is the responsibility of the end-users to recover from the loss of USER INFORMATION messages.

Note that no notification of network congestion is made until the user attempts to send a USER INFORMATION message.

3.7.2.8 Clearing the CA TSC

Normal call clearing procedures are used to simultaneously disconnect the CA TSC and the B-channel connection. The DISCONNECT message initiates the clearing procedure.[8] The Cause information element associated with the messages above will be independent of the CA TSC because these messages explicitly clear the B-channel connection. Only the FACILITY REJECT message will contain a Cause information element pertaining to the TSC itself.

3.7.3 Non-Call Associated Temporary Signaling Connection (NCA TSC)

3.7.3.1 General Characteristics

This feature allows the users to communicate by means of user-to-user signaling without setting up a circuit-switched connection. A temporary signaling connection is established and cleared in a manner similar to the control of a circuit-switched connection.

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8. The use of other call clearing messages in error recovery situations (i.e., RELEASE and RELEASE COMPLETE) also clears the CA TSC.

3.7.3.2 Call Establishment

On call request, the calling user sends a SETUP message identifying, within the Bearer capability and Channel identification information elements, a temporary signaling connection to be established on SAPI=0. The SETUP message is encoded to indicate:

- Bearer capability information element

  — Unrestricted digital information in the Information transfer capability field

  — Packet mode in the Transfer mode field

  — User information layer 2 protocol is Q.921 and user information layer 3 protocol is Q.931 in the Layer and protocol identification field[9]

- Channel identification information element

  — Exclusive in the Preferred/Exclusive field

  — D-channel in the D-channel indicator field

  — No channel in the Channel selection field

- Network-specific facilities information element

  — Binary facility coding = SDN or ACCUNET[*] Switched Digital

3.7.3.3 Acknowledgement of the NCA TSC Request

As indicated above, an acknowledgement must be received from the user opposite the NCA TSC request before USER INFORMATION messages may be transmitted in either direction. The acknowledgements are summarized below in Figure II-3-6. The terminating user and the network positively acknowledge the NCA TSC request with a CONNECT[10] message.

The network rejects the NCA TSC request when TSC resources are busy by sending a RELEASE or RELEASE COMPLETE message with a Cause information element indicating cause 29, "facility rejected" or 42 "Switching equipment congestion". The terminating user rejects a NCA TSC request by sending a RELEASE message with a cause information element | indicating cause 29, "facility rejected". This message may be preceded by a CALL | PROCEEDING message. The terminating user may also reject the NCA TSC request by | responding to the SETUP message with a RELEASE COMPLETE message with a Cause information element indicating cause 29. Note that in both cases the originating user will receive these messages with cause value 21 "Call rejected".

If the network receives a CALL PROCEEDING message, PROGRESS message, or an ALERTING message from the terminating user before the CONNECT or the RELEASE COMPLETE message, the network will ignore these messages locally. If a FACILITY message is received from the terminating user before a CONNECT or a RELEASE COMPLETE message, the network will respond with a FACILITY REJECT message.

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9. These field settings are currently ignored by the network, but may become mandatory.

10. Message Associated User-to-User Information should not be present in a CONNECT message used to acknowledge a NCA TSC request.

Request Message	Positive Acknowledge	Negative Acknowledge
SETUP	CONNECT	RELEASE RELEASE COMPLETE

Figure II-3-6. NCA TSC Request Acknowledgements

3.7.3.4 Transfer of USER INFORMATION Messages

The procedures described in Section 3.7.2.5 apply, where the call reference applies to the signaling connection.

3.7.3.5 Flow Control of USER INFORMATION Messages

The procedures described in Section 3.7.2.6 apply.

3.7.3.6 Clearing the NCA TSC

Clearing of the NCA TSC connection is initiated by either entity using a RELEASE message. The other entity responds with RELEASE COMPLETE. A DISCONNECT message is not used since there is not a B-channel to disconnect.

3.8 Application of Circuit-Switched Supplementary Services to Terminals Using Stimulus Procedures — Not applicable.

3.9 List of System Parameters

Descriptions of various timers are summarized in tabular form as specified in TR 41449. Note that for the AT&T Network, T303 is twice the standard value of T303, which is 4 seconds. At the first expiration of T303, the network sends a RELEASE COMPLETE, sends a RESTART on the channel, and hunts a new channel. A SETUP with a different call reference value is transmitted for this new channel. If T303 expires again, a RELEASE COMPLETE message is sent, a RESTART message is sent on the channel, the call is considered terminated, and an announcement is played. This procedural difference does not affect compatibility with equipment following the procedures described in TR 41449. See Section 3.5.1.2.1 for more detail.

3.10 Maintenance and Management

3.10.1 Maintenance

3.10.1.1 Message Structure

The protocol discriminator supported for maintenance messages has the value 0000 0011 as defined in TR 41449.

The global call reference value is used for all maintenance messages. See TR 41449 for codings.

The following two message types will be recognized by the network as maintenance messages:

— SERVICE

— SERVICE ACKNOWLEDGE

3.10.1.1.1 Maintenance Messages

The following maintenance messages must be implemented.

3.10.1.1.1.1 Service

This message is used to change the current status of the interface or channel to one of the following states: *In Service, Maintenance,* or *Out of Service.* The Channel identification information element is used to identify a specific channel instead of an interface. See Table II-3-52.

TABLE II-3-52. SERVICE Message Content

Information Element	Direction	Type	Length
Protocol discriminator	both	M	1
Call reference	both	M	2
Message type	both	M	1
Change status	both	M	3
Channel identification	both	M	3-6

Note 1: The network will support SERVICE messages for individual B-channels only. Thus, the Channel identification information element is mandatory.

Note 2: The length of the Channel identification information element must be 3 or 4 for D-channel backup procedures, and 5 or 6 otherwise.

Note 3: See Section 3.10.2 for the usage of this message for D-Channel Backup Procedures.

3.10.1.1.1.2 Service Acknowledge

The SERVICE ACKNOWLEDGE message is used to return the new status of the channel. See Table II-3-53.

TABLE II-3-53. SERVICE ACKNOWLEDGE Message Content

Information Element	Direction	Type	Length
Protocol discriminator	both	M	1
Call reference	both	M	2
Message type	both	M	1
Change status	both	M	3
Channel identification	both	M	3-6

Note 1: The network will support SERVICE ACKNOWLEDGE messages for individual B-channels only. Thus, the Channel identification information element is mandatory.

Note 2: The length of the Channel identification information element must be 3 or 4 for D-channel backup procedures, and 5 or 6 otherwise.

Note 3: See Section 3.10.2 for the usage of this message for D-Channel Backup Procedures.

3.10.1.1.2 Other Information Elements

The information elements listed below will be supported. The following sections outline which specific codings of those information elements will be recognized by AT&T network.

— Change status

— Channel identification

3.10.1.1.2.1 Change Status

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Preference	channel
	New Status	in service
		maintenance
		out of service

3.10.1.1.2.2 Channel Identification

See Section 3.4.5.13 for the coding of this information element..

3.10.1.2 Maintenance Procedures

Test calls, SERVICE messages and procedures, and RESTART messages and procedures will be supported in both directions on time slots/B-channels which underlay H_0 and/or H_{11} channels which are otherwise dedicated to carrying commercial calls of those bandwidths (384 Kbps and 1536 Kbps). Test calls, Service procedures and Restart procedures on the B-channels will be used to indirectly affect testing, change status, and reset the H-channels. In order to request a test call, the CPE needs to include in its SETUP message a valid Network-specific facilities information element for CBC TGs.

The Service procedure and messages will only refer to B-channels. The status of an H_0 and H_{11} channel is the least available status of the underlying B-channels. Note that H_0 or H_{11} channels dedicated to carrying calls of those bandwidths will still be considered as underlaid by B-channels for the purposes of supporting Service procedures.

All SERVICE messages will specify individual B-channels only. The response to a SERVICE message specifying an interface is a STATUS message indicating cause 100 (invalid information contents).

Only test calls may be placed by either side of the interface on a channel that has *Maintenance/FE* status. If a non-test call is received for a channel that has *Maintenance/FE* status, a service audit is triggered.

A channel or interface that is in the *Out of Service* status may not be assigned for out going traffic by either side of the interface. Neither side of the interface is required to process any incoming calls. If a SETUP message is received in this state:

a. Respond with a RELEASE COMPLETE (or DISCONNECT in the case of channel negotiation) with the cause value 44 ("requested channel not available").

b. If the *Out of Service* status was originally requested by the far end, the network will initiate procedures to bring the channel *In Service* and proceed as in "a" above.

3.10.1.2.1 Status Audits

Audit procedures are as described in TR 41449 with the implemented triggers being:

- Normal incoming calls while in the maintenance status or any incoming call while in the out-of-service status.

- Once every 24 hours on all channels.

3.10.1.2.2 Error Conditions

If a SERVICE or SERVICE ACKNOWLEDGE message is received without a global call reference value, a RELEASE COMPLETE shall be sent with cause "invalid call reference" (cause value 81).

If a SERVICE message is received with a missing or invalid Change status or Channel identification information element, the message will be ignored.

If a SERVICE ACKNOWLEDGE message is received with an invalid or missing Channel identification information element, the message will be ignored.

If a SERVICE ACKNOWLEDGE message is received without a Change status information element, the message will be ignored.

If a SERVICE ACKNOWLEDGE is received with an invalid Change status information element, a STATUS message with cause 100, "invalid information element content," will be returned. The call state information element will specify the current call state. The current call reference will be specified unless the current call state is null, in which case the global call reference value will be specified."

If an unsolicited SERVICE ACKNOWLEDGE message is received, it will be ignored.

3.10.2 D-Channel Backup Procedures for Non-Associated Signaling

These procedures are specified in Annex F of TR 41449.

3.11 Procedures for Accessing Network Features and Services

To select a particular service or facility supported by the network, the user can:

- indicate this selection by including the appropriate coding of information elements (e.g., Bearer capability, Channel identification, Network-specific facilities) in the SETUP message,

- subscribe to the service on a continuous basis, or

- request it by using a FACILITY message.

The following sections detail how access to various network provided services is provided. Table II-3-54 shows the interplay of specific fields within the Bearer capability, Called party number, Channel identification, and Network-specific facilities information elements in requesting a service or feature from the network at call initiation via a SETUP message.

3.11.1 Calling Party Number (CPN) to the Network

The user sends the Calling party number (CPN) in the Calling party number information element contained in the SETUP message. See Section 4.7 in Part I for additional information.

3.11.2 CPN/BN Privacy Optioning

The calling user may specify "presentation restricted" in the Presentation indicator field of the Calling party number information element and not allow the CPN/BN to be passed to a terminating customer. The user specified value in the Presentation Indicator field over-rides the network stored default value for that call. See Section 4.8 in Part I for additional information.

3.11.3 CPN/BN to Terminating End

In all cases when CPN and/or BN is delivered to the terminating user, the Presentation indicator is coded as "presentation allowed". When CPN and/or BN cannot be delivered because the presentation indication is set to "presentation restricted", it is treated the same as CPN/BN not available.

- CPN on a Subscription Basis: Optional. The called user may elect to have CPN delivered on all incoming calls. Whenever available, the network will deliver the CPN in the SETUP message. The screening indicator for CPN may be "user provided" or "network provided".

- BN on a Subscription Basis: Optional. The called user may elect to have BN delivered on all incoming calls. Whenever available, the network will deliver the BN in the SETUP message. The screening indicator for BN is always "network provided".

- CPN/BN on a Per-Call Basis.

    The network may allow the user to request CPN/BN on a per-call basis. The user requests this information by sending a FACILITY message to the network. The network will deliver this information, when available, by sending a FACILITY ACKNOWLEDGE message containing the calling party number information element. The screening indicator for BN is always "network provided", while for CPN it may be "user provided" or "network provided". The FACILITY message must be sent by the user before an ALERTING message (i.e., network will process the FACILITY message at either Network Call state 6 or 9). Note that before sending an ALERTING message, the user should wait for a FACILITY ACKNOWLEDGE or FACILITY REJECT response to the FACILITY message. Otherwise, the network may not return a FACILITY REJECT when CPN/BN is unavailable.

    If the information is unavailable, the network will inform the user by sending a FACILITY REJECT message with the Cause information element specifying the reason. The possible values include 29 "facility rejected", 50 "requested facility not subscribed", and 69 "requested facility not implemented". Sending of a FACILITY ACKNOWLEDGE or a FACILITY REJECT message does not make any state transition at the network side.

See Section 4.9 in Part I for additional information.

3.11.4 56 Kbps

To request a 56 Kbps channel, the user shall use the Bearer capability information element in the following manner:

- The Information transfer capability is set to unrestricted/restricted digital information.

- The Information transfer rate is set to 64 Kbps.

- The extension bit in Octet 5 is set to 0, the Layer identification is set to Layer 1 and the protocol identification is set to rate adaption.

- Octet 5a is set to the 56 Kbps stream according to CCITT Recommendation I.463.

3.11.5 64 Kbps Clear/Restricted

To request a 64 Kbps clear/restricted channel, the user shall use the Bearer capability information element in the following manner:

- The Information transfer capability is set to unrestricted/restricted digital information.

- The Information transfer rate is set to 64 Kbps.

3.11.6 Wide Band Switching

To request a 384/1536 Kbps clear/restricted channel, the user makes use of the Bearer capability information element as follows:

- the Information transfer capability is set to unrestricted/restricted digital information.

- The Information transfer rate is set to 384/1536 Kbps.

In addition, the Channel identification information element is used as follows:

- For 1536 Kbps service, the Interface identifier uniquely identifies the set of time-slots to be used.

- For 384 Kbps service, the Channel type is set to H_0 channel units. To indicate the identities of the six contiguous 64 Kbps time-slots that make up a 384 Kbps unit, the channel slot map will be used.

3.11.7 Presentation Restriction of Calling Party Subaddress (CPS)

With the presentation restriction capability of CPS, the AT&T PRI caller can control the presentation of CPS to the called user, including international endpoints. This feature consists of applying the presentation restriction indication contained within the Calling party number (CPN) information element (see Section 4.7, 4.8, and 4.9 in Part I, and also see Section 3.11.2 and 3.11.3 in Part II for additional information on CPN/BN call handling) to the contents of the CPS information element. When the CPN is not delivered to the called user because it is coded "presentation restricted" then the CPS information element, if present, is also dropped by the network and not delivered to the called user. The presentation restriction applies to the delivery of the CPS regardless of the CPN/BN Delivery subscription options of the egress user (i.e., whether "CPN on a subscription basis" or "CPN/BN on a Call-by-Call basis").

At service provisioning, an AT&T PRI customer may choose on a per trunk group basis the requested privacy value settings for CPN/BN Privacy Optioning, that will define the default values for presentation restriction of CPS.

If the access trunk group is marked "presentation restricted", then the network will not pass CPS to the called user. On egress from the network, if CPN is not present or available, it is assumed CPS is "presentation allowed" and CPS can be delivered to the called user. See Section 4.11 of Part I for additional details.

3.11.8 Connected Line Identification (COLI) Presentation and Restriction

The Connected Line Identification Presentation is a feature offered to the calling party, including international endpoints, that provides the connected party's number to the calling party. The calling party must subscribe to this capability. On access, the calling user will subscribe to receive the connected party number as an option on a per service basis. On egress, the called user does not subscribe to this service. The called user delivers a user provided connected number, coded as a national number, to the network by including it in the Connected number information element in a CONNECT message. If the terminating user does not wish to provide the user-provided connected number to the calling user, the Connected number information element should not be included in the CONNECT message to the network.

A network-provided connected number may be provisioned for each egress service. The network-provided connected number can be provisioned as "presentation restricted". The network-provided number is passed to the calling user that subscribes to this capability, if presentation is not restricted, and only when the called user does not provide a user-provided connected number. The restriction of the connected line identification is a capability offered to the called party. A customer may elect, at service provisioning, to have the connected line identification information provisioned to be "presentation restricted". "Presentation restricted" prevents the network-provided connected number information from being passed across the interface to the calling user.

The Connected Line Identification Restriction capability is not supported on a per call basis. The Connected number information element does not support Octet 3a, which contains bit fields for a "presentation indicator" or a "screening indicator". The network will not notify the calling user if the connected number is not available. See Section 4.12 of Part I for additional information.

3.11.9 Facility Summary

The following figure shows the interplay of specific fields within the Bearer capability, Called party number, Channel identification, and Network-specific facilities information elements in a SETUP message for services described in Section 5 and 6 of Part I. Note that the information contained in the table does not preclude other possible codings to support additional feature or services.

TABLE II-3-54. Information Element Codings for Nodal Services

Information Element	Field	Codings	DESIRED SERVICE							
			SDN / GSDN	MEGACOM / Int. MEGACOM	MEGACOM 800	AT&T World Connect	ACCUNET / SDI (56, 64 C/R)	WIDEBAND (384 C/R, 1536 C/R)	B800	AT&T MultiQuest
Network-specific facilities	Binary facility coding values	SDN	M	X	X	X	X	X	X	X
		MEGACOM	X	M	X	X	X	X	X	X
		MEGACOM 800	X	X	M	X	X	X	X	X
		LDS	X	X	X	M	X	X	X	X
		ACCUNET	X	X	X	X	M	M	X	X
		B800	X	X	X	X	X	X	M	X
		AT&T MultiQuest	X	X	X	X	X	X	X	M
Called party number	Numbering plan	ISDN/Telephony	O (Note 1)	M	M	M	M	M	M	M
		private	O (Note 1)	X	X	X	X	X	X	X
	Type of number	national	O (Note 2)	*	M	*	**	**	M	M
		international	O (Note 2)	*	X	*	**	**	X	X
		subscriber	O (Note 3)	X	X	X	X	X	X	X
Bearer capability	Info. transfer capability	speech	O (Note 4)	O (Note 6)	O (Note 6)	O (Note 6)	X	X	O (Note 6)	O (Note 6)
		unrestricted digital info.	M (64C, 384C, 1536C) (Note 4) X (64R, 384R, 1536R) O (56) (Note 7)	X	X	X	M (64C) X (64R) O (56) (Note 7)	M (384C, 1536C) X (384R, 1536R)	X	X
		restricted digital info.	M (64R, 384R, 1536R) (Note 4) X (64C, 384C, 1536C) O (56) (Note 7)	X	X	X	M (64R) X (64C) O (56) (Note 7)	M (384R, 1536R) X (384C, 1536C)	X	X
		3.1 KHz audio	O (Note 4)	O (Note 6)	O (Note 6)	O (Note 6)	X	X	O (Note 6)	O (Note 6)
	Info. transfer rate	64 Kbps	M (56, 64 C/R, Voice)	M	M	M	M	X	M	M
		384 Kbps	M (384 C/R) X (56, 64 C/R, 1536 C/R, Voice)	X	X	X	X	M (384 C/R) X (1536 C/R)	X	X
		1536 Kbps	M (1536 C/R) X (56, 64 C/R, 384 C/R, Voice)	X	X	X	X	M (1536 C/R) X (384 C/R)	X	X
	Protocol rate adaption	56 Kbps	M (56) X (64 C/R, Voice)	X	X	X	M (56) X (64 C/R)	X	X	X
Channel identification	Interface identifier		D (56, 64C/R 384 C/R, Voice) M (1536 C/R)	D	D	D	D	D (384 C/R) M (1536 C/R)	D	D
	Number/Map	Number	M (56, 64 C/R, Voice) O (1536 C/R) X (384 C/R)	M	M	M	M	O (1536 C/R) X (384 C/R)	M	M
		Map	M (384 C/R) X (56, 64 C/R, 1536 C/R, Voice)	X	X	X	X	M (384 C/R) X (1536 C/R)	X	X
	Channel type	B Channel	M (56, 64 C/R, Voice)	M	M	M	M	X	M	M
		H$_0$ Channel	M (384 C/R)	X	X	X	X	M (384 C/R)	X	X
		H$_{11}$ Channel	O (1536 C/R)	X	X	X	X	O (1536 C/R)	X	X

Legend:

X — Field coding is not permitted.

* — Field coding is either national or international, dependent upon destination location.

** — For 56, 64C, 384C and 1536C calls, the field coding can be national or international. For domestic 64R, 384R and 1536R calls, it must be national.

D — Field coding is optional for Facility Associated Signaling[11] and is mandatory if the B-channel is not on the interface containing the D-channel in Non-facility Associated Signaling[12].

M — Field coding is mandatory.

O — Field coding is optional.

Note 1: Either the "ISDN/Telephony" coding or the "private" coding must be specified.

Note 2: Field coding is either national or international, dependent upon destination location, if the coding for the Numbering plan field of the Called party number is "ISDN/Telephony".

Note 3: Field coding is mandatory if the coding for the Numbering plan field of the Called party number is "private".

Note 4: Either the "speech" coding, "unrestricted digital info", "restricted digital info" or "3.1 KHz audio" coding must be specified.

Note 5: This table includes only selected fields of the information elements. Refer to text for complete coding information.

Note 6: Either the "speech" coding or "3.1 KHz audio" coding must be specified.

Note 7: Either the "restricted" or the "unrestricted" coding must be specified.

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11. In Facility Associated Signaling, the D-channel signaling entity can only assign calls to channels on the interface containing the D-channel.
12. In Non-facility Associated Signaling, the D-channel signaling entity can assign calls to channels on more than one interface (including the one containing the D-channel).

REFERENCES

1. AT&T Technical Reference, Requirements for Interfacing Digital Terminal Equipment to Services Employing the Extended Superframe Format, Technical Reference 54016, September 1989.

2. AT&T Technical Reference, ACCUNET* T1.5 Service Description and Interface Specifications", Technical Reference 62411, December 1988.

APPENDIX 1

AT&T NETWORK ISDN PRIMARY RATE INTERFACE

AND SPECIAL APPLICATIONS

SPECIFICATION

User Network Interface Description

Feature Control Interface Specification

APPENDIX 1

AT&T NETWORK INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PRIMARY RATE INTERFACE

USER-NETWORK INTERFACE DESCRIPTION
FEATURE CONTROL INTERFACE SPECIFICATION

CONTENTS

LIST OF FIGURES

1. Introduction

This document is an appendix to AT&T Technical Reference 41459 and serves to expand the scope of the ISDN Interface described in this publication to include special applications. Described in this document is a new interface between customer premise equipment (CPE) and an AT&T network switch.

Information Delivery Capability (IDC) provides the ability to deliver specific data to the customer via the Feature Control Interface. AT&T 800 INformation FOrwarding (INFO) is the first application of Information Delivery Capability. This 800 Service feature terminates toll-free calls in the network and delivers to the customer the calling number as well as four digits which identify the dialed number. This information is then used by customers for special data applications. The calling party number is obtained by the network via Equal Access (EA) signaling or through an attendant.

1.1 Introduction to this Issue of Appendix 1 to TR 41459

This appendix supersedes Appendix 1 to the previous issue of TR 41459[1], dated April 1988 and TR 41459 Addenda[2] [3] dated October 1988 and January 1989, respectively. This issue of the Feature Control Interface Specification incorporates changes to the physical layer protocol made since earlier issues of the specification. The Feature Control Interface will no longer support new installations of 4-wire analog private lines utilizing 4.8 or 9.6 modems. The Network - CPE interface will now be via either a 9.6 or 56 Kbps DDS line. See Section 2.1 for details. The Feature Control Interface will also not support the new ASF information element identifier that is described in Appendix 2 and in TR 41449. The Feature Control Interface will continue to support the ASF IE identifier described in previous issues of this specification. See Section 2.3.3.5.6 for details.

1.2 Scope of the Specification

The procedures currently described in the initial sections of this appendix are for the control of information services that are described in subsequent sections.

Section 2.1 is compatible with the Digital Data System (DDS) Channel Interface Specification[4]. The Feature Control Interface will support physical layer data signaling rates of 9.6 Kbps and 56 Kbps.

Sections 2.2 and 2.3 are based on the 1984 CCITT Recommendation Q.931[5], the "AT&T ISDN Primary Rate Interface Specification" (TR 41449[6]), its Addendum[7], and the earlier sections of this document. These sections describe messages, information elements, and general procedures for the Feature Control Interface specification.

The approach in Layer 3 of this interface (Section 2.3) is to build upon the messages, information elements, and procedures defined in [6], [5] and this document for basic transaction control and information exchange. Consequently this section will not duplicate material found in these references unless there are significant differences.

2. Interface Protocol Description
2.1 Layer 1 - Physical Layer Protocol

Two data rates will be supported by the Feature Control Interface. The Network - CPE

interface is via either a 9.6 or 56 Kbps DDS line. The digital private line facilities must be compatible with the Digital Data System (DDS) Channel Interface [4]. It is the user's responsibility to obtain a compatible digital access line.

Note: The Feature Control Interface will no longer support new installations of 4-wire analog private lines utilizing 4.8 or 9.6 modems.

It is also the user's responsibility to obtain customer premises equipment that is signal compatible with the DDS line and provides an EIA Standard RS-232-C interface[8] for the 9.6 Kbps data signaling rate or the CCITT Recommendation V.35[9] interface for the 56 Kbps data signaling rate for connection to the customer application equipment. The physical layer protocol for the Feature Control Interface is covered by CCITT Recommendation X.21 bis [10].

2.2 Layer 2 - Data Link Layer Protocol

The Layer 2 specification is as described in TR 41449.

2.3 Layer 3 - Network Layer Protocol

2.3.1 Scope of the Layer 3 Specification

This section describes the Q.931 based Feature Control Interface signaling used between the network and the customer premise equipment. Please note that the purpose of this signaling is exclusively for the exchange of Feature Control messages. This signaling channel is *not* intended for setting up calls in other channels. There are no Bearer (or B) channels associated with this signaling channel as in other applications of Q.931 - e.g., the ISDN Primary Rate Interface. The protocol for message oriented signaling between the user and the network is described in this section.

2.3.2 Message Functional Definitions

2.3.2.1 Overview

The message functional definitions are listed in alphabetical order. Each definition includes:

a)   a brief description of the message direction and use;

b)   a figure listing the information elements contained in the message. For each information element, the figure indicates:

   1)   the direction in which it may be sent, i.e., user to network ('u→ n'), network to user ('n→ u'), or both. For the purpose of this specification, the *customer premise equipment (CPE)* will be the "Q.931 user side" and the *serving switch* will be the "Q.931 network side."

   2)   whether its inclusion is mandatory ('M') or optional ('O');

   3)   its length 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.

2.3.2.2 Layer 3 Messages for the AT&T Feature Control Interface

Figure 1 summarizes the messages for Feature Control Interface transactions.

Message	Reference
FACILITY	2.3.2.2.1
REGISTER	2.3.2.2.2
RELEASE COMPLETE	2.3.2.2.3
STATUS	2.3.2.2.4

Figure 1. Messages for CPE-Network Transactions

2.3.2.2.1 Facility

This message is sent by the user to the network to respond to an invocation of a service.

Message type: FACILITY

Information element	Direction	Type	Length
Protocol discriminator	u → n	M	1
Call reference	u → n	M	3
Message type	u → n	M	1
Locking Shift to codeset 6	u → n	M	1
AT&T Standardized Facilities	u → n	M	4-* (Note 1)

Note1: In this offering of the Feature Control Interface, the length of the ASF information element in a FACILITY message is 6 octets (see Section 2.3.3.5.6.1.2).

2.3.2.2.2 Register

This message is sent by the network to the user to initiate a Feature Control Interface transaction. This message is used to assign a call reference value for the duration of the transaction and to convey the identity of the service being requested.

Message type: REGISTER

Information element	Direction	Type	Length
Protocol discriminator	n → u	M	1
Call reference	n → u	M	3
Message type	n → u	M	1
Locking Shift to codeset 6	n → u	M	1
AT&T Standardized Facilities	n → u	M	4-*(Note 1)

Note1: In this offering of the Feature Control Interface, the length of the ASF information element in a REGISTER message is 25 octets (see Section 2.3.3.5.6.1.1).

2.3.2.2.3 Release Complete

This message is sent by either the user or the network to release the call reference value and terminate the transaction. The receiver of this message shall release the call reference.

Message type: RELEASE COMPLETE

Information element	Direction	Type	Length
Protocol discriminator	both	M	1
Call reference	both	M	3
Message type	both	M	1
Cause	both	M	4-22 (Note 1)
Locking Shift to codeset 6	both	O	1
AT&T Standardized Facilities	both	O	4-* (Note 2)

Note 1: In this offering of the Feature Control Interface the Cause information element has a length of 4 octets. (see Section 2.3.3.5.5).

Note 2: In this offering of the Feature Control Interface, the length of the ASF information element in a RELEASE COMPLETE message is either 4 or 5 octets (see Section 2.3.3.5.6.1.3).

2.3.2.2.4 Status

This message is sent by either the network or the user at any time during a transaction when an unexpected message is received. The STATUS message is coded as described in TR 41449 and Part II of this document.

2.3.3 Message Structure

This section describes message contents for the Feature Control Interface, and provides a guide to information elements recognized by the network. 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.

2.3.3.1 Overview

Every message may consist of the following parts:

a. protocol discriminator;

b. call reference;

c. message type;

d. mandatory information elements as required;

e. additional information elements as required;

Elements a), b), and c) are common to all the messages and must always be present, while elements d) and e) are specific to each message type. Refer to TR 41449 for further details on Q.931 message organization.

2.3.3.2 Protocol Discriminator

The protocol discriminator is the first part of every message and its purpose is to distinguish messages for call control from other messages such as maintenance. The AT&T Feature Control Interface will follow the coding of the protocol discriminator as described in TR 41449.

Note: In this offering of the Feature Control interface, only the protocol discriminator for Q.931 user-network call control messages shall be used. The protocol discriminator for Q.931 maintenance messages shall **not** be implemented.

2.3.3.3 Call Reference

The call reference is the second part of every message. Refer to TR 41449 and Part II of this document for information and coding of the call reference value.

Note: In this offering of the Feature Control Interface, the length of the Call Reference information element is 3 octets (i.e., the call reference value has a length of 2 octets).

2.3.3.4 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. Refer to TR 41449 for the coding of the FACILITY, REGISTER, RELEASE COMPLETE and STATUS message types.

2.3.3.5 Other Information Elements

2.3.3.5.1 Coding Rules

Refer to TR 41449 for details on the coding rules for this specification. Information element identification codings for Cause, Call State, Calling Party Number, Called Party Number, Locking Shift to Codeset 6 and AT&T Standardized Facilities (ASF) can also be found in the above reference.

Note: The Feature Control Interface will continue to support the ASF information element identifier codepoint of "00011100", independent of any changes to either Appendix 2 or TR 41449.

The Feature Control Interface implements these information elements as follows.

2.3.3.5.1.1 Locking Shift to Codest 6

Refer to TR 41449 for the structure and coding of the Locking Shift to Codest 6 information element.

Note: In this offering of the Feature Control Interface, information elements containing shifts to codesets 1 through 5 or 7 are treated as unrecognized information elements in codeset 0.

2.3.3.5.2 Call State

The purpose of the Call state information element is to describe the current state of the call. Refer to TR 41449 and Part II of this document, for the structure and coding of the Call state information element.

Note: Only the null state (state 0) and the active state (state 10) will be supported by the Feature Control Interface.

2.3.3.5.3 Called Party Number

Refer to TR 41449 and Part II of this document for the structure and coding of the Called party number information element.

2.3.3.5.4 Calling Party Number

Refer to TR 41449 and Part II of this document for the structure and coding of the Calling party number information element.

2.3.3.5.5 Cause

Refer to TR 41449 and Part II of this document for the structure of the Cause information element and Cause definitions.

Note: In this offering of the Feature Control Interface, only the causes shown in Figure 2 will be supported. Diagnostics (which begin at octet 5 of the Cause information element) will not be supported and the Cause information element will have a length of 4 octets. Cause #69 may be sent by the user only. All other cause values listed below may be sent by either the network or the user.

Cause Number	Cause
31	normal, unspecified
69	requested facility not implemented
81	invalid call reference
96	mandatory information element is missing
97	message type non-existent or not implemented
100	invalid information element contents

Figure 2. Causes Supported by the Feature Control Interface

2.3.3.5.6 AT&T Standardized Facilities

The purpose of the AT&T standardized facilities (ASF) information element is to indicate which of the AT&T standardized services is being requested.

Refer to TR 41449 for the structure and coding of the AT&T Standardized Facilities information element.

Note 1: The Feature Control Interface will continue to support the ASF information element identifier codepoint of "00011100", independent of any changes to either Appendix 2 or TR 41449.

Note 2: In this offering of the Feature Control interface:

1. Multiple ASF information elements may not be included in a message.

2. The control types *reject, invoke not last* and *abort* will not be supported.

Specific Information Delivery examples of the coding of this information element for each of the possible control types that may be identified in octet 4 can be found in Figures 3, 4, 5 and 6. Details on the application of this information element for Information Delivery Capability are contained in Section 2.3.5.5.1.

The Feature Control Interface implements this information element as follows.

*Ext*ension bit (Octets 3, 4, 5, and 6)

    1 : last octet of the description

Note: Bit 8 is marked *1 Ext* if this is the last octet in the extension domain. Additional octets may be defined later (i.e., *1 Ext* changed to *0/1 Ext*) and equipments shall be prepared to receive additional octets although the equipment need not be able to interpret or act upon the content of these octets.

Process Identifier (Octet 3, Bits 7 through 1)

A binary field assigned by the sender of this information element when the control type in octet 4 indicates either of the two possible "invoke" codings (i.e., *invoke* or *invoke last*). For all other control types (i.e., *return result* or *return error*), the "process identifier" corresponds to one received in an ASF information element with one of the invoke codings.

See section 2.3.5.5.1.1 for the assignment of process identifiers (PIDs) for Information Delivery Capability.

Control Type (Octet 4)

Octet 4 may be coded as one of the four possible Control types for the Feature Control Interface. These types are: *invoke, return result, return error* and *invoke last.* See TR 41449 for the values of these codings.

Correlated Process Identifier (Octet 4.1, Bits 7 through 1)

A binary field inserted by the sender of this information element when the control type in octet 4 indicates *invoke last.* The contents of this field identify a "process identifier" received in an ASF information element with an *invoke* control type coding.

See section 2.3.5.5.1.1 for the assignment of correlated process identifiers (COPIDs) for Information Delivery Capability.

Service Element (Octet 6)

This field identifies the service to be provided or being provided in conjunction with the control type. The field has different families associated with each of the control types of octet 4.

Note: In this offering of the Feature Control Interface, the service element is absent when the control type in octet 3 is *return result.*

Control Type = Invoke

Bits
7 6 5 4 3 2 1

0 0 1 0 1 1 0	Information Delivery Capability
0 0 1 0 1 1 1	Information Delivery Capability - Attendant Handled

Control Type = Invoke Last

Bits
7 6 5 4 3 2 1

0 0 1 0 1 0 1	Event Report

Control Type = Return Error

Bits
7 6 5 4 3 2 1

0 0 0 0 0 0 1	Error Code

Parameters for Service Element (Octet 7, etc.)

Parameters associated with a service are coded as information elements as defined in TR 41449.

Parameters for a service element follow the rules for presentation of information elements in a call control message. Specifically, information elements are presented in increasing octal identifier from codeset 0.

Note: The only information elements currently supported by the Feature Control Interface as parameters for the service element are Called Party Number and Calling Party Number.

2.3.3.5.6.1 Examples of AT&T Standardized Facilities Information Elements

2.3.3.5.6.1.1 Example of Invoke Control Type

An example of an ASF with the control type set to *invoke* is shown in Figure 3. This example shows the ASF information element used in a REGISTER message for the delivery of the calling party number and the called party number. For the Information Delivery Capability (IDC) application, the Called Party Number information element contains 4 digits which identify the dialed number.

In Figure 3, a unique process identifier is assigned in octet 3 (see Section 2.3.5.5.1.1) and the control type is set to *invoke* (bits 1, 2 and 3 of octet 4). The correlated process identifier (octet 4.1) is not present when the control type is set to *invoke*. The service element (octet 5) is set to the value for *Information Delivery Capability*. The Calling and Called Party Number information elements are conveyed as service element parameters in Octets 6-25.

8	7	6	5	4	3	2	1	
ASF Info. Element Id.								Octet 1
0	0	0	1	1	1	0	0	
Length of ASF Info. Element								2
0	0	0	1	0	1	1	1	
1 Ext	Process Identifier							3
	0	0	0	0	0	0	1	
1 Ext	Spare				Invoke			4
	0	0	0	0	0	0	1	
1 Ext	Information Delivery Capability							5
	0	0	1	0	1	1	0	
Calling Party Number Info. Element Id.								6
0	1	1	0	1	1	0	0	
Length of Calling Party Info. Element								7
0	0	0	0	1	0	1	1	
1 Ext	Type of Address			Numbering Plan Id.				8
	0	1	0	0	0	1	0	
Calling Party Address Digits								9-18
Called Party Number Info. Element Id.								19
0	1	1	1	0	0	0	0	
Length of Called Party Info. Element								20
0	0	0	0	0	1	0	1	
1 Ext	Type of Address			Numbering Plan Id.				21
	0	1	0	0	0	1	0	
Called Party Address Digits								22-25

Figure 3. Example of Invoke Control Type

2.3.3.5.6.1.2 Example of Invoke Last Control Type

Figure 4 illustrates an example of an ASF with control type set to *invoke last*. This example illustrates the coding of the ASF information element in a FACILITY message in response to an invocation in a REGISTER message.

A process identifier is assigned a unique value (see Section 2.3.5.5.1.1). With the control type

set to *invoke last* a correlated process identifier (Octet 4.1) is included and assigned the same value as the process identifier used for the invocation (i.e., same value as in the REGISTER message). A service element value corresponding to *event report* acknowledges the contents of the invocation.

8	7	6	5	4	3	2	1	
			ASF Info. Element Id.					Octet 1
0	0	0	1	1	1	0	0	
			Length of ASF Info. Element					2
0	0	0	0	0	1	0	0	
1			Process Identifier					3
Ext	0	0	0	0	0	1	0	
1	0	0	0	0		Invoke Last		4
Ext		Spare			1	1	0	
1			Correlated Process Id.					4.1
Ext	0	0	0	0	0	0	1	
1			Event Report					5
Ext	0	0	1	0	1	0	1	

Figure 4. Example of Invoke Last Control Type

2.3.3.5.6.1.3 Example of Return Result and Return Error Control Types

Figures 5 and 6 show illustrations of ASF information elements with control type set to *return result* and *return error*, respectively. Either of these examples would be included in a RELEASE COMPLETE message to confirm (i.e., *return result*) or cancel a transaction (i.e., *return error*). In both cases, the process identifier is assigned the same value as the process identifier used in the FACILITY message. No correlated process identifier is required in this example.

In the *return result* control type, the service element (Octet 5) is omitted, whereas in the *return error* control type, a service element of *error code* is included.

8	7	6	5	4	3	2	1	
			ASF Info. Element Id.					Octet 1
0	0	0	1	1	1	0	0	
			Length of ASF Info. Element					2
0	0	0	0	0	0	1	0	
1			Process Identifier					3
Ext	0	0	0	0	0	1	0	
1	0	0	0	0		Return Result		4
Ext		Spare			0	1	0	

Figure 5. Example of Return Result Control Type

8	7	6	5	4	3	2	1	
	ASF Info. Element Id.							Octet 1
0	0	0	1	1	1	0	0	
	Length of ASF Info. Element							2
0	0	0	0	0	0	1	1	
1 Ext	Process Identifier							3
	0	0	0	0	0	1	0	
1 Ext	0	0	0	0	Return Error			4
	Spare				0	1	1	
1 Ext	Error Code							5
	0	0	0	0	0	0	1	

Figure 6. Example of Return Error Control Type

2.3.4 General Rules for Message Processing

The following rules are listed in order of precedence:

a) when a message is received that is less than five octets long, that message shall be ignored;

b) when a message is received with a protocol discriminator not in accordance with Section 2.3.3.2, that message shall be ignored;

c) if a message is received which has one or more mandatory information elements missing, a RELEASE COMPLETE message is sent to the user.

2.3.5 Procedures for CPE-Network Interactions

CPE-Network interactions are controlled by a sequence of messages flowing across the Feature Control Interface.

Before these procedures are invoked, a reliable data link connection must be established between the two sides of the ISDN interface.

For any unique transaction, the call reference contained in all the messages exchanged across the Feature Control Interface shall contain the call reference value specified in the REGISTER message.

2.3.5.1 Establishment of CPE-Network Transactions

The network shall indicate the beginning of a transaction at the Feature Control Interface by transferring a REGISTER message across the interface.

The REGISTER message shall contain a call reference value that is not currently in use and one ASF information element. A process identifier is assigned to the ASF information element and the control type is set to *invoke*. Any parameters associated with the facility are passed in the parameter list (as Q.931 information elements) of the ASF information element sent in the REGISTER message.

After sending the REGISTER message, the transaction is in the *Active* state. The network initializes timers T371 and T372. Timer T371 is a facility timer which requires the user side to respond to the facility identified in the REGISTER message to guarantee success in the performance of a facility. Timer T372 governs the maximum duration of a transaction and is

used to clear inactive transactions under error conditions. The values of timers T371 and T372 can be found in Section 2.3.6

2.3.5.2 Transaction Confirmation

Upon receipt of the REGISTER message, the transaction is in the *Active* state at the user side. In addition, the user side initializes timer T372 which is described above. User equipment can respond to the REGISTER message with either a FACILITY or RELEASE COMPLETE message. Receipt of the FACILITY message on the network side causes timer T371 to be canceled. Receipt of the RELEASE Complete message on the network side causes timer T372 to be canceled.

2.3.5.2.1 Transaction Acceptance

The user indicates acceptance of the transaction by sending a FACILITY message with the following information:

— a call reference value corresponding to the one sent in the REGISTER message above,

— an ASF information element containing

- a process identifier

- a control type set to *invoke last,*

- a correlated process identifier corresponding to the original process identifier sent in the REGISTER message, and

- a service element set to *Event Report.*

Note: For the purposes of this interface, the process identifier assigned by the user side in response to the REGISTER message must be different from the correlated process identifier, when the control type is set to *invoke last* (see Section 2.3.5.5.1.1).

2.3.5.3 Transaction Clearing

Under all conditions, the transaction is terminated by the user or the network by sending a RELEASE COMPLETE message.

For a collision involving RELEASE COMPLETE messages, the user and network will release the call reference value, and consider the transaction to be completely terminated.

2.3.5.3.1 Normal Clearing by the Network

The transaction is terminated when the network sends the user a RELEASE COMPLETE message containing the call reference value established for this transaction, a Cause information element with the cause value set to *normal, unspecified* (cause value 31), an ASF information element with process identifier corresponding to the one sent in the FACILITY message above, and either one of the following:

- a control type set to *return result,* indicating success, or

- a control type set to *return error,* indicating failure of the facility.

Under error conditions, the network will terminate the transaction by sending a RELEASE COMPLETE message which will release any resources (e.g., call reference value).

2.3.5.3.2 Abnormal Clearing

Upon expiry of timer T372 at either side of the interface, a RELEASE COMPLETE is sent to the other side of the interface thereby terminating the transaction. The Cause information element shall specify the cause *normal, unspecified* (cause value 31).

If the compatibility requirements indicated in the REGISTER or FACILITY messages are not satisfied, a RELEASE COMPLETE message is returned. The Cause information element should specify one of the following cause values:

— If one or more mandatory information elements are missing, cause value 96 is used.

— If the contents of a valid information element are recognized but invalid (e.g., a REGISTER message with control type coding corresponding to *return result* in the ASF information element), cause value 100 is used.

— If the coding in the ASF information element is unrecognized, (e.g., unrecognized service element value or process identifier not in accordance with Section 2.3.5.5.1.1), cause value 69 is used.

2.3.5.4 Handling of Error Conditions

The following are the minimal procedures which need to be implemented to allow for proper handling of error conditions.

2.3.5.4.1 Messages with Non-existent Call Reference

   a. Whenever the network side of the Feature Control Interface receives a FACILITY message specifying a call reference which it does not recognize as in use, it shall send a RELEASE COMPLETE message with Cause information element indicating *invalid call reference* (value 81).

   b. The receiver of a RELEASE COMPLETE message specifying a call reference that is not recognized as in use shall ignore the receipt of this message.

In all these clearing messages, the Cause information element shall specify the cause *invalid call reference value* (cause value 81), the location being the user or local network (as is appropriate).

2.3.5.4.2 Errors Due to an Unexpected Message

Whenever the user side of the Feature Control Interface receives a REGISTER message specifying a call reference which is already in use, it shall send a RELEASE COMPLETE message with Cause information element indicating *invalid call reference* (value 81).

Receipt of any message besides FACILITY and RELEASE COMPLETE shall be considered unexpected, and shall result in the transmission of a STATUS message with Cause information element specifying the cause *unrecognized message type* (cause value 97).

The network shall ignore the receipt of any more than one FACILITY message on an active transaction.

2.3.5.5 Facilities

The following sub-section describes how various network provided services are invoked.

2.3.5.5.1 Information Delivery Capability

Please refer to Figures 7 and 8 for the message flow described below.

1. The network initiates the transaction by transferring a REGISTER message containing:

   * Protocol Discriminator (Q.931), Call Reference (not in use) and Message Type (REGISTER),

   * Locking Shift to Codeset 6 containing the ASF information element coded in the following manner:

     — A unique Process identifier (see Section 2.3.5.5.1.1),

     — a control type set to *invoke*,

     — a Service Element identifier set to *Information Delivery Capability* or *Information Delivery Capability - Attendant Handled*, and

     — a Parameter Description list containing the Calling Number Address information element (with the 10 digit number of the caller), followed by the Called Party Number information element (four digits [XXXX] which identify the called number).

   See Figure 3 for the layout and coding of the ASF in the REGISTER message.

2. The response to the REGISTER message shall be a FACILITY message containing:

   * Protocol Discriminator (Q.931), Call Reference (active, same as one used in previous REGISTER message above) and Message Type (FACILITY),

   * Locking Shift to Codeset 6 containing the ASF information element coded in the following manner:

     — a Process Identifier which does not equal the Process Identifier used in the REGISTER message (see Section 2.3.5.5.1.1),,

     — a control type set to *invoke last*,

     — a Correlated Process Identifier set to the same value as the Process Identifier used in the REGISTER message (see Section 2.3.5.5.1.1), and

     — a Service Element identifier set to *Event Report.*

   See Figure 4 for the layout and coding of the ASF in the FACILITY message.

3. Under normal conditions, the network will provide an indication of success by sending a RELEASE COMPLETE message containing:

   * Protocol Discriminator (Q.931), Call Reference (active, same as one used in previous REGISTER and FACILITY messages above), Message Type (RELEASE COMPLETE) and Cause (normal, unspecified)

   * Locking Shift to Codeset 6 containing the ASF information element with a Process Identifier set to the same value as the Process Identifier used in the FACILITY message (see Section 2.3.5.5.1.1) and a control type set to *return result.*

   See Figure 5 for the layout and coding of the ASF in the RELEASE COMPLETE under normal conditions.

4. If the network must cancel the feature due to call abandonment, etc., the network will send a RELEASE COMPLETE message containing:

- Protocol Discriminator (Q.931), Call Reference (active, same as one used in previous REGISTER and FACILITY messages above), Message Type (RELEASE COMPLETE) and Cause (normal, unspecified).

- Locking Shift to Codeset 6 containing the ASF information element coded in the following manner:

  — a Process Identifier set to the same value as the Process Identifier used in the FACILITY message (see Section 2.3.5.5.1.1), .

  — a control type set to *return error*, and

  — a Service Element identifier set to *Error Code*.

See Figure 6 for the layout and coding of the ASF in the RELEASE COMPLETE message under call abandonment.
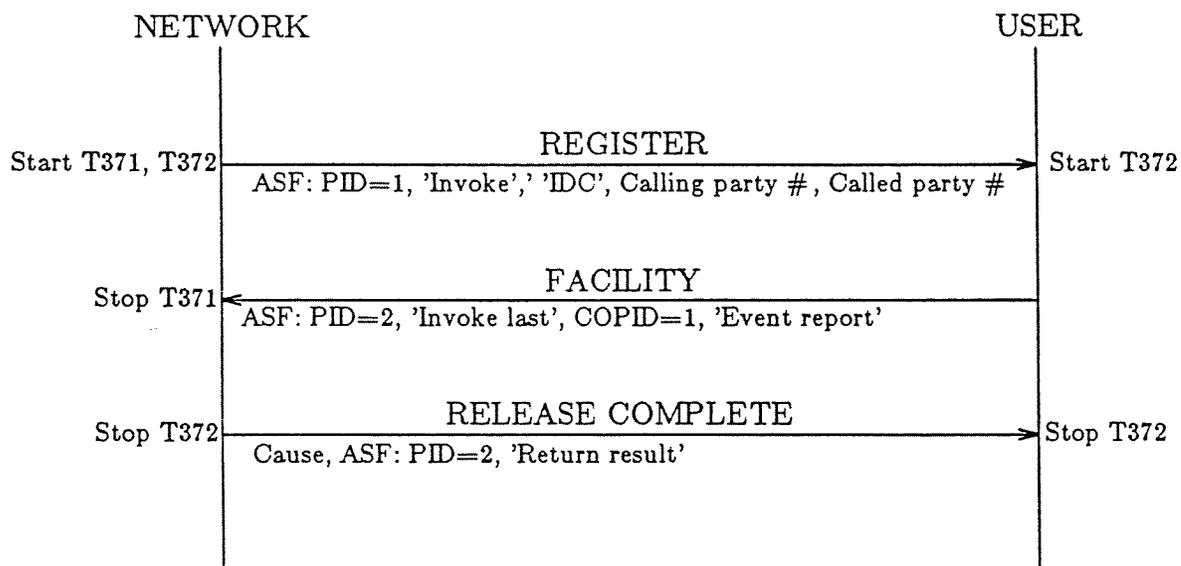
NETWORK   USER

REGISTER

Start T371, T372   ASF: PID=1, 'Invoke',' 'IDC', Calling party #, Called party #   Start T372

FACILITY

Stop T371   ASF: PID=2, 'Invoke last', COPID=1, 'Event report'

RELEASE COMPLETE

Stop T372   Cause, ASF: PID=2, 'Return result'   Stop T372

Figure 7. Successful Information Delivery Capability (IDC) Transaction

NETWORK   USER

Start T371, T372
                    REGISTER
                    ASF: PID=1, 'Invoke', 'IDC', Calling party #, Called party #   Start T372

Stop T371
                    FACILITY
                    ASF: PID=2, 'Invoke last', COPID=1, 'Event report'

Stop T372
                    RELEASE COMPLETE
                    Cause, ASF: PID=2, 'Return error', Error code   Stop T372
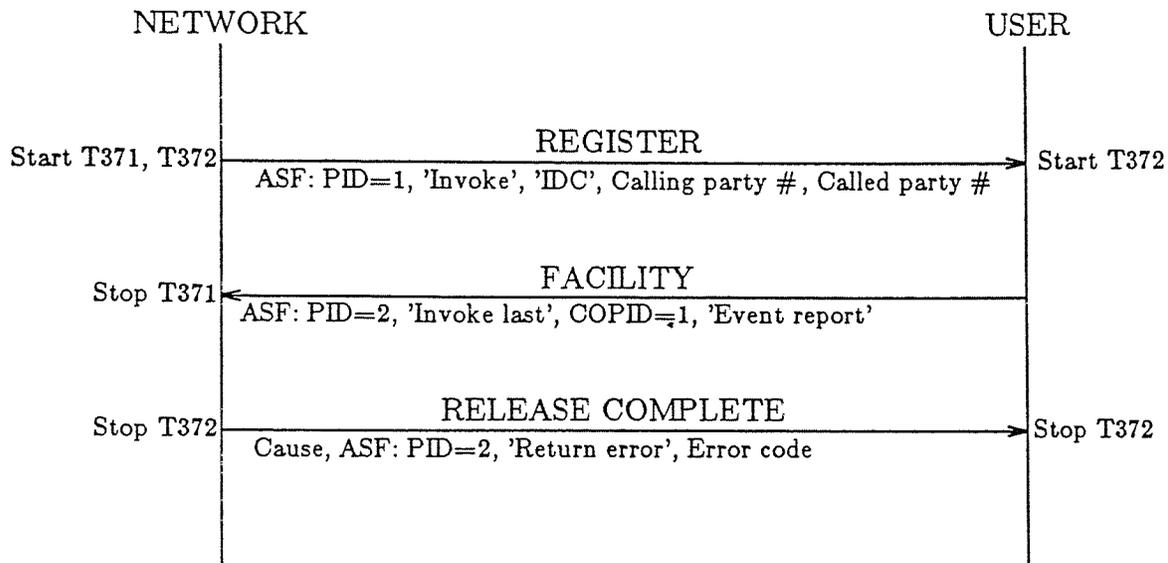
Figure 8. Unsuccessful Information Delivery Capability (IDC) Transaction

2.3.5.5.1.1 Process Identifiers used with Information Delivery Capability

In this offering of Information Delivery Capability and for the purpose of simplifying the ASF information element codings, the following process identifiers are assigned:

Process Identifier when Control Type = Invoke

Bits	
7 6 5 4 3 2 1	Service Element value
0 0 0 0 0 0 1	Information Delivery Capability
0 0 0 0 0 1 1	Information Delivery Capability - Attendant Handled

Process Identifier when Control Type = Invoke Last, Return Result, Return Error

Bits	
7 6 5 4 3 2 1	Service element value specified by *invocation*
0 0 0 0 0 1 0	Information Delivery Capability
0 0 0 0 1 0 0	Information Delivery Capability - Attendant Handled

Correlated Process Identifier when Control Type = Invoke Last

Bits	
7 6 5 4 3 2 1	Service element value specified by *invocation*
0 0 0 0 0 0 1	Information Delivery Capability
0 0 0 0 0 1 1	Information Delivery Capability - Attendant Handled

2.3.6 Timer Values

2.3.6.1 Timer T371

Timer T371 is a facility timer governing the maximum period in which to respond to a facility invocation (i.e., control type set to *invoke* in an ASF information element). The value for timer T371 is 4 seconds.

2.3.6.2 Timer T372

Timer T372 governs the maximum duration of any CPE-Network transaction. The value for timer T372 is 10 seconds.

2.3.7 Layer 2 - Layer 3 Primitives

The Layer 2-Layer 3 primitives are as described in TR 41449.

Note: It is strongly recommended that the network layer request the link layer to release the logical link connection (i.e., transfer a DL_RELEASE_REQUEST primitive from Layer 3 to Layer 2) in the event of bad link facilities, equipment problems or congestion.

REFERENCES

1. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459, April 1988.

2. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459 Addendum, October 1988.

3. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459 Addendum, January 1989.

4. Digital Data System - Channel Interface Specification, Technical Reference 62310, November 1987.

5. 1984 CCITT Recommendation Q.931 (I.451), "ISDN User-Network Interface Layer 3 Specification".

6. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface Specification, Technical Reference PUB 41449, March 1986.

7. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface Specification, Technical Reference PUB 41449A — Addendum 1, March 1988.

8. "Interface Between Terminal Equipment and Data Communications Equipment Employing Serial Binary Interchange," Electronic Industries Association Standard RS-232-C, August 1969, (Reaffirmed June 1981).

9. "Data Transmission at 48 Kilobits Per Second Using 60-108 KHz Group Band Circuits," CCITT Recommendation V.35, 1980 (Unchanged in 1984).

10. "Use on Public Data Networks of Data Terminal Equipment (DTE) which is Designed for Interfacing to Synchronous V-Series Modems," CCITT Recommendation X.21 bis, 1980 (Amended in 1984).

APPENDIX 1

AT&T NETWORK INTEGRATED SERVICES DIGITAL NETWORK (ISDN) PRIMARY RATE INTERFACE

USER-NETWORK INTERFACE DESCRIPTION
FEATURE CONTROL INTERFACE SPECIFICATION

CONTENTS

LIST OF FIGURES

2.3.5.5.3 Process Identifiers used with Information Delivery Capability

In this offering of Information Delivery Capability and for the purpose of simplifying the ASF information element codings, the following process identifiers are assigned:

Process Identifier when Control Type = Invoke

Bits 7 6 5 4 3 2 1	Service Element value
0 0 0 0 0 0 1	Information Delivery Capability, Information Delivery Capability - Non-Confirmed
0 0 0 0 0 1 1	Information Delivery Capability - Attendant Handled

Process Identifier when Control Type = Invoke Last, Return Result, Return Error

Bits 7 6 5 4 3 2 1	Service element value specified by *invocation*
0 0 0 0 0 1 0	Information Delivery Capability
0 0 0 0 1 0 0	Information Delivery Capability - Attendant Handled
0 0 0 0 0 0 1	Information Delivery Capability - Non-Confirmed

Correlated Process Identifier when Control Type = Invoke Last

Bits 7 6 5 4 3 2 1	Service element value specified by *invocation*
0 0 0 0 0 0 1	Information Delivery Capability
0 0 0 0 0 1 1	Information Delivery Capability - Attendant Handled

2.3.5.5.4 User Information Format for Non-Confirmed Delivery Capability

In this offering of the Feature Control Interface, the *user information* field of the User-user information element will be structured as follows:

— the first two octets of the block represent the called number in Binary Coded Decimal (BCD),

— the third octet of the user information block contains the number of calling numbers within the information block, and

— the remaining octets contain the calling party numbers in five octet BCD sets.

See Figure 12 as an example of the format of the User-user information element.

2.3.5.5.4.1 Non-Confirmed Delivery Test Calls

In this offering of the Feature Control Interface, the network may deliver a REGISTER message with the *user information* field of the User-user information element formatted as follows:

— the called number will be set to 2222,

— the number of calling numbers will be set to 16, and

— the calling numbers will be 999-999-1111 through 999-999-1126, consecutively.

This sequence will be sent to the user as a test sequence. The user must respond to the REGISTER message as if it is a valid message, and then ignore the calling numbers.
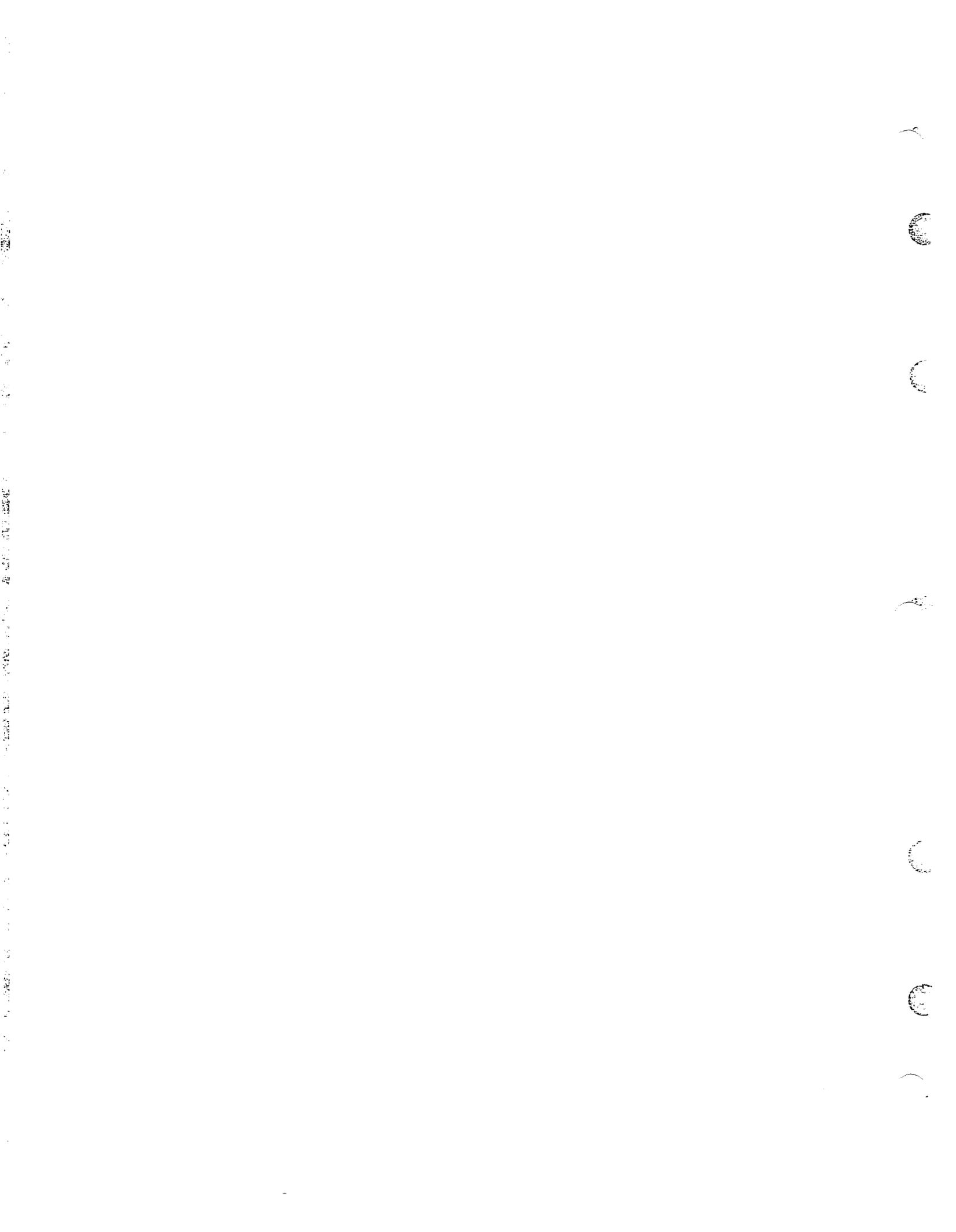
APPENDIX 2

AT&T NETWORK ISDN PRIMARY RATE INTERFACE

AND SPECIAL APPLICATIONS

SPECIFICATION

User Network Interface Description

Capability for an ISDN Tandem Interface

APPENDIX 2

AT&T NETWORK INTEGRATED SERVICES DIGITAL NETWORK (ISDN)
PRIMARY RATE INTERFACE

USER-NETWORK INTERFACE DESCRIPTION
CAPABILITY FOR ISDN TANDEM INTERFACE

CONTENTS

LIST OF FIGURES

1. Introduction

This document is an appendix to the AT&T Technical Reference 41459 and does not supersede that publication. This appendix serves to expand the scope of the Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Applications Specification to include the specification for the AT&T Service Node with the Capability for an ISDN Tandem Interface. Described in this document is a new interface between customer premise equipment (CPE) and an AT&T network switch. It is being provided to registered owners of the specification to provide information on AT&T's Service Node with the Capability for an ISDN Tandem Interface (CITI) for designers, manufacturers, consultants, and suppliers of systems and equipment that would meet the described interface.

The main purpose of this document is to publish information for tandem producers so that they may be able to interface to a Service Node with CITI (SNC) to provide Electronic Tandem Network (ETN) customers the ability to utilize "Call-by-Call Service (CBC) Selection" and "Tandem Routing Efficiency (TRE)" functionalities. These functionalities described in Sections 1.3.1 and 1.3.3, respectively, are possible through use of the ISDN D-channel.

Routing intelligence and translation capability remain at the customer premise Tandem (a tandem switch capable of Tandem Routing Efficiency), and are driven by ISDN D-channel messages. The CITI interface allows most tandem features to be provided without change.

1.1 Introduction to this Issue of Appendix 2 to TR 41459

TR 41449[1] contains the complete protocol specification for the ISDN Primary Rate Interface. TR 41459 is intended for use in conjunction with TR 41449 to detail the protocol options supported by AT&T for its customer-to-network configuration. This appendix to TR 41459 details the procedures for accessing features and services supported by the SNC (Service Node with CITI) interface arrangement.

This appendix supersedes Appendix 2 to the previous issue of TR 41459[2], dated April 1988 and TR 41459 Addenda[3] [4] dated October 1988 and January 1989, respectively. There are no technical changes since last issue of TR 41459 Addendum, dated January 1989, except for the codepoint for the AT&T standardized facilities information element (refer to TR 41449 for the new codepoint).

Differences between Parts I and II of this document and this appendix are highlighted in *bold italics*. The term "network" refers to the "AT&T network".

This introduction contains: a physical interface description, a description of the new capabilities available through this interface, a listing of existing capabilities available through the use of ISDN, and a high level description of the application specific, Layer 3 Protocol additions to Part II for this CITI. This document includes the Introduction Section, the Interface Specification for Layer 1, the Interface Specification for Layer 2, and the Interface Specification for Layer 3 for the SNC Interface with reference to TR 41449 and Parts I and II of this document.

1.2 Physical Interface

Figure Appendix 2-1 gives a view of an SNC Interface for an ETN Architecture. Not shown in the figure is a possible connection to a Local Exchange Carrier local office which may be available. A tandem is a CPE vehicle containing the customer's routing intelligence and which may originate and terminate calls. This appendix only refers to a Tandem interface. A Tandem (capital "T") is a tandem switch capable of Tandem Routing Efficiency (Section 1.3.3) through an out-of-band ISDN D-channel link for routing information exchange between the SNC and Tandem. By implementing Tandem Routing Efficiency one can avoid having to use B-channels between the SNC and the Tandem unnecessarily when serving routing requests for calls between other switches. This includes calls coming to the SNC when it is an intermediate node on a

private network connection between other network nodes and calls coming to the SNC from a "nodal main".

A main is a PBX switch which relies on a Tandem for routing. Any main directly connected to a Service Node is a nodal main. A "direct main" is a main directly connected to a Tandem and not directly connected to the SNC. This appendix only refers to nodal mains, because the SNC does not have information about remote connections to direct mains. ISDN nodal mains may have a Primary Rate Interface as specified in TR 41449. Additionally, mains may have an inband signaled DS 1 or a 4-wire connection as specified in TR 41458[5]. If a tandem not capable of Tandem Routing Efficiency is directly connected to the SNC, it is treated by the SNC as a nodal main. Any inband trunks of a Tandem would also be treated by the SNC as if belonging to a nodal main.

This appendix is an interface specification only for Tandems capable of Tandem Routing Efficiency. The access interface between the SNC and the Tandem must have at least one ISDN Primary Rate Interface for the exchange of routing information. For increased reliability, the use of D-channel backup is available. See TR 41449 for details.

User Side   Network Side
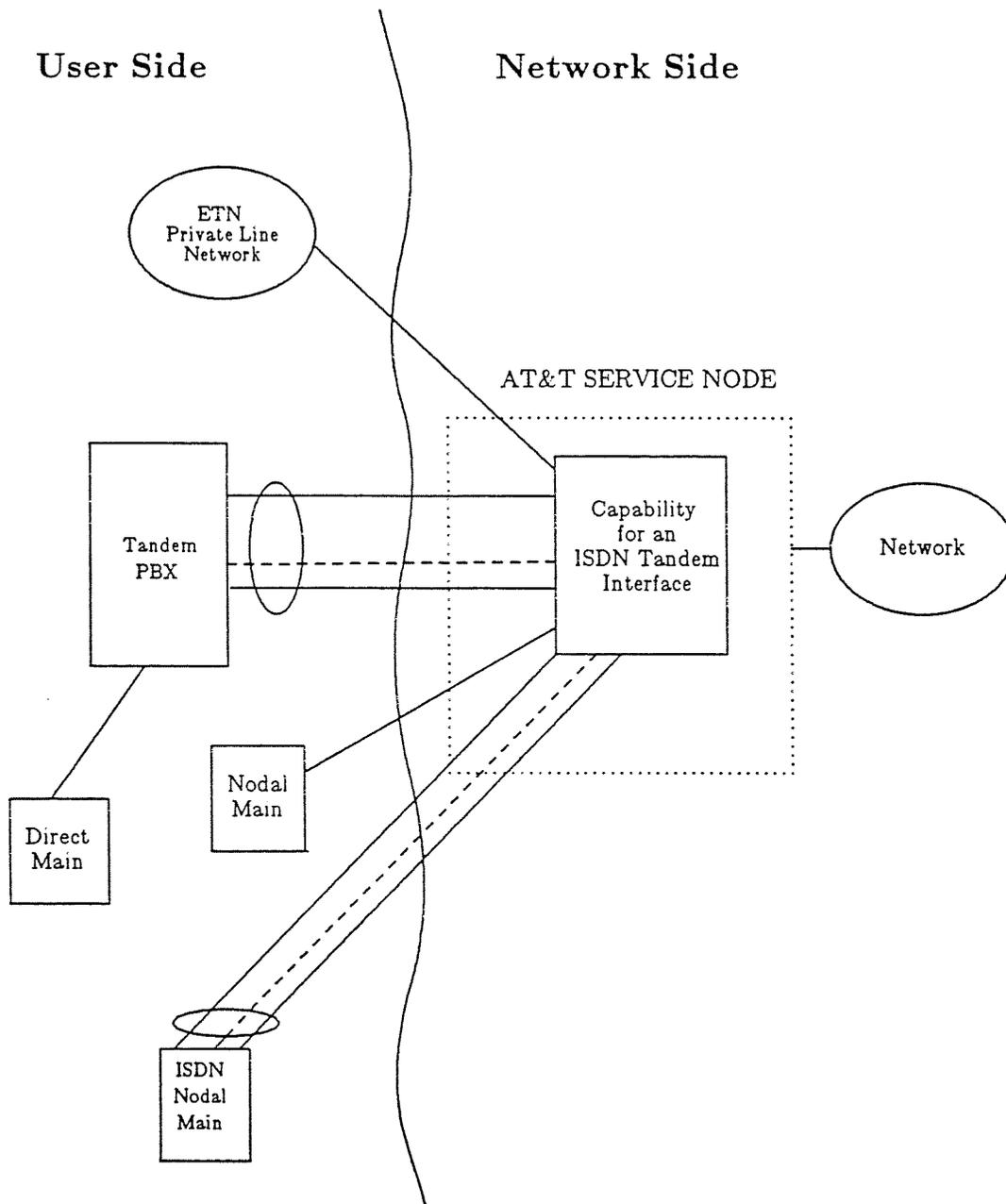
Figure Appendix 2-1. Service Node with CITI (SNC) with an ETN Architecture

1.3 New Capability Descriptions

The Capability for an ISDN Tandem Interface extends or adds to the ISDN capabilities described in Part I of this document. The functionalities provided by the SNC include the extended functionality of Call-by-Call service selection described in Part I to include access to Private Line services as well as to AT&T Switched services and the new functionality of Tandem Routing Efficiency (TRE). Other new capabilities available are Signaling Conversion,

Call Progress Monitoring, and Trunk Group Status Audits.

1.3.1 Call-By-Call Service Selection

The SNC has extended the Call-by-Call (CBC) capability described in Part I to include the CBC capability for private line customers. With an SNC connection to the network, CBC service selection provides dynamic integrated access to private line services and public switched services supported by the ISDN Primary Rate Interface.

This capability eliminates the need for B-channels to be dedicated exclusively to private or public calls. In the SETUP message carried on the D-channel, the user can designate to the SNC, on a call-by-call basis for a given B-channel, whether a public switched service or a private line service is desired.

Also, over the SNC to Tandem interface, signaling is done on a call-by-call basis for all the different types of facilities utilizing Tandem Routing Efficiency.

1.3.2 Signaling Conversion

During the period of transition to end-to-end ISDN, much CPE will remain non-ISDN. This necessitates the deployment of a network capability to interwork the signaling between ISDN CPE and non-ISDN CPE. This capability, referred to as "signaling conversion", interworks out-of-band ISDN and inband (Robbed Bit Signaling and inband tones) signaling. The signaling conversion capability allows customers to use ISDN signaling for calls which are destined for non-ISDN private or public switched end points.

1.3.3 Tandem Routing Efficiency

Tandem Routing Efficiency (TRE) is the primary functionality of the SNC. It provides customers the capability to switch calls to or from a nodal main of their private network without having to physically route the call through a Tandem unnecessarily. Only "routing information", that information needed to setup a call, must pass over the SNC to Tandem interface via the ISDN D-channel. Any query to the customer's Tandem switch for routing information is done on a call-by-call basis for those calls controlled by that Tandem. The routing information is sent by the Tandem to the SNC, and the call itself is not connected to the Tandem, thus freeing B-channels.

A fundamental call procedure with reference to the REGISTER and FACILITY messages is described next. See Section 1.5.1 of this appendix and Part II of this document, respectively, for high-level descriptions of these messages. SNC implementation specifics are included in Sections 4.2.10 and 4.2.6, respectively.

For an incoming call to the SNC not from a Tandem's ISDN facilities, the SNC queries the Tandem for routing information by sending the REGISTER message which includes: identification of the incoming trunk being used at the SNC for the call, the called party address digits and the present bearer service of the call. Additional information such as the traveling class marks of the call, Message Associated UUI or CPN/BN[1] information, if present, will also be forwarded to the Tandem. If the routing information request is sufficient to determine routing,

the Tandem may return a FACILITY message with the appropriate routing instructions. If the Tandem needs more information to route the call, it may send the SNC a FACILITY message indicating that the caller needs to enter more information. The SNC will complete the connection as indicated in Section 4.5.3.2.

For a Tandem-originated call, procedures may differ; see Section 4.5.3.1.

1.3.4 Call Progress Monitoring

The SNC can pass to the Tandem, at the Tandem's option, information that can be used to provide Call Detail Recording for all calls handled by the Tandem. This includes those calls switched through the Tandem and those which are not. This allows the customer's private ETN network to operate in a similar manner as before the introduction of an SNC in terms of the call detail records produced as the call progresses. A Tandem may request that call progress monitoring take place by coding an AT&T standardized facilities information element (Section 4.4.18.1) with a monitor request in response to a routing query. The Tandem will be sent notification of Message Associated UUI being passed by the SNC after the circuit call has been set up and will not be sent the actual Message Associated UUI.

The Call state information element described in Part II may be used to notify the Tandem of the call progress events: alerting, answer supervision, and disconnect supervision. See Section 4.5.4 for details.

1.3.5 Trunk Group Status Audits

The SNC will accept queries from the Tandem regarding the status of a given trunk group. Requests are made via the Trunk group/trunk identification information element and the Trunk group/trunk status information element. See Sections 1.5.8 and 1.5.9, respectively, for a description of these information elements. Also see Section 4.5.6 on Trunk Group Status Audit Procedures.

The Tandem may request that the SNC send back to the Tandem a count of the number of trunks in a given trunk group that have a given status. The status values supported are: In use, Idle, Maintenance busy, Transitional and Other unavailable. The Tandem may request one or more of the possible counts.

Queries for the status of an individual trunk are not supported by the SNC. A change in the status of an individual trunk within a trunk group may cause an unsolicited audit report to be generated from the SNC to the Tandem in cases where the Tandem cannot otherwise know that the status has changed. For example, an unsolicited audit report from the SNC may occur when craft at the SNC busies out a trunk, or if a facility failure occurs at the SNC. This unsolicited audit report will allow the Tandem to update its status of available trunks and trunk groups.

1.4 Existing Capabilities Descriptions

The following is a listing of existing capabilities detailed in Part I of this document and how they pertain to the SNC.

---

1. Calling Party Number (CPN) was previously known as Station Identification (SID). Billing Number (BN) was previously known as Automatic Number Identification (ANI).

1.4.1 CPN/BN Delivery

The Calling Party Number or the Billing Number will be forwarded as is described in Part I and Part II.

1.4.2 Non-Facility Associated Signaling

Non-facility associated signaling is supported as described in Part I.

1.4.3 B-Channel Negotiation

B-Channel negotiation is supported as described in Part I and Part II.

1.4.4 D-Channel Backup

D-channel backup is supported as described in TR 41449.

1.4.5 User-to-User Information (Message Associated)

Message Associated User-to-User Information is supported as described in Part I and Part II with the following exceptions:

— The SNC does not support *Calling party subaddress IE* and *High layer compatibility IE* as user data information elements, and

— The SNC restriction on the length of MA UUI is *128* octets.

1.4.6 Capabilities of Part I of this Document Not Supported

Although present in Part I, the SNC will *not* support *Temporary Signaling Connections* or access to *Wideband Switched Services (384 Kbps and 1.536 Mbps).*

1.5 Description of Layer 3 Protocol Additions to Part II

Additions to the protocol of Part II are needed to communicate information for Tandem Routing Efficiency. These are described here at a high level. Section 4 of this appendix contains the detailed SNC to Tandem Interface Specification for all of Layer 3, consisting of message functional definitions, message structure with the information element definitions, and call control procedures.

The SNC supports the additional message, REGISTER, and the information elements: AT&T standardized facilities (ASF), Call identity, Signal, Subnetwork trunking, Traveling class mark, Trunk group/trunk identification, Trunk group/trunk status, and User-entered code. These optional information elements are described here at a high level and may be included in the messages SETUP, REGISTER, FACILITY, DISCONNECT and RELEASE COMPLETE. See Section 4 of this appendix.

1.5.1 Register

This message is sent to initiate registration to a networked service (to invoke Tandem Routing Efficiency, for example) provided by the SNC. This message is used to assign a Call reference value for the duration of the networked service interaction and to convey the identity of the services being requested. See Section 4.2.10 for details.

1.5.2 AT&T Standardized Facilities

The purpose of the AT&T standardized facilities (ASF) information element in codeset 6 is to request or respond to requests for AT&T standardized services. Up to four ASF information

elements may be included in a message when multiple services are to be indicated. Other information elements can be embedded in this information element as Parameters. See Section 4.4.18.1 for details.

1.5.3 Call Identity

If a Tandem wishes to be able to associate a routing query/response exchange with a successive incoming SETUP message for routing the call from the SNC to the Tandem itself, the Call identity information element is a mechanism available. The Tandem may include with its routing instructions in the FACILITY message not only all the information required to route the call, but also a Call identity information element (Section 4.4.3) to be included in the SETUP message by the SNC.

The Tandem is responsible for assigning a Call identity information element which is unique across all interfaces between itself and the SNC. The SNC will not screen or verify this information. The SNC will include the Call identity information element in SETUP messages to Tandems. If the Call identity information element is included in the routing instructions by the Tandem for a call to any other location other than the Tandem, the Call identity information element will be dropped. No indication will be sent to the Tandem. The Call identity information element may be passed in an AT&T standardized facilities information element via a FACILITY message. This information element may only be passed between the Tandem and the SNC.

1.5.4 Causes and Diagnostics

The SNC supports all of the causes listed in Part II of this document except the following: *cause 6 and 44. The tone treatment mapping for the cause values differs from TR 41459.* See Part II, Section 3.4.5.12 for details.

1.5.5 Signal

The purpose of the Signal information element is to convey information regarding tones and alerting signals. For instance, it can specify the prompt used for digit collection of user-entered codes. Only one length and signal value is supported by the SNC implementation at this time. See Section 4.4.16 for details.

1.5.6 Subnetwork Trunking Indication

This information element is a codeset 6 IE used to allow the Tandem to provide information on how to send the digits when the SNC is completing a circuit call over non-ISDN facilities in a subnetwork configuration.

Note: The Tandem must only sent the Subnetwork Trunk IE when the outgoing facility is non-ISDN. Otherwise it will be discarded by the SNC.

This instructs the SNC to pause between outpulsing successive sets of digits. See Section 4.4.18.3 for details.

1.5.7 Traveling Class Mark

The purpose of the Traveling class mark (TCM) information element is to identify the user's calling privileges (i.e., Facility restriction level, Satellite hop count).

The traveling class mark information may be sent to the SNC in the codeset 6 TCM IE of the protocol or as 0, 1, or 2 inband digits from a non-ISDN facility. First, in the case of an ISDN Nodal Main originating the call, such information may come to the SNC via the codeset 6 TCM

IE which is then passed along to the Tandem to validate routing privileges. Second, if a non-ISDN Nodal Main originates the call and sends such information to the SNC via 0, 1, or 2 inband digits, the SNC converts it from inband digits to the codeset 6 TCM IE and passes it to the Tandem in the routing query. In these cases and the case of a Tandem-originated call, the Tandem may return the codeset 6 TCM IE to the SNC with the routing instructions (to be relayed to the terminating end).

See Section 4.4.18.4 for further details.

1.5.8 Trunk Group/Trunk Identification

The Trunk group/trunk identification information element is used to identify the physical trunk group and trunk on which a call is present at the SNC or to identify a trunk group the SNC should use to route a call. This information element may also be used to identify a trunk group being audited. See section 4.4.18.5 for coding details.

1.5.9 Trunk Group/Trunk Status

The Trunk group/trunk status information element is used to convey information about the busy/idle status of trunks at the SNC. This information element corresponds to the trunk group given in the Trunk group/trunk identification information element. See section 4.4.18.6 for coding details.

1.5.10 User-Entered Code

The User-entered code information element in conjunction with the Signal information element provides the ability for the Tandem to tell the SNC to collect digits. The Tandem may request that the SNC collect User-entered code information via an AT&T standardized facilities IE in a FACILITY message. The SNC will cut through to the trunk; prompt the user with a recall dial tone for the number of digits requested by the Tandem (1-31 digits), using the timeout interval specified by the Tandem (e.g., 10 seconds); and collect the digits. The SNC will return the collected digits to the Tandem in the User-entered code IE. See section 4.4.18.7 for details.

2. Interface Specification for Layer 1

The physical layer specification of the SNC to Tandem DS 1 interface is as described in Section II of TR 41449.

3. Interface Specification for Layer 2

The Layer 2 specification of the SNC to Tandem interface is as described in Section III of TR 41449.

4. Interface Specification for Layer 3

4.1 General

This part of the interface description defines the Layer 3 protocol options and service-related procedures which will be supported by the Service Node with CITI in its implementation of the ISDN Primary Rate Interface. The following sections discuss the messages, information elements, and call control procedures supported by this interface. These sections will focus on the interactions between the SNC and the Tandem required for 1) call processing (by the SNC) of calls originated by the Tandem, and 2) information regarding call routing to be exchanged between the SNC and the Tandem.[2]

The differences between Parts I and II of this document and this appendix are highlighted in bold italics. Note that in the Tandem interface, the Tandem is the user side of the interface, and the SNC is the network side of the interface.

Call control configurations and terminology are as in TR 41449. Individual calls on an interface may have any of the call states as defined in Part II.

4.2 Message Functional Definitions for the SNC-Tandem Interface

The Call Information Phase Message, USER INFORMATION, of Part II is not supported. All messages for Call Establishment, Call Disestablishment, and Miscellaneous Messages of Part II may be used on the Tandem interface *except CONGESTION CONTROL.* These are:

Call Establishment:

ALERTING	4.2.1
CALL PROCEEDING	4.2.2
CONNECT	4.2.3
CONNECT ACKNOWLEDGE	4.2.4
PROGRESS	4.2.9
SETUP	4.2.15

Call Clearing:

DISCONNECT	4.2.5
RELEASE	4.2.11
RELEASE COMPLETE	4.2.12
RESTART	4.2.13
RESTART ACKNOWLEDGE	4.2.14

Miscellaneous Messages:

FACILITY	4.2.6
FACILITY ACKNOWLEDGE	4.2.7
FACILITY REJECT	4.2.8
REGISTER	4.2.10
STATUS	4.2.16
STATUS ENQUIRY	4.2.17

---

2. SNC-ISDN nodal main protocol interactions are fully covered in TR 41449. Where more detail on those interfaces is needed because of the SNC application, the following sections will cover those points.

Additionally, the SERVICE and SERVICE ACKNOWLEDGE messages are supported for maintenance purposes. These messages and associated maintenance procedures are described in TR 41449.

4.2.1 Alerting

This message is implemented as described in Section 3.3.1.1 of Part II, *with the following exceptions:*

Information element	Length
Channel identification	*4-6*
User-user	*3-128*
Local network specific (codeset 6)	*1-127*
User-specific (codeset 7)	*1-127*

4.2.2 Call Proceeding

This message is implemented as described in Section 3.3.1.2 of Part II, *except that the length of the Channel Identification Information Element is 4-6.*

4.2.3 Connect

This message is implemented as described in Section 3.3.1.4 of Part II, *with the following exceptions:*

Information element	Length
Channel identification	*4-6*
User-user	*3-128*
Local network specific (codeset 6)	*1-127*
User-specific (codeset 7)	*1-127*

4.2.4 Connect Acknowledge

This message is implemented as described in Section 3.3.1.5 of Part II.

4.2.5 Disconnect

This message is implemented as described in Section 3.3.1.6 of Part II, *with the following exceptions:*

Information element	Length
User-user	*3-128*
AT&T standardized facilities	*9-44*
Local network specific (codeset 6)	*1-127*
User-specific (codeset 7)	*1-127*

Note: The SNC supports the use of the optional AT&T standardized facilities IE.

4.2.6 Facility

For the SNC implementation, *additional optional information elements* have been added to the end of the FACILITY message layout specified in Section 3.3.5.2 of Part II. *These are: the Locking shift to codeset 6 IE (length 1) and the AT&T standardized facilities IE (length 5-214). The Network-specific facilities IE is optional for this implementation. See TR 41449 if needed.*

This message may be used in either of two ways:

- By including the Network-specific facilities (NSF) information element (in codeset 0) the FACILITY message may be sent by the user to the network to request a facility.

- *By including the AT&T standardized facilities information element (in codeset 6) this message may be used to invoke a service or respond to an invocation of a service. Up to 4 AT&T standardized facilities information elements may be included in this message and need no set ordering. The length of the ASF IE supported in this message is 5-214.*

Note that the length of the Channel Identification Information Element supported in this message is 4-6.

4.2.7 Facility Acknowledge

This message is implemented as described in Section 3.3.5.3 of Part II, *except that the length of the Calling Party Number Information Element is 3-14.* Note that this message is not used in conjunction with a FACILITY message for an SNC application.

4.2.8 Facility Reject

This message is implemented as described in Section 3.3.5.4 of Part II. Note that this message is not used in conjunction with a FACILITY message for an SNC application.

4.2.9 Progress

This message is implemented as described in Section 3.3.1.10 of Part II, *except that the length of the Channel Identification Information Element is 4-6.*

4.2.10 Register

This message is an addition to Part II and is implemented as described in TR 41449. The supported length of the AT&T standardized facilities information

element is 10-187.

Note: Up to 4 AT&T standardized facilities information elements may be included in this message and need no set ordering.

4.2.11 Release

This message is implemented as described in Section 3.3.1.11 of Part II, but the SNC will *not* support any of the information elements following the Cause information element in the message layout: *User-to-user, Locking shift to codeset 6, Network-specific in codeset 6, Locking shift to codeset 7, and User-specific in codeset 7.*

4.2.12 Release Complete

This message is implemented as described in Section 3.3.1.12 of Part II, but the SNC will *not* support the following information elements: *User-to-user, Network-specific in codeset 6 other than the AT&T standardized facilities information IE, Locking Shift to codeset 7, and User-specific in codeset 7. Note: The SNC supports the use of the optional AT&T standardized facilities IE with length 9-44.*

4.2.13 Restart

This message is implemented as described in Section 3.3.4.1 of Part II.

4.2.14 Restart Acknowledge

This message is implemented as described in Section 3.3.4.2 of Part II.

4.2.15 Setup

Information element	Length	Type
Protocol discriminator	1	M
Call reference	2-3	M
Message type	1	M
Bearer capability	4-8	M
Call identity (Note 1)	*3-10*	*O*
Channel identification	*4-6*	M
Network-specific facilities	*4-11*	O
Calling party number	3-17	O
Called party number	*3-18 (Note 2)*	M
Called party subaddress	3-64	O
Redirecting number	3-17	O
Low layer compatibility	4-6	O
User-user information	3-128	O
Locking shift to codeset 6	1	O
AT&T Standardized Facilities	*9-20 (Note 3)*	*O*
Network-specific in codeset 6 (other) (*Note 3*)	1-127	O
Locking shift to codeset 7	1	O
User-specific in codeset 7	1-127	O

Note 1: The Call identity information element may be passed between the Tandem and the SNC only. It may not be passed over other ISDN interfaces on the SNC.

Note 2: For subnetwork trunking applications only, the length of the Called party number information element may be extended to 34 octets.

Note 3: For the SNC application, the AT&T standardized facilities information element may be present. For clarity, the ASF information element is explicitly shown, while other Network-specific in codeset 6 IEs follow. When the ASF information element appears in this message, it must appear in accordance with the coding rules in Section IV-4.5 of TR 41449. Up to 4 AT&T standardized facilities information elements may be included in this message and need no set ordering.

4.2.16 Status

This message is implemented as described in Section 3.3.1.18 of Part II. *This message is also supported for REGISTER-established Call reference values.*

4.2.17 Status Enquiry

This message is implemented as described in Section 3.3.1.19 of Part II. *This message is also supported for REGISTER-established Call reference values.*

4.3 Message Structure

4.3.1 General

Unless otherwise stated, this implementation is as described in Part II.

4.3.2 Other Information Elements Supported

The information elements listed below will be supported. The following sections outline which specific codings for those information elements will be recognized by the SNC. This section assumes that information elements are formulated and presented in accordance with the coding rules identified in TR 41449. The single octet information elements, *Congestion level IE* and *More data IE,* in Part II will not be supported by the SNC. The variable length information elements in codeset 0, *Calling party subaddress IE* and *High layer compatibility IE* in Part II will not be supported by the SNC. Procedures for handling information elements and information element codings which are not recognized are described in Part II. Codeset 6 and codeset 7 information elements not listed here will be sent through the network as Message Associated UUI as described in Part II of this document.

Single Octet Information Elements	Reference
Locking shift to codeset 6 or 7	4.4.1

Variable Length Information Elements in Codeset 0	Reference
Bearer capability	4.4.2
Call identity	4.4.3
Call state	4.4.4
Called party number	4.4.5
Called party subaddress	4.4.6
Calling party number	4.4.7
Cause	4.4.8
Channel identification	4.4.9
Connected number	4.4.10
Low layer compatibility	4.4.11
Network-specific facilities	4.4.12
Progress indicator	4.4.13
Redirecting number	4.4.14
Restart indicator	4.4.15
Signal	4.4.16
User-user	4.4.17

Variable Length Information Elements in Codeset 6	Reference
AT&T standardized facilities	4.4.18.1
Network-specific in codeset 6 (other)	4.4.18.2
Subnetwork trunking	4.4.18.3
Traveling class mark	4.4.18.4
Trunk group/trunk identification	4.4.18.5
Trunk group/trunk status	4.4.18.6
User-entered code	4.4.18.7

Variable Length Information Element in Codeset 7	Reference
User-specific in codeset 7	4.4.19

4.4 Information Elements

This section describes the allowed values for fields within the information elements supported by the SNC. *Additional notes* regarding the use of these information elements which pertain

specifically to the Service Node with CITI application are also provided.

4.4.1 Locking Shifts to Codesets

The SNC will support the use of the Locking shift information element to indicate a locking shift to codeset 6 and/or codeset 7 as described in TR 41449.

4.4.2 Bearer Capability

This information element is implemented as described in' Part II, *but only 56 Kbps, 64 Kbps, and 3.1 KHz Audio bearer capabilities are supported by the SNC. Wideband and TSC's are not supported. Specifically, of Part II only the values for the Octet 4 and 5 fields listed below will be supported.*

Octet 4| Transfer Mode Field: circuit mode
     Information Transfer Rate: 64 Kbps

Octet 5| Layer Identification: Layer 1
     Protocol Identification: Rate adaption

4.4.3 Call Identity

The SNC implements the Call identity information element as coded below. The Call identity information element may be used by the Tandem for the purpose of correlating an incoming SETUP message with a previous routing transaction.

This information element is coded as follows:

8	7	6	5	4	3	2	1	
Call identity								Octet 1
0	0	0	1	0	0	0	0	
Information Element Identifier								
Length of Call Identity Contents								Octet 2
Call Identity								Octet 3
(optional)								Octet 4
								....
								Octet 10

This information element is treated transparently by the network.

This information element may be up to 10 octets long.

4.4.4 Call State

This information element is implemented as described in Part II.

4.4.5 Called Party Number

This information element is implemented as described in Part II *except that the maximum number of address digits supported is 15.*

For subnetwork trunking applications, the length of this information element may be extended to allow up to 31 address digits. The digits in the Called party number information element can be divided into four groups. The first three groups allow 0-15 digits to be specified. The fourth group defaults to meaning "the rest of the digits". See Section 4.4.18.3 on the Subnetwork trunking information element.

4.4.6 Called Party Subaddress

This information element is implemented as described in Part II.

4.4.7 Calling Party Number

This information element is implemented as described in Part II *except that the maximum number of address digits supported is 13.*

4.4.8 Cause

This information element is implemented as described in Part II *except that cause value 6 and 44 are not supported.*

The tone treatment for causes is as follows:

Switch Tone treatment	Cause number(s)
busy tone	17
reorder tone (fast busy)	18, 34, 42, 58, 82 and 102
intercept tone (siren)	01, 02, 22, 28, 29, 50, 52, 54, 65, 66, 69, 81, 88, 96, 97, 98 and 100

Note: The default tone for causes other than those given above is a reorder tone.

4.4.9 Channel Identification

This information element is implemented as described in Part II.

4.4.10 Connected Number

This information element is implemented as described in Part II.

4.4.11 Low Layer Compatibility

This information element is implemented as described in Part II *except that the length supported is 4-6.*

4.4.12 Network-Specific Facilities

This information element is implemented as described in Part II, *with the addition of Octet 7, Parameterized Field.* The SNC will support the Facility values listed there *with the addition of the Private Line and the WATS maximal subscribed band codings and additionally, the Parameterized value for OUTWATS band.*

OCTET	FIELD	VALUE(S) RECOGNIZED
7	Parameterized Field	OUTWATS Band

Note: CITI will support the WATS codepoints for outgoing-only calls to a Local Exchange local office.

Binary Facility Coding Value (Octet 6, Bits 5 through 1)

```
  Bits
5 4 3 2 1        Service (Bit 6=1)          Comment
0 0 1 0 1    WATS maximal subscribed band    access only
0 1 1 0 0    Private Line                    access or egress
```

Parameterized Facility Coding Value (Octet 6, Bits 5 through 1)

```
      Bits
5   4   3   2   1      Service (Bit 6=1)
0   0   0   0   1      OUTWATS Band
```

Parameterized Field (Octet 7, bits 7 through 1)

IA5 characters are used for coding.

4.4.13 Progress Indicator

This information element is implemented as described in Part II.

4.4.14 Redirecting Number

This information element is implemented as described in Part II.

4.4.15 Restart Indicator

This information element is implemented as described in Part II.

4.4.16 Signal

The SNC implements the Signal information element as coded below.

The purpose of the Signal information element is to convey information regarding tones and alerting signals. The Signal information element is coded as shown below. Only one length and signal value is supported by the initial SNC implementation. Other values could be supported in the future.

8	7	6	5	4	3	2	1	
Signal								Octet 1
0	0	1	1	0	1	0	0	
Information Element Identifier								
Length of Signal Information Element								Octet 2
0	0	0	0	0	0	0	1	
Signal Value								Octet 3

The signal value supported is the value for recall dial tone:

```
    Bits
8 7 6 5 4 3 2 1
0 0 0 0 1 0 1 0    Recall Dial Tone
```

4.4.17 User-user

This information element is coded and transported as described in Part II. The SNC restriction on the length of this information element is 128 octets.

4.4.18 Codeset 6 Information Elements

4.4.18.1 AT&T Standardized Facilities

The SNC implements this information element as coded in TR 41449 with the exception of the Abort control type.

The AT&T standardized facilities (ASF) information element may be repeated up to four times in a message when multiple services are to be indicated. Details on the application of this information element to provide the majority of the Tandem/SNC interactions are contained in Sections 4.5.1 and 4.5.3.2.

The SNC implements this information element as follows.

OCTET	FIELD	VALUE(S) RECOGNIZED
3	Extension	last octet of the description
	Process identifier	valid value between 0-127
4	Extension	last octet of the description
	Control Type	Invoke
		Return result
		Return error
		Reject
		Invoke not last
		Invoke last
4.1	Extension	last octet of the description
	Correlated process identifier	valid value between 0-127
5	Extension	last octet of the description
	Service Element	Request notification
		Request value
		Set value
		Cancel notification
		Event report
		Routing
		Incoming call notification
		Error code
		Problem code
6,etc.	Parameter Description List for Service element	any coded IE *except an ASF IE identifier*

Note: For the SNC application, an ASF information element may not be embedded in the Parameter list of another ASF information element. Depending on the application, Parameters associated with a service are coded as any mentioned information element in this appendix. If an information element not supported by the SNC is received in this ASF Parameter field, the SNC will pass it on to the destination in the SETUP message. In regards to information element ordering, if an information element of lower information element identifier value appears after an information element of higher information element identifier value, that information element (the one of lower value) may be treated as unrecognized optional information and discarded.

Process Identifier (Octet 3, Bits 7 through 1)

Allowed Process identifier values are in the range of 0-127.

Control Type (Octet 4)

Octet 4 may be coded as one of six possible Control types:
Invoke, Return result, Return error, Reject, Invoke not last, and Invoke last.

Correlated Process Identifier (Octet 4.1, Bits 7 through 1)

Allowed values for the Correlated process identifier are in the range of 0-127.

Service Element (Octet 5)

The field has different restrictions associated with each of the Control types of octet 4. Allowed values for the Service element with the following Control Types are those corresponding to:

Control Type = Invoke, Invoke not Last, Invoke last, Return result

```
    Bits
7 6 5 4 3 2 1
```
0 0 0 1 0 1 0	Request notification
0 0 0 1 1 0 0	Request value
0 0 0 1 1 0 1	Set value
0 0 1 0 1 0 0	Cancel notification
0 0 1 0 1 0 1	Event report
0 1 1 0 0 0 0	Routing
0 1 1 0 0 1 0	Incoming call notification

Control Type = Return Error

```
    Bits
7 6 5 4 3 2 1
```
0 0 0 0 0 0 1	Error code

Control Type = Reject

```
    Bits
7 6 5 4 3 2 1
```
0 0 0 0 0 0 1	Problem code

4.4.18.2 Network-Specific in Codeset 6 (Other)

Other codeset 6 information elements not described in this appendix are treated as MA UUI by this implementation and are supported as described in Part II.

4.4.18.3 Subnetwork Trunking

The SNC implements this information element as coded below. This information element is used to convey instructions to the SNC regarding proper outpulsing of digits in subnetwork trunking configurations. The digits which will be outpulsed appear in the Called party number information element. This information element allows for the outpulsing of a maximum of 31 digits which can be split into 4 groups. The number of digits in the first three groups may range from 0-15. The last group is allocated for the rest of the digits.

8	7	6	5	4	3	2	1	
Subnetwork trunking								
0	0	0	0	1	1	0	0	Octet 1
Information Element Identifier								
Length of Information Element Contents								Octet 2
1	Spare			Pause Length				Octet 3
1	# Digits			Sig. Type				Octet 4
1	Spare			Pause Length				Octet 5
1	# Digits			Sig. Type				Octet 6
1	Spare			Pause Length				Octet 7
1	# Digits			Sig. Type				Octet 8
1	Spare			Pause Length				Octet 9
1	Spare			Sig. Type				Octet 10

Pause Length (Octets 3, 5, 7, 9)

Allowed values are from 0-15 seconds, except
Octet 3 precludes the 0 value.
If the set value is odd, the actual pause length will be rounded up to be even.

 # Digits (Octets 4, 6, 8)

Allowed values are from 0-15 digits.

Signaling Type (Octets 4, 6, 8, 10)

Bits

3 2 1

---

0 0 0   dial pulse

0 0 1   DTMF

Note: After interdigit timeout or answer supervision, any digits not yet sent may be sent out as DTMF (Dual Tone Multi-Frequency) regardless of the received coding in this Signaling type field.

Note: The Tandem must only sent the Subnetwork Trunk IE when the outgoing facility is non-ISDN. Otherwise it will be discarded by the SNC.

4.4.18.4 Traveling Class Mark

The Traveling class mark information element in codeset 6 is coded as in TR 41449.

4.4.18.5 Trunk Group/Trunk Identification

The SNC implements this information element as coded below. The Trunk group/trunk identification information element is used to identify the physical trunk group and trunk on which a call is present at the SNC or to identify a trunk group the SNC should use to route a call. This information element may also be used to identify a trunk group being

audited. Refer to Sections 1.3.5 and 4.5.6 on trunk group status audits.

8	7	6	5	4	3	2	1	
	Trunk group/trunk identification							Octet 1
0	0	0	0	1	0	1	0	
	Information Element Identifier							
Length of Trunk Identification								Octet 2
1	Direction			0	0		0	Octet 3
					Spare			
0/1 Ext.	Trunk Group							Octet 4
	Number							4a
0/1 Ext.	Trunk							Octet 5
	Number							5a

Octet 5 may be omitted when a trunk group is being identified. Octets 4a and 5a may be omitted if the trunk group or trunk may be identified in 7 bits.

Direction (Octet 3, Bits 7 through 4)

Bits
7 6 5 4

0 0 0 0   No Direction (AUDIT CASE)
0 0 0 1   Call Incoming to the SNC
0 0 1 0   Call Outgoing from the SNC

Extension bit (Octet 4,4a, 5,5a, bit 8):

0:   description is extended through next octet
1:   last octet of the description

With a number greater than 127 the extension bits are set with Bit 7 of Octet 4 or 5 being the highest order bit of the extended octet. Bits 4 through 1 of Octets 4a and 5a are spare.

Trunk Group Number (Octet 4, Bits 7 through 1; Octet 4a, Bits 7 through 5)

For the binary coding of trunk group number in Octet 4 and 4a, Bit 7 is the high order bit.

Trunk Number (Octet 5, Bits 7 through 1; Octet 5a, Bits 7 through 5)

For the binary coding of trunk number in Octet 5 and 5a, Bit 7 is the high order bit.

4.4.18.6 Trunk Group/Trunk Status

The SNC implements this information element as coded below. This Trunk group/trunk status information element is used to convey information about the busy/idle status of trunks at the SNC. Refer to Sections 1.3.5 and 4.5.6 on trunk group status audits.

8	7	6	5	4	3	2	1	
			Trunk group/trunk status					
0	0	0	0	1	0	1	1	Octet 1
			Information Element Identifier					
			Length of IE Contents					Octet 2
1	In Use	Idle	Maint. Busy	Other Unavail.	Trans.	0	0 Spare	Octet 3
0/1 Ext.	Count of Highest Bit in Octet 3 with Status Requested							Octet 4 4a
0/1 Ext.	Count of Second Highest Bit in Octet 3 with Status Requested							Octet 5 5a
0/1 Ext.	Count of Third Highest Bit in Octet 3 with Status Requested							Octet 6 6a
0/1 Ext.	Count of Fourth Highest Bit in Octet 3 with Status Requested							Octet 7 7a
0/1 Ext.	Count of Fifth Highest Bit in Octet 3 with Status Requested							Octet 8 8a

*Ext*ension Bit (Octets 4,4a, 5,5a, 6,6a, 7,7a, 8,8a):

0:   description is extended through next octet
1:   last octet of the description

Status Bits (Octet 3)

Allowed status values are: **In use, Idle, Maintenance busy, Other unavailable, and Transitional.** If the status field bit is set to "1", this means that the indicated status for that bit is being reported or requested.

— Idle: Trunk is not being used and is available for use.

— In use: Trunk is being used for a trunk-trunk call, or it is being used for the collection of user-entered code information.

— Maintenance busy: Trunk is not available for use; it is being used for maintenance activities.

— Other unavailable: Trunk is not available for use. The reason for this unavailability is other than one of these statuses defined.

— Transitional: The trunk is in the process of transitioning from the idle state to any other state; or vice versa, it is in the process of transitioning from any other state (e.g., In use) to the idle state.

Counts (Octets 4 through 8)

Octets containing counts are correlated with the status requested in the following way: Octet 4 conveys the status represented by the highest bit set in octet 3. Typically, that would be the In use count, but it could be the Idle count if bit 7 of Octet 3 was set to 0 and bit 6 was set to 1.

Subsequent count octets convey the count for the next highest order status bits set. Note that any, some or all of octets 4 through 8 may be extended to accommodate counts greater than 127 as in the extension of the Trunk group/trunk identification IE.

Octets 4 through 8 would not be present in an audit request. Minimally, Octet 4 would be present in an audit response or an unsolicited audit report. Octets 5, 5a, 6, 6a, 7, 7a and 8, 8a

would optionally be present depending on the statuses which were requested and the trunk group size.

In an unsolicited audit report, all counts are present.

4.4.18.7 User-Entered Code

The SNC implements this information element as coded below. The User-entered code information element is used for requesting that a user-entered code be collected. It is also used for conveying user-entered information from the SNC to the Tandem.

8	7	6	5	4	3	2	1	
			User-entered code					Octet 1
0	0	0	0	0	0	1	0	
			Information Element Identifier					
		Length of User-Entered Code Information Element						Octet 2
			Type of User Code					Octet 3
1	0	0	0	0	0	0	0	
1	Collect/ Collected Indication		Timeout Interval					Octet 4
			User-Entered					Octet 5
			Code					...
			Digits					Octet n

Type of User Code (Octet 3, bits 7 through 1)

Only the value "0 0 0 0 0 0 0" is supported by the SNC at this time.

Collect/Collected Indication (Octet 4)

Bits
7 6
0 0   # of Digits TO BE COLLECTED indicated in following octets
1 0   COLLECTED USER-ENTERED DIGITS contained in following octets

The SNC will only support a timeout value of 10 seconds.

User-Entered Code Digits (Octet 5 and following Octets)

The number of digits to Collect/Collected are to be encoded in IA5.

The maximum number of digits to collect/collected is 31. The SNC will support a range of 1-31 digits. The actual range a customer may use will be determined at the provisioning time.

4.4.19 Codeset 7 Information Elements

User-specific in codeset 7 information elements are implemented as described in Part II.

4.5 Call Control Procedures

This section describes the procedures that define the flow of messages across an interface between a Service Node with CITI and a Tandem. The focus of this section is the SNC to Tandem interface.

In terms of the traditional user-network terminology, a Tandem is the user side of the interface and the SNC is the network side of the interface. See Figure Appendix 2-1.

These procedures assume that a reliable point-to-point data link connection has been established between both sides of the interface.

The discussion of Call Control Procedures which follows can be separated into four primary components:

— Discussion of the AT&T standardized facilities information element

— Routing and Monitoring Procedures

— Trunk Group Status Audit Procedures

— D-Channel Backup Procedures for Non-Facility Associated Signaling

4.5.1 Discussion of AT&T Standardized Facilities Information Element

The ASF information element is the primary mechanism used to exchange information between the SNC and a Tandem. The components of an ASF IE are: a Process identifier, a Control type, a Correlated process identifier, and a Service element with associated Parameters. The presence of these components in a particular ASF IE depends upon the Control type. For the purpose of this discussion, a "transaction" is defined as the establishment of a chain of PIDs created in a service interaction (or ASF IE exchange).

4.5.1.1 Process Identifiers / Correlated Process Identifiers

4.5.1.1.1 Definition and Establishment

Process identifiers (PID) and Correlated process identifiers (COPID) are numbers which can be used to relate information received in an ASF information element to an ongoing transaction associated with a call.

A new Process identifier is established whenever an ASF information element with one of the invoke control types (Invoke, Invoke not last, Invoke last) is used. See Section 4.5.1.2. Either the user or the network may send an ASF with one of the invoke control types, thus, either the user or the network may establish a new Process identifier. The COPID is mandatory with the control types "Invoke not last" and "Invoke last".

A Process identifier is "local" to the Call reference value with which it is associated, meaning that on the SNC to Tandem interface there may only be one Process identifier with a certain value associated with a particular Call reference value. When establishing a new Process identifier, the user side will always use odd values, and the network side will use even values. There is no other restriction on the algorithm used to pick Process identifiers, and no requirement that Process identifiers be used sequentially. Allowed Process identifiers, for this implementation may range from 0-127.

4.5.1.1.2 Linking of Process Identifiers in Complex Interactions

In a complex service interaction, several messages containing ASF information elements may be exchanged prior to completion of the service request. Any transaction is initiated with an ASF information element containing the control type "Invoke". In a simple transaction, the ASF with the control type Invoke may be responded to by an ASF with a control type "Return result", "Return error", or "Reject".

In a complex transaction, the response to the ASF with the control type Invoke may be an ASF with either the control type "Invoke not last" or "Invoke last". Both of these Control types would establish a new Process identifier and return a Correlated process identifier. The Correlated process identifier is the Process identifier in the ASF information element which is being responded to.

The following table illustrates a possible scenario of a complex transaction involving messages containing ASF information elements with control types of Invoke not last being exchanged. The Process identifiers in all of these messages are linked, as in a chain. In this table, the network side of the interface initiated the interaction.

Message Initiator	Control Type	PID	COPID
Network	Invoke	0	-
User	Invoke not last	1	0
Network	Invoke not last	2	1
User	Invoke not last	3	2
Network	Invoke not last	4	3
User	Invoke last	5	4
Network	Return result	5	-

By virtue of the series of messages exchanged, all the Process identifiers, 0 through 5 are linked. All the Process identifiers are active and may not be re-used for another transaction associated with the same call until the Process identifiers are cleared by the "Return result".

4.5.1.1.3 Closing vs. Clearing of Process Identifiers

A Process identifier and its associated process identifiers (all those PIDs and COPIDs which are linked together) can be considered "closed" if an ASF information element with an Invoke last control type has been sent. No new interactions associated with those Process identifiers may be initiated; however, reports of successful or unsuccessful completion of the request (i.e. Return result, Return error, Reject) may be sent. When a Process identifier is closed, it is still considered active and is not available for re-use. Note that none of the associated Process identifiers are available for re-use.

A Process identifier is considered "cleared" if it is no longer actively associated with a call and is available for re-use in subsequent messages. A Process identifier may be cleared and made available for re-use in either of two ways:

1. A Process identifier may be cleared by sending an ASF with a Return result, Return error, or Reject control type.

2. A Process identifier may be cleared by clearing the Call reference value with which it is associated.

When a Process identifier is cleared, all other Process identifiers with which it is associated are

also cleared and available for re-use.

4.5.1.2 Control Types

The possible Control types following the control type Invoke are:

1. *Invoke Not Last* implies that more than one response is possible for the service identified in the Correlated process identifier.

   This Control type is returned when additional information is needed to comply with the original request or to report on the status of a request. The Correlated process identifier is any Process identifier received in the ASF information element with one of the invoke control types.

2. *Invoke Last* is similar to the control type Invoke not last with the exception that it is the final report request on a capability that has been requested. This Control type closes an operation that has been started. This Control type also requires the presence of a Correlated process identifier in the ASF information element.

3. *Return Result* implies positive acknowledgement to the request. The Process identifier with the control type Return result will be the same as the Process identifier received in the request. Return result clears an operation that has been started.

4. *Return Error* implies that the identified service could not be provided, and a Cause information element in the Parameter field indicates the reason for failure. The Process identifier with the control type Return error will be the same as the Process identifier received in the request (with one of the invoke control types). Return error clears an operation that has been started.

5. *Reject* implies that the original request was not understood due to protocol or coding errors. The Process identifier with the control type Reject will be the same as the Process identifier received in the request. This is similar to sending a STATUS message with the addition of clearing the request. A Cause information element is sent in the Parameter field to identify the reason for failure.

The return of the control types Invoke last, Return result, Return error, or Reject, closes or clears the interaction for the service identified in the ASF with the Control type set to Invoke. Use of these Control types releases the Process identifier conveyed in the ASF information element with Control type set to Invoke. See Section 4.5.1.1.3 for further information.

4.5.1.3 Discussion of Service Elements

The following is a description of the Service elements with associated Parameters which may be included in the ASF information element for the Service Node with CITI implementation.

Request Notification

> The Request notification Service element is used to explicitly request continued call progress monitoring. It may be sent by a Tandem to the SNC.

> No Parameter field is associated with the Request notification service element.

Request Value

The Request value service element is used to convey a request for information from the network side of the interface. It may be sent by the Tandem to request that the SNC collect a user-entered code, or it may be sent by the Tandem to request that the SNC perform a trunk group status audit.

The Parameters in the ASF information element identify which value is being requested. When requesting collection of a user-entered code, the Parameter field of the ASF contains the Signal information element and the User-entered code information element. When requesting a trunk group status audit, the Parameter field of the ASF contains the Trunk group/trunk status information element and the Trunk group/trunk identification information element.

Set Value

The Set value service element is used to convey the response to an information request. It may also be used to pass unsolicited information across the interface.

The Set value service element will be sent by the SNC to convey the user-entered code digits that were collected at the request of the Tandem. The Parameter field of the ASF will contain the User-entered code information element.

The Set value service element will be sent by the Tandem to convey the information required for call establishment: digits, bearer capability, etc., in response to a routing request from the SNC. The Parameter field of the ASF will contain the Bearer capability and Called party number information elements, and may optionally contain any of the following information elements: Call identity, Network-specific facilities, Calling party number, Called party subaddress, Redirecting number, Low layer compatibility, User-user information, Locking shift to Codeset 6, any Network-specific in codeset 6 information elements with the exception of the ASF IE, Locking shift to codeset 7, and any User-specific in codeset 7 information elements. Inclusion of any of the optional information elements listed above is subject to the same constraints as in a SETUP message.

The Set value service element will be sent by the SNC to convey the results of a trunk group status audit. The trunk group status audit may have been initiated by the Tandem or may have been unsolicited by the Tandem. The Parameter field of the ASF will contain the Trunk group/trunk status and Trunk group/trunk identification information elements.

Cancel Notification

The Cancel notification service element may be sent from the Tandem to the SNC to inform the SNC that continued call progress monitoring is no longer required. Use of this Service element and support of this Service element by a Tandem is optional. The SNC will accept this Service element only if it is conveyed in a RELEASE COMPLETE message from a Tandem.

There is no Parameter field associated with this Service element.

Event Report

The Event report service element will be sent from the SNC to the Tandem to inform the Tandem of continued call progress during call progress monitoring. Support of call progress monitoring by a Tandem is optional.

The Parameter field of the ASF will contain the Call state information element and additionally may contain the User-user information element with length=1.

Routing

The Routing service element is used by either side to convey information about the way in which a call is routed at the SNC. The SNC will send a Routing service element to the Tandem with the incoming trunk group and trunk information; the Tandem will send a Routing service element to the SNC with outgoing trunk group information. The SNC will also send the Routing service element when informing the Tandem of the outgoing trunk used for the call.

The Parameter field of the ASF will contain the Trunk group/trunk identification information element and may include a Subnetwork trunking information element for outpulsing characteristics to non-ISDN locations.

Incoming Call Notification

The Incoming call notification service element is sent by the SNC to the Tandem to convey information regarding an incoming call attempt. The Parameter field of the ASF will contain the Called party number and Bearer capability information elements. In addition, the Parameter field may optionally contain any of the following information elements: Call identity, Network-specific facilities, Calling party number, Called party subaddress, Redirecting number, Low layer compatibility, User-user information, Locking shift to codeset 6, any Network-specific in codeset 6 information elements with the exception of the ASF, Locking shift to codeset 7, and any User-specific in codeset 7 information elements. The Traveling class mark information element (in Codeset 6) may be present if such information was received either out-of-band or inband as part of the incoming call request to the SNC. Inclusion of any of the other optional information elements listed above is subject to the receipt of the information elements in a SETUP message for the incoming call request (i.e., the incoming call request must be ISDN).

Error Code

The Error code service element is only used with the control type Return error. The Service element may be sent in either direction across the interface. The Parameter field associated with the Error code will be a Cause information element.

Problem Code

The Problem code service element is only used with the control type Reject. The Service element may be sent in either direction across the interface. The Parameter field associated with the Service element will be a Cause information element.

4.5.2 ASF Procedures

When the Tandem or SNC wishes to exchange information with the other side of the interface that is associated with a call, it will pass an indication in a call control message.[3] This indication will be contained in the AT&T standardized facilities (ASF) information element from codeset 6.

For the desired capability, the SNC or Tandem will assign in the ASF information element a *Process identifier* that is local to the Call reference value on the SNC to Tandem interface. For each desired capability, an ASF information element should be sent; multiple ASF information elements may be present in a message. To prevent collision of Process identifiers, the user side of the interface will assign odd numbered Process identifiers, and the network side of the interface will assign even numbered Process identifiers. The Control type field in the ASF will indicate *Invoke*.[4] The application capability desired is mapped into an appropriate *Service element* in octet 5 of the ASF information element.

Any Parameters required for the capability are coded as information elements following the "Service element" octet. See Section 4.4.18.1. The Parameters provide additional information which when combined with the Service element define the overall capability to be provided.

The response to the request may be conveyed in a FACILITY message or a RELEASE COMPLETE message. The ASF information element returned as a response to the request will contain a Process identifier, a Control type, a Correlated process identifier if required by the Control type, and a Service element with associated Parameters.

In order to gracefully clear process identifiers, a RELEASE COMPLETE or a DISCONNECT message may include an ASF with a clearing control type when an open process is associated with the transaction's Call reference value.

4.5.3 Routing and Monitoring Procedures

Two categories of procedures are required to support the routing and monitoring capabilities defined for the Service Node with CITI. These categories, distinct in terms of the protocol mechanisms required at layer 3, are:

— Tandem-initiated calls on ISDN B-channels, with routing information conveyed in the call request

In addition to establishing the B-channel call, the Tandem and the SNC may exchange subsequent routing information.

— Information exchange regarding routing and monitoring for calls not originated on Tandem ISDN B-channels but which come over trunks directly connected to the SNC

An incoming call from a nodal main would use these procedures, as would a call from a Tandem which did not convey routing information in the call request, whether that be by a call over an ISDN facility or an inband facility. Also, calls coming to the SNC via the network or the private line network would also fit in this category.

The following sub-sections present the procedures required to support each category. After the SNC has seized the outgoing trunk, the remainder of the procedures defined in TR 41449 for

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3. For the SNC application the allowed messages are REGISTER, FACILITY, RELEASE COMPLETE, DISCONNECT and SETUP (for Tandem initiated calls only).

4. Note: No "Correlated process identifier" is conveyed with the control type Invoke.

call establishment and clearing apply. The error recovery procedures for messages out of sequence, expiration of timers, mandatory and optional information elements missing, coding violations, etc. are as defined in TR 41449.

4.5.3.1 Tandem Initiates an ISDN B-channel Call

When the Tandem initiates a call, the Tandem will use the procedures defined in TR 41449. A Call reference value will be assigned by the Tandem and conveyed in a SETUP message to the SNC. All mandatory and any optional information elements (e.g., Bearer capability, Called party number, Calling party number) are passed in the SETUP message sent to the SNC.

4.5.3.1.1 Routing Information in SETUP

The routing instructions for the call (e.g., the outgoing trunk group to be used for the call) may be contained in the SETUP message. When present in the SETUP message, the routing instructions (for the outgoing part of the call) will be conveyed in the Trunk group/trunk identification information element within an AT&T standardized facilities (ASF) information element from codeset 6.

In response to receiving the SETUP message, the SNC will return a CALL PROCEEDING message to the Tandem confirming the B-channel to be used for the call before attempting to seize the outgoing trunk. When the outgoing trunk is successfully seized, the SNC will return a FACILITY message to the Tandem with an ASF information element containing the Trunk group/trunk identification information element indicating that routing was successful.

When the routing instructions which were contained in the SETUP message did not result in successful seizure, the SNC will transfer a FACILITY message across the interface to indicate routing failure with a Return error ASF on routing and to query the Tandem for new routing instructions[5]. The Tandem will respond in one of the following ways:

A. The Tandem may respond with new routing instructions in a FACILITY message[6]. When an outgoing trunk is successfully seized, the SNC will return a FACILITY message to the Tandem with an ASF information element indicating that routing was successful.

B. The Tandem may respond with a FACILITY message requesting that a user-entered code be collected. The SNC will cut through the B-channel to the Tandem and send a PROGRESS message to the Tandem indicating that the call progress information prompt is expected inband. Note that the receipt of the PROGRESS message by the Tandem cancels timer T310 at the Tandem. After collecting the user-entered code (digits), the SNC will forward the information to the Tandem in a FACILITY message. The Tandem may respond by sending a FACILITY message containing routing instructions as in point A.

C. Alternatively, the Tandem may choose to clear the call.

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5. The SNC will query the Tandem for new routing instructions a limited number of times. When that limit is reached, the SNC will clear the call by sending a DISCONNECT message to the Tandem. A RELEASE COMPLETE message will be sent to the Tandem in this same instance (reroute limit exceeded) if a REGISTER-established Call reference value was established for routing exchange, such as described in Sections 4.5.3.1.2 and 4.5.3.2.

6. The Tandem may choose to implement a timer on the user side which would be initiated when the FACILITY message was sent. At the expiry of that timer, the Tandem will clear the call by initiating the three step clearing sequence (DISCONNECT, RELEASE, RELEASE COMPLETE).

4.5.3.1.2 No Routing Information in SETUP

If the routing instructions are not present in the SETUP message, but the B-channel is acceptable to the SNC, the SNC will return a CALL PROCEEDING message to the Tandem. The SNC will then query the Tandem for routing instructions, treating the call in the same way as a call originating from a nodal main, consistent with the procedures in the next section. The SNC will initiate routing queries by sending a REGISTER message with a new Call reference value.

4.5.3.2 Procedures for Information Exchange for Calls Not Originated on Tandem ISDN B-channels

The procedure for providing information exchange between the SNC and the Tandem for calls not originated on Tandem ISDN B-channels is described below. The procedures for this type of interaction build upon those defined in Section 4.5.1 for the ASF information element. A session, or D-channel information exchange between the SNC and the Tandem, is described next.

1. The SNC begins the session after collecting address digits from an inband-signaled location or after receiving a SETUP message from an ISDN location. The SNC sends a REGISTER message to the Tandem with a previously *idle*[7] Call reference value which then becomes *active*, a locking shift to codeset 6, and one or more ASF information elements. Each ASF information element identifies a separate capability to be provided. For this application there are two ASF information elements present, one conveying the request for routing and identifying the incoming trunk group and trunk, and one containing the characteristics of the incoming call (bearer capability, dialed digits, etc.)

2. Any Parameters associated with the capability are passed in the Parameter list of the ASF IE included in the REGISTER message. Section 4.4.18.1 describes Service elements and associated Parameters supported by the SNC.

3. Upon sending the REGISTER message, the SNC initializes timer T371. The value of timer T371 is 4 seconds. If T371 expires before the SNC receives a response to its routing request, the SNC will retransmit the REGISTER message and re-initialize T371. If T371 expires a second time, the SNC will clear the request by transferring a RELEASE COMPLETE message to the Tandem.

4. The response to the REGISTER message is either:

   — a FACILITY message with the REGISTER-established Call reference value and one or more ASF information elements indicating the response to the request

   Possible responses are routing and monitoring instructions or a request for the collection of a user-entered code[8].

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7. An idle Call reference value is one that is not currently assigned by the layer 3 entity to either call control applications or service applications independent of a call.

8. The SNC will query the Tandem for new routing instructions a limited number of times as in Section 4.5.3.1.1.

— a RELEASE COMPLETE message with the REGISTER-established Call reference value and an ASF information with a Control type indicating that no additional interaction is to occur on the requested service

This may be used to end the session if there was an error in the request from the SNC or if the Tandem is unable or unwilling to process any routing queries at the time. As a consequence, the call incoming to the SNC will be cleared.

Receipt of either message terminates timer T371.

5. When the session is to be concluded, a RELEASE COMPLETE message with the REGISTER-established Call reference value is sent by either side of the interface. This will serve to release any non-call related resources[9] (e.g., Call reference value). The RELEASE COMPLETE message may contain an ASF information element to release Process identifiers that have not been released. If an outgoing trunk has been successfully seized, this RELEASE COMPLETE message does not the clear the incoming call, but clears the Call reference value between the SNC and the Tandem.

4.5.3.3 Call Screening

Before routing or responding to a Trunk Group Status Audit as requested by the Tandem, the SNC will verify that the trunk group indicated is assigned to the control of the Tandem.

If the trunk group indicated is not under the control of the Tandem, the SNC will clear the call by sending a RELEASE COMPLETE message to the Tandem with cause 31, "normal unspecified".

4.5.4 Call Progress Monitoring by the SNC

The SNC has the capability to provide call progress monitoring information to the Tandem to allow the Tandem to perform its own Call Detail Recording. The Tandem should keep the signaling connection active until it has received notification that the call was successfully routed. Continued monitoring after trunk seizure information has been received is performed by the SNC at the option of the Tandem.

4.5.4.1 Trunk Indication

4.5.4.1.1 Calls Involving One Tandem on One SNC

After receiving routing instructions from the Tandem, the SNC will attempt to seize a trunk in the indicated trunk group. When a trunk seizure is successful, the SNC will notify the Tandem of the trunk chosen for the call. On calls over ISDN facilities, the SNC will notify the Tandem of trunk seizure after B-channel negotiation is completed. The SNC will inform the Tandem by sending a FACILITY message to the Tandem containing two ASF information elements indicating the control type "Return result". The first ASF IE will contain a Service element indicating "Routing". The Parameter field will contain the Trunk group/trunk identity information element indicating the outgoing trunk group and trunk used for the call. The second ASF IE will contain a Service element indicating "Set value" and is an indication to the

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9. Non-call related resources that can be released in this fashion include notification and status query. Releasing a Call reference value does not terminate a process that was initiated or manipulated by the Tandem for which it is not a party (e.g., a call between two nodal mains).

Tandem that the call establishment information received with the Set value service element was used by the SNC.

Note that once the call is successfully routed, that call is unaffected by a Tandem's decision to continue monitoring or to clear or close the Call reference value between the Tandem and the SNC.

4.5.4.1.2 Calls Involving Two Tandems Directly Connected to the Same SNC

The SNC is able to complete calls between two endpoints homed on two different Tandems on the same SNC. This type of call, in concept, is similar to a call between two endpoints homed on different SNCs.

When an SNC receives instructions from one Tandem to route a call to a second Tandem (which may in turn be routed to a nodal main homed on that second Tandem), the Trunk group/trunk ID in the routing instructions will contain the number of the trunk group to the second Tandem. This trunk group chosen will have the characteristics of the calling party's trunk group. The SNC will, as part of its screening process, recognize that the indicated trunk group is going to another Tandem. The SNC will formulate a query for routing instructions (a REGISTER message) to the second Tandem. Issuance of the REGISTER message effectively transfers control of the call from the first Tandem to the second Tandem.

After having issued the REGISTER message, the SNC will inform the first Tandem that an outgoing "facility" was successfully seized by returning a FACILITY message to the first Tandem as described in the previous section under the single Tandem case except that the Trunk group/trunk ID IE will indicate that the outgoing trunk group was the trunk group to the second Tandem and no trunk group index (or trunk) will be included. In the REGISTER message issued to Tandem 2, this same Trunk group/trunk ID IE was included except that the trunk group direction was "incoming" instead of "outgoing". Therefore, in this application, the incoming trunk group index is not sent in the REGISTER message and Tandem 1's outgoing trunk group = Tandem 2's incoming trunk group.

A call may ultimately involve more than two Tandems, but its progress can be viewed as a series of hand offs between two Tandems.

4.5.4.2 Tandem Monitoring Option

As mentioned above, once the routing of the call has been successfully accomplished, it is not a requirement on the Tandem that the Tandem maintain a Call reference value with the SNC for the purposes of call progress monitoring for calls not originated by the Tandem. The Tandem has the option of clearing the REGISTER-established Call reference value with a RELEASE COMPLETE message with cause 16, "normal call clearing", any time after the trunk seizure information has been conveyed.[10] If the Tandem desires call progress monitoring, it must include the ASF information element requesting notification with its first routing instructions to the SNC. For this release of CITI, a monitoring request in a subsequent message will be ignored.

A Tandem Originated call with routing instructions in a SETUP may not contain this monitoring request. If monitoring is requested for this type of call, the SNC will respond to the Tandem with a FACILITY message with a Return error ASF with the Error code service element and cause 69 "requested facility not implemented".

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10. It is recognized that if the Tandem clears the Call reference value, indication of clearing will not be passed. This may affect performance of CPE which chooses to implement a trunk status map.

If the Tandem does not request monitoring, and does not clear the Call reference value after trunk seizure, the SNC will not forward call progress information to the Tandem. The SNC will not clear the Call reference value to the Tandem until the associated B-channel (or voice channel) call has been cleared.

4.5.4.2.1 Monitoring on Calls Routed to the Tandem

When calls terminate at the Tandem, the Tandem has an option regarding the degree to which it differentiates calls routed to itself from calls which it routes to other endpoints. This differentiation is manifested in the level of continued call progress monitoring seen by the Tandem after a call has been successfully routed to the Tandem. The Tandem may instruct the SNC to route the call to the Tandem, and may include a monitoring request in the FACILITY message. This could be described as "dual monitoring".

Dual monitoring occurs when the Tandem chooses not to differentiate calls which the Tandem routes to itself from those which the Tandem routes to other destinations. This means that the Call reference value used for the routing transaction is not cleared, and that the Tandem receives "duplicated" call progress monitoring information for the call. As an example, the Tandem would send an ALERTING message for the call that the SNC delivered with a SETUP message, but the Tandem would also receive a FACILITY message (with the REGISTER-established Call reference value) indicating that alerting was occurring.

"Single monitoring" occurs when the Tandem chooses to provide different treatment for calls which the Tandem routes to itself. When the Tandem receives an indication from the SNC that the trunk was successfully seized, the Tandem may choose to release the Call reference value used for the routing transaction by sending a RELEASE COMPLETE with the REGISTER-established Call reference value. In this way, the Tandem will only get a single indication that, for example, a call was answered: only a CONNECT message would be received. Single monitoring will occur when the Tandem does not include a monitoring request in its routing instructions to the SNC.

The SNC will support both options.

When the Tandem receives an indication from the SNC that the trunk was successfully seized, the Tandem may choose to release the signaling link with a RELEASE COMPLETE message containing cause 16, "normal call clearing", and either the Cancel Notification or the Event report service element in an ASF as described next.

If the signaling link was torn down by the Tandem via the Cancel notification service element before ALERTING and CONNECT was sent, the Tandem will receive those messages as the call progresses and not the SNC-specific call progress information messages.

If the signaling link tear-down has not occurred and dual monitoring notification of ALERTING has been received by the Tandem, the Tandem may still clear the signaling link with a RELEASE COMPLETE message with the Event report service element in an ASF.

4.5.4.3 Alerting and Connect Indications

When monitoring has been invoked, the SNC will inform the Tandem of alerting and answer supervision on calls. Each of these indications will be conveyed in a FACILITY message to the Tandem. The ASF information element will contain a Control type coding of "Invoke not last" and a Service element indicating "Event report". The Parameter field in the ASF will contain a Call state information element which will indicate which event is being reported (call state 7 for ALERTING, call state 10 for answer supervision). The presence/absence of MA UUI in the alerting or answer sequence will also be indicated to the Tandem by the presence in the Parameter field of the User-user information element with length=1. The MA UUI itself will not be forwarded to the Tandem.

If alerting cannot be detected on the call, then no indication will be passed to the Tandem. Answer supervision indication will always be sent to the Tandem.

4.5.5 Call Clearing

The SNC will inform the Tandem that call clearing has occurred by sending an Event report. The procedure described below is a two step clearing sequence, and assumes that the **Tandem or the SNC has not previously cleared the REGISTER-established Call reference value.** No indication of call clearing will be passed to the Tandem if the Call reference value was previously cleared.

If call progress monitoring was invoked, upon detecting clearing on a call (on-hook, or a DISCONNECT message, for example), the SNC will forward a FACILITY message to the Tandem indicating that the call was cleared, and indicating the presence/absence of MA UUI in the clearing sequence. This information is conveyed in an ASF information element in the FACILITY message. The ASF information element will contain a control type "Invoke last", a Service element indicating "Event report", and the Parameter field will contain the Call state information element indicating the Null state and a User-user information element with length=1 (if MA UUI was present). The Parameter field will also contain the cause from the call clearing sequence, if available. The presence of the Cause information element in the Parameter list will allow the Tandem to monitor abnormal clearing events. This ASF information element is correlated to the monitoring process.

If call progress monitoring was not invoked, when the SNC detects clearing on the associated B-channel (or voice channel), the SNC will forward a FACILITY message to the Tandem. The FACILITY message will contain an ASF information element with the Control type set to Invoke, the Service element set to Event report, and the Parameter set to Call state information element with the value for Null state. The Tandem is expected to reply with the RELEASE COMPLETE message.

The Tandem will respond to the FACILITY message with a RELEASE COMPLETE message containing an ASF with a control type "Return result" with the Event report service element in response to the Event report ASF invoked. The codeset 0 Cause information element in the RELEASE COMPLETE message should indicate normal call clearing.

4.5.6 Trunk Group Status Audit Procedures

This procedure will enable the Tandem to query the SNC in order to verify the busy/idle status of the SNC trunk groups which reside at the Tandem with the busy/idle status of the SNC trunk groups which reside at the SNC. Due to the volatile nature of calls, this audit procedure will only provide a snapshot of SNC trunk status and may not be current. Generally, this procedure will be invoked by the Tandem. In some cases an unsolicited trunk group status audit may be sent by the SNC to the Tandem. See the last paragraph of this section. However, the SNC will not query the Tandem regarding trunk or trunk group status.

When initiated by the Tandem, the procedure is invoked with a REGISTER message transferred across the interface from the Tandem to the SNC. The REGISTER message contains an ASF with control type set to "Invoke", a Service element indicating "Request value", and a trunk group/trunk identification IE indicating the trunk group to be audited. The Trunk group/trunk status information element will also be included in the ASF to indicate which trunk group statuses should be reported. The statuses possible are: Idle, In use, Maintenance busy, Transitional, and Other unavailable.

The SNC will respond with a RELEASE COMPLETE message containing an ASF IE with control type set to "Return Result", a Service element indicating "Set value" and a Trunk

group/trunk identification IE indicating the trunk group or trunk which was audited. The Trunk group/trunk status information element will be included in the ASF and will provide the counts of trunks in the respective states.

The SNC will respond to queries from the Tandem about trunk group status. Tandems are not required to implement either a busy/idle status of trunk groups under their control at the SNC or to implement the audit procedure.

The SNC will reject a request for an individual trunk audit or a request for multiple trunk group status audits with a RELEASE COMPLETE message containing an ASF with a "Reject" control type and cause 100, "invalid information element contents". A Tandem may have only one trunk group status audit request outstanding.

The SNC will initiate an unsolicited audit report by transferring a REGISTER message across the SNC to Tandem interface. The REGISTER message will contain the "Invoke" control type, a Service element indicating "Set value", the Parameter list with the Trunk group/trunk identity IE and the Trunk group/trunk status IE with the statuses of indicated trunk groups. These would be sent if the status of the trunks in the trunk groups changed as a result of maintenance activity or a facility failure. The Tandem should return a RELEASE COMPLETE message with Cause 16. It is recommended that the Tandems be able to support unsolicited audit reports.

REGISTER messages may be retransmitted for a Trunk Group Status Audit. The Trunk group status audit REGISTER retransmission procedure is also implemented when requesting routing information. The SNC may resend the message after T371 expires and re-initialize T371. If T371 expires a second time, the SNC or Tandem will clear the request by transferring a RELEASE COMPLETE message.

When the SNC receives an unexpected message during a non-circuit, REGISTER-established call such as: ALERTING, CALL PROCEEDING, CONNECT, DISCONNECT, FACILITY ACKNOWLEDGE, PROGRESS, REGISTER, RELEASE, and RESTART, it will send a STATUS message with cause 98 "message not compatible with call state". In the case of the STATUS message being sent for a retransmitted REGISTER message, this STATUS message will not cause the call to be killed.

4.5.7 D-Channel Backup Procedures for Non-Facility Associated Signaling

These are supported as described in Parts I and II.

4.6 Maintenance

The maintenance procedures described in Part II will be supported.

REFERENCES

1. AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface Specification, AT&T Technical Reference PUB 41449, March 1986 with Update March 1988.

2. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, TR 41459, April 1988.

3. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459 Addendum, October 1988.

4. AT&T Technical Reference, AT&T Integrated Services Digital Network (ISDN) Primary Rate Interface and Special Application Specification, Technical Reference 41459 Addendum, January 1989.

5. AT&T Technical Reference of Special Access Connections to the AT&T Network for New Service Applications, AT&T TR 41458, October 1985.