

**Lucent Technologies**  
Bell Labs Innovations



**DEFINITY<sup>®</sup>**  
**Communications System**  
**Generic 2.2 and Generic 3 V2**  
**DS1/CEPT1/ISDN PRI Reference**

555-025-107  
Issue 1  
July 1993

## Notice

Every effort was made to ensure that the information in this book was complete and accurate at the time of printing. However, information is subject to change.

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**Part 68: Answer-Supervision Signaling.** Allowing this equipment to be operated in a manner that does not provide proper answer-supervision signaling is in violation of Part 68 rules. This equipment returns answer-supervision signals to the public switched network when:

- Answered by the called station
- Answered by the attendant
- Routed to a recorded announcement that can be administered by the CPE user

This equipment returns answer-supervision signals on all DID calls forwarded back to the public switched telephone network. Permissible exceptions are:

- A call is unanswered
- A busy tone is received
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DEFINITY is a registered trademark of Lucent Technologies in the U.S. and throughout the world. In this document, DEFINITY Communications System Generic 1 and Generic 3 is often abbreviated to DEFINITY Generic 1 or Generic3 or G1/G3.

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## Acknowledgment

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## About This Document

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This document covers narrowband switching using digital facilities based on the digital signal level 1.(DS1) 1.544 mbps and Conference of Postal and Telecommunications (CEPT) 2.048 mbps rates in the DEFINITY<sup>®</sup> G2.2 and G3V2 systems. Narrowband switching means switching single 64 kbps timeslots, which has been the only type of digital switching on DEFINITY systems until G3V2. Starting with G3V2, multiple 64 kbps timeslots can be switched as a single entity. This is called wideband switching. Wideband switching employs digital facilities on both the line side and trunk side of the system.

A separate reference document exists for wideband switching. For technical information on all aspects of wideband switching in DEFINITY systems, see *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

The document at hand covers the narrowband DS1 and CEPT1 switching capabilities of DEFINITY systems, including the following general subjects:

- The capabilities of DS1 and CEPT1 facilities in the DEFINITY systems
- How these capabilities have been designed into the DEFINITY systems
- How to implement digital facilities
- General information on digital trunks and digital facilities

The DEFINITY systems this document covers are as follows:

- Generic 2.2, referred to as G2.2.
- Generic 3 version 2, referred to as G3V2. When necessary, the distinction G3iV2 and G3rV2 will be used to distinguish the two types of G3V2 systems.

For DS1/CEPT1/ISDN PRI information on G1, G2.1, G3iV1, G3rV1 and G3i-Global, see *DS1/CEPT1/ISDN PRI Reference*, 555-025-103, issue 1, August 1992.

The important digital trunk changes from G3iV1, G3rV1, and G3i-Global that have been incorporated into G3V2 are as follows:

- The capabilities of G3i-Global have been incorporated into G3V2.
- Wideband switching has been added. For information on this subject, refer to *AT&T DEFINITY Wideband Technical Reference*, Issue 1, 555-230-230.
- The European Computer Manufacturers Association (ECMA) specification for ISDN PRI layer 3 basic call setup between two private network switches has been implemented.
- Support for overlap receiving on ISDN PRI trunk groups has been added.
- Improved glare handling for ISDN PRI trunks has been added.
- ISDN PRI support for Spain and Japan and digital trunk capabilities for other countries has been added.

Two types of digital trunks are supported on the DEFINITY systems, including trunks based on the digital signal level 1 (DS1, 1.544 mbps) standard and trunks based on the "Conference of Postal and Telecommunications Rate 1" Conference of Postal and Telecommunications Rate 1 (CEPT1 2.048 mbps) standard. The capabilities and features supported by these trunks vary depending on the signaling schemes used on the trunks, which can be bit-oriented signaling or message-oriented signaling. Digital trunks can use several types of bit-oriented signaling but only one kind of message-oriented signaling—ISDN PRI signaling.

Describing how DS1 and CEPT1 trunk capabilities have been designed into these systems entails describing the following:

- **Applications**  
Different applications require different implementations of digital trunks. For example, the AT&T network offers 56 kbps, 64 kbps, 384 kbps, and 1536 kbps digital data services that can be accessed via DEFINITY systems' digital trunks. The 56 kbps option requires a DS1 trunk with robbed bit signaling or a DS1 trunk with ISDN PRI signaling. The 64, 384, and 1536 kbps options, however, require ISDN PRI signaling.
- **Implementation Guidelines**  
This includes the details needed by field personnel to implement digital trunks, consisting of subjects such as ordering information for required equipment and software and guidelines for how to administer various features and capabilities on DS1 and CEPT1 based trunks.

- **General Information**

This includes DS1 and CEPT1 concepts having relevance to field personnel. For example, it is important for some field personnel to understand the meaning of B8ZS line coding in addition to knowing that this option exists on the DS1 circuit pack administration form.

- **Design Details**

This includes details on how the field-relevant DS1 and CEPT1 items have been designed into the systems. For example, since line coding has field impact (it must be administered correctly given the transmission facilities), it is important to know such things as the fact that if ZCS is administered, the bit stream on an outgoing ISDN PRI D channel is automatically inverted.

Given these goals, the document is organized as follows:

- [Chapter 1, "Introduction"](#), introduces the subjects covered in the remainder of the document.
- [Chapter 2, "Applications"](#), describes the various uses for digital trunks in the DEFINITY systems.
- [Chapter 3, "Equipment and Software Requirements"](#), provides ordering information for the equipment and software required to implement digital trunks. It also describes necessary connectivity information and hardware switch settings.
- [Chapter 4, "Physical Layer"](#), describes how the physical layer standards of DS1 and CEPT1 trunks have been designed into the DEFINITY systems. It also includes general information on these subjects. It covers these topics as they relate to narrowband (64 kbps channels) switching.
- [Chapter 5, "Layers 2 and 3"](#), describes how the layers 2 and 3 protocols for bit-oriented and ISDN PRI signaling have been designed into the DEFINITY systems. It covers the subjects found in the CCITT, AT&T, and other specifications, that have relevance to personnel implementing digital trunks on these systems. It includes general information about these subjects and also describes how these subjects have been designed into the DEFINITY systems. It covers these topics as they relate to narrowband (64 kbps channels) switching.
- [Chapter 6, "System Administration"](#), is a guide to the procedures needed to administer various capabilities and features that use digital trunks. It covers these topics as they relate to narrowband (64 kbps channels) switching.
- [Appendix A, "G2 ISDN PRI Implementation in Administration"](#), is a summary of how ISDN PRI has been implemented in G2 administration procedures on a procedure-by-procedure basis.
- [Appendix B, "Digital Trunk Administration Summary for U.S. Applications"](#), summarizes some key administration settings for digital trunks based on their applications in the U.S.

The following documents should be used in conjunction with this document to compose a complete reference for digital trunks on the DEFINITY systems:

- *AT&T DEFINITY Communications Systems Wideband Technical Reference*, 555-230-230
- *Network and Data Connectivity Reference*, 555-025-201
- *AT&T DEFINITY Communications Systems Generic 1 and System 75 and System 75 XE Feature Description*, 555-200-201
- *AT&T DEFINITY Communications Systems Generic 1.1 Implementation*, 555-204-654
- *AT&T DEFINITY Communications Systems Generic 2 and System 85 Feature Descriptions*, 555-104-301
- *AT&T DEFINITY Communications Systems Generic 2.1 Administration Procedures*, 555-104-506
- *AT&T DEFINITY Communications Systems Generic 2.1 Administration of Features and Hardware*, 555-104-507
- *AT&T DEFINITY Communications Systems Generic 2.2 Administration Procedures*, 555-105-506
- *AT&T DEFINITY Communications Systems Generic 2.2 Administration of Features and Hardware*, 555-105-507
- *AT&T DEFINITY Communications Systems Generic 1 and Generic 3 Feature Descriptions*, 555-230-201
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- *AT&T DEFINITY Communications Systems Generic 3i Implementation*, 555-230-650
- *AT&T DEFINITY Communications Systems Generic 3r Implementation*, 555-230-651
- *AT&T DEFINITY Communications Systems Generic 3i(enGlobal Implementation*, 555-230-652
- *Digital Multiplexed Interface (DMI) Technical Specification*, select code 500-029
- AT&T Technical Publication TR62411 *ACCUNET T1.5 Service Description and Interface Specification*
- AT&T Technical Publication TR41458 *Special Access Connections to the AT&T Network for Nodal Service Applications*
- AT&T Technical Publication TR41449 *AT&T ISDN Primary Rate Interface Specification*
- *AT&T DEFINITY Line Side ISDN Primary Rate Interface AT&T Technical Reference*. This specification is useful for wideband switching applications.

- *Private Branch Exchange (PBX) Switching Equipment for Voiceband Application, EIA/TIA-464-A*, February 1989. Published by Electronics Industry Association, engineering department, 1722 Eye Street, N.W., Washington, D.C. 2006.
- AUSTEL (the Australian Standards Institute) TS 014.1/1990, *PRI Connection Volume I: Interface Specification for Layers 1,2, and 3*
- ETSI (the European Telecom Standards Institute) ETS 300102-1, *ISDN User-Network Interface Layer 3 Specification for Basic Call Control Applications of CCITT Recommendations Q.930/I.450 and Q.931/I.451*
- National ISDN Users Forum NIU.302 *ISDN PRI for Circuit Switched Calls*
- ANSI T1.607, *ISDN Circuit-Switched Call Procedures*
- *Digital Access Signalling Standard II/Digital Private Network Signalling Standard (DASSII/DPNSS)*

# Introduction

# 1

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A digital trunk on a DEFINITY system is a 64 kbps channel, called a DS0 channel, that has been administered as a trunk in system administration. This channel is time-multiplexed onto a single 1.544 mbps (digital signal level 1, or DS1) or 2.048 mbps (European Conference of Postal and Telecommunications Rate 1, or CEPT1) bit stream carried on a single set of four wires connected to a digital interface circuit pack. Thus, a DS1 or CEPT1 interface circuit pack provides 24 or 32 64 kbps DS0 channels respectively, which can be administered as trunks. Conventional analog trunks would require 24 or 32 sets of wires and several circuit packs for the same number of trunks. In most applications of digital trunks switching occurs at the DS0 level. For example, a call from a telephone on the switch occupies one recurring 64 kbps time slot on the TDM bus and is switched to a single DS0 channel on a DS1 or CEPT1 interface that has been administered as a trunk. This is called narrowband switching and is the focus of this document. Beginning with G3V2, a call from an endpoint occupying multiple 64 kbps timeslots can be switched to multiple DS0s that have been administered as trunks and remain in the same sequence as they were when originated. In other words, multiple DS0s can be switched as a single entity. This is called wideband switching. Wideband switching allows data rates in multiples of 64 kbps to be switched as single entities. For technical information on wideband switching, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

At present, digital trunks in the DEFINITY systems consist of the following:

- Trunks connected to digital interface circuit packs conforming to the digital signal level 1 (DS1) standard (1.544 mbps)
- Trunks connected to digital interface circuit packs conforming to the Conference of European Postal and Telecommunications Rate 1 (CEPT1) standard (2.048 mbps)

The capabilities and features supported by these trunks vary according to the signaling schemes they employ, including the following:

- Bit-oriented signaling, including:
  - Robbed bit signaling (DS1-only)
  - Bit-oriented common channel signaling
- ISDN PRI signaling, which is message-oriented common channel signaling

Based on these distinctions, the following terms will be used in this document when describing these different digital trunks:

Robbed-bit trunk	A DS0 channel on a DS1 interface circuit pack administered for robbed bit signaling and added to a trunk group.
DS1 Common Channel BOS Trunk	A DS0 channel on a DS1 interface circuit pack administered for common channel or 24th channel signaling and added to a trunk group
CAS Trunk	A DS0 channel on a CEPT1 interface circuit pack administered for channel-associated signaling and added to a trunk group.
DS1 ISDN PRI Trunk	A DS0 channel on a DS1 interface circuit pack administered for ISDN PRI signaling and added to a trunk group. Unless it is necessary to emphasize the CEPT1 or DS1 facility, these trunks will be referred to as ISDN PRI trunks.
CEPT1 ISDN PRI Trunk	A DS0 channel on a CEPT1 interface circuit pack administered for ISDN PRI signaling and added to a trunk group. Unless it is necessary to emphasize the CEPT1 or DS1 facility, these trunks will be referred to as ISDN PRI trunks.

These trunks have varying capabilities depending on the signaling used. For example, if robbed bit signaling is used on a DS1 interface, all 24 channels on the interface can be used as trunks to carry voice or data. Because the signaling is robbed from each channel, however, the maximum amount of information that can be carried by each channel is only 56 kbps. If common channel signaling is used, however, only 23 channels can be used as trunks to carry voice or data, the 24th channel being exclusively used for the signaling information.

The signaling information in the 24th channel of a DS1 or the 16th channel in a CEPT1 can also vary. The simplest method is to provide only the basic A and B bit type of signaling, which requires only one or two bits of information (depending on the trunk type), and is thus limited in the amount of information that can be transferred. This is called bit-oriented common channel signaling. In the DS1 standard, this type of signaling can be either DMI bit-oriented signaling (DMI-BOS) or AT&T proprietary bit-oriented signaling. In the CEPT1 standard, this type of signaling is called channel-associated signaling (CAS).

A more sophisticated form of common channel signaling allows the signaling channel to carry large, sophisticated messages, which can convey a lot of information, such as the calling party's number, and much more. This type of signaling is called message-oriented signaling, or DMI-MOS. The only message-oriented signaling supported on DS1 and CEPT1 trunks is ISDN PRI signaling. ISDN PRI signaling is message-oriented signaling based on the CCITT recommendations Q.921 layer 2 and Q.931 layer 3 protocols on the signaling (D) channel.

The following table summarizes the signaling available on DS1 and CEPT1 interfaces:

<b>Interface</b>	<b>Bit Rate</b>	<b>Signaling</b>
DS1	1.544 mbps	Robbed bit Common channel DMI-BOS Common channel AT&T Proprietary BOS ISDN PRI
CEPT1	2.048 mbps	CAS bit-oriented ISDN PRI



The following table summarizes the DS1/CEPT1 support on the different interface circuit packs for the various DEFINITY systems:

Interface	System	Interface Board
DS1	G3iV2	TN722, TN767, TN464 (C or later). The TN722 only supports bit-oriented signaling.
	G2.2	ANN11 in a traditional module. Bit oriented signaling only. No ISDN PRI. ANN35 in a traditional module. ISDN PRI signaling only. TN722, TN767/TN555 in a universal module. The TN722 only supports bit-oriented signaling.
	G3rV2	TN722, TN767. Bit oriented signaling only (can be used for NFAS B channels however).  TN464 C or later. Bit oriented and ISDN PRI signaling. This is the only circuit pack that can be used for an ISDN PRI D channel.
CEPT1	G3iV2 G3rV2	TN464 C or later. The TN464D or later is required for applications in Belgium, the Netherlands and Mexico.

Implementing digital trunks requires first understanding the required applications and then implementing the particular types of digital trunks to suit the applications. From this point, implementing digital trunks requires the following steps:

- Ordering services or facilities, if applicable, from the local or long distance company
- Ordering and installing equipment, such as DS1 and CEPT1 interface circuit packs and channel service units, and setting option switches on the equipment
- Ordering special software, such as ISDN PRI software if required.
- Administering the system — this usually constitutes the bulk of the implementation process

The remainder of this document expands on the above subjects, providing both the background information and the detailed design and implementation information.

# Applications

# 2

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This chapter discusses some of the applications for digital trunks on DEFINITY systems. Applications for digital trunks can be divided into applications requiring services from the public network of the different countries and private network applications not requiring public network services. Within these two categories, some applications require only trunks with bit-oriented signaling while others require ISDN PRI signaling.

## Narrowband vs. Wideband Switching

G3V2 systems are the first AT&T private switches to offer wideband switching. Until G3V2 all applications for trunks, digital and analog, were for switching an incoming 64 kbps channel to an outgoing 64 kbps channel. A call from a voice terminal, for example, is carried on a single 64 kbps timeslot on the switch's TDM bus. An 8-bit sample is transmitted 8000 times per second, yielding the 64 kbps rate. This type of equipment makes calls generating 64 kbps channels when digitized. This is called narrowband switching and is the focus of this document.

Applications such as video transmission require more bandwidth than 64 kbps, however. Thus, new equipment can generate calls at greater than 64 kbps. To be compatible with the 64 kbps timeslots used in the switch, however, these calls must be made by sending them on multiple 64 kbps channels that adhere to the DS1 or CEPT1 framing formats (24 or 32 8-bit timeslots). Thus, a call from one of these devices must be at a rate that is a multiple of 64 kbps. For example, a call of 128 kbps can be made by a device that generates a DS1 or CEPT1 data stream by placing that call on two contiguous (consecutive) channels. These two channels are then placed onto the TDM bus in the switch in the same order and within the same frame and switched to two outgoing channels in the same order and in the same frame. It is as if the 64 kbps channels were the cars of a train entering a switchyard. The train, which represents the call, enters the switchyard, is switched to another track, and leaves the switchyard with its cars following one

behind the other in the same order as they came in. This is wideband switching. This same analogy applied to narrowband switching would have multiple engines, each representing a call on a single channel, entering the switchyard from different tracks and leaving the switchyard on different tracks.

One might ask why does a single call have to be carried on separate channels — why not just put 100 kbps, for example, on one bit stream and switch it end-to-end? The reason is that the TDM bus on the switch can work only with 64 kbps timeslots. With wideband switching, it is up to the originating and terminating endpoints to generate the data in this format and to receive and decipher it in this format.

For detailed technical information on DEFINITY wideband switching, see *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

## **Mixed Mode Signaling in G3V2**

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Independent of the ISDN PRI application, G3V2 systems can split the channels on a DS1 interface between trunks using ISDN PRI signaling and trunks using robbed bit signaling. This allows you to direct some trunks on an interface to one destination and the rest to different destinations. If all trunks on an interface are ISDN PRI trunks, they must all terminate at the same destination. For more information on how to implement this capability, see the section [“G3V2 Signaling Implementation”](#) in [Chapter 4, “Physical Layer”](#).

## **Global Public Network Applications**

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The telecommunications systems of other countries differ from that of the U.S. and from each other in the applications available using digital trunks. Most countries, for example, do not have separate carriers for long distance and local service. Some countries offer more services than others. At present, G3V2 systems have the capability to work with the public networks in the following countries, though G3V2 has not been certified in these countries:

Argentina  
Australia  
Belgium  
CIS (Russia)  
Czechoslovakia  
France  
Germany  
Greece  
Italy  
Japan  
Mexico  
Netherlands  
Saudi Arabia  
Singapore  
Spain  
United Kingdom  
United States

For information on the current state of the services accessible via G3V2 in countries other than the United States, consult your AT&T sales channel.

## **Public Network Applications in the United States**

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In the U.S., the public network consists of two types of service providers, the local exchange carriers (LECs) and the Interexchange Carriers (IXCs). The LECs provide service to locations within a local access and transport area (LATA), which is virtually equivalent to all locations within an area code (variations to this rule are beginning to appear). Companies such as the Regional Bell Operating Companies (RBOCs) provide local exchange service. The switching systems in LEC central offices providing these services include the AT&T 5ESS<sup>®</sup> and the Northern Telecom DMS<sup>®</sup> 100, among others. The IXCs provide service between LATAs, which is commonly called long distance service. Companies providing interexchange services include AT&T, MCI, and U.S. Sprint, among others. Switching systems such as the AT&T 4ESS<sup>™</sup> and the Northern Telecom DMS<sup>®</sup> 250 provide these services.

### **Local Exchange Applications**

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The services generally available from local exchange companies in the U.S. are as follows:

- Direct outward dial/attendant completing inward dial  
This is often called central office (CO) service. If connected to an exchange other than the local exchange, it is called a foreign exchange (FX) service.
- Incoming and outgoing wide area telecommunication service (In-WATS and Out-WATS)

- Direct inward dial (DID) service
- Electronic Tandem Network (ETN) service

Each of the above applications is available over DS1 robbed bit or DS1 common channel BOS trunks. They are also available over DS1 ISDN PRI trunks if the local or foreign exchange is equipped with an ISDN PRI-capable switch, such as the AT&T 5ESS<sup>®</sup> or the Northern Telecom DMS<sup>®</sup> 100.

## Interexchange Carrier Applications

AT&T, MCI, U.S. Sprint and other interexchange carriers (IXCs) in the U.S. offer various services accessible over digital trunks. This document discusses only the AT&T services. AT&T offers many digital services, but only some of these are appropriate for use with private switching systems. The following applications are available using DS1 robbed bit trunks and DS1 ISDN PRI trunks in the United States through AT&T interexchange switches (4ESS<sup>®</sup>):

- ACCUNET<sup>®</sup> Switched 56 service (robbed bit trunks only)
- ACCUNET<sup>®</sup> Switched Digital service (DS1 ISDN PRI trunks only)
- MEGACOM<sup>®</sup> service (robbed bit or DS1 ISDN PRI trunks)
- MEGACOM<sup>®</sup> 800 service (robbed bit or DS1 ISDN PRI trunks)
- Software Defined Network (SDN) service, including Software Defined Data Network (SDDN) service (robbed bit or DS1 ISDN PRI trunks)

Note that none of these services use DS1 common channel trunks. This is because the facilities required to access these services are available only with either robbed bit signaling or ISDN PRI signaling. At present, accessing these services using DS1 ISDN PRI trunks has the following advantages:

- The call-by-call service selection (CBC) feature is available via ISDN PRI access. The CBC feature allows you to use the same trunk group for ACCUNET SDS, MEGACOM service, MEGACOM 800 service, and SDN service calls on a per-call basis. In addition, with the G3V2 systems you can further tailor the call-by-call capabilities by administering a usage allocation plan and an incoming call handling table in the trunk group administration form.

You do not have to use CBC. If you wish, you can put the services on dedicated trunk groups. For example, you can put all ACCUNET Switched Digital Services calls on one of the trunk groups and all MEGACOM calls on a different set of trunk groups. Using call-by-call service selection with the usage allocation plan and the incoming call handling table, however, can significantly increase trunk use efficiency.

- 56 kbps, 64 kbps, 384 kbps, and 1.536 mbps data calls can be made through the 4ESS using ISDN PRI trunks whereas data calls are limited to 56 kbps maximum using robbed bit trunks. ISDN thus gives the DEFINITY user the ability to make mode 0, mode 1, mode 2, mode 3, and wideband data calls through the 4ESS in addition to voice or voice-grade data calls. With robbed bit trunks only voice/voice-grade data and mode 1 calls are possible. Following are the characteristics of these modes:
  - Mode 0 is 64 kbps digital data with no protocol packaging of any kind.
  - Mode 1 is 56 kbps digital data that uses the DDS bit format.
  - Mode 2 is 64 kbps data packaged in an inverted HDLC protocol and limited to user data rates between 300 bps and 19.2 kbps.
  - Mode 3, when circuit switched, is 64 kbps digital data packaged in LAPD protocol.
  - Wideband data is digital data with no protocol packaging at rates that are multiples of 64 kbps. For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.
- With ISDN PRI trunks, you can route calls to specific trunk groups based on the voice or data characteristics of the calls.
- The ability to pass information to the end user is available with ISDN PRI. For example, the name of the calling party can be sent to be displayed by the far-end.
- The feature called CPN/BN (formerly called SID/ANI) is available with all ISDN PRI-based services. Calling Party Number (CPN) allows the called party to display the station number of the calling party. Billing Number (BN) allows the called party to display the calling party's billing number. Two options, which must be specified in the service order, are available from the 4ESS as follows:
  - CPN/BN can be delivered to the DEFINITY systems on a per-trunk group basis.
  - CPN/BN can be delivered on a per-call basis, depending on whether the DEFINITY system requests it. G2.2 systems do not have the capability to request CPN/BN on a per call basis.
- Call setup times are faster with ISDN PRI.
- Call holding times (the time a trunk is occupied) is shorter with ISDN PRI.
- G3V2 systems have a built in way to handle the addition of new service offerings. If the AT&T network offers a new service, the name and numerical value for this service can be added to the network facilities administration form and all other related screens are automatically updated to accommodate the new feature. This capability allows G3V2 users to avert software upgrades when adding most new services.

- Tones are provided locally on ISDN PRI calls. For example, if the far-end is busy, the calling switch provides busy tone to the caller.

## Call-by-Call Service Selection Application

The call-by-call service selection (CBC) feature of ISDN PRI offered by the AT&T network and supported by DEFINITY systems allows more efficient use of trunks than is possible with robbed bit trunks, which do not support call-by-call service selection. The primary reason for the added efficiency with call-by-call service selection is the fact that with robbed bit trunks, network services, including MEGACOM, MEGACOM 800, ACCUNET Switched 56, and Software Defined Network (SDN) services, must be put on dedicated trunk groups (MEGACOM, MEGACOM 800, and SDN services can be put on the same trunk group with SASS, Shared Access for Switched Services). CBC, however, allows a trunk to carry a call of any service. Thus, without CBC, a service with low usage still incurs the same facility costs (port hardware and access charges) as a service with high usage. Also, the trunks used for the low-usage service have much unused capacity that could be used for calls of another service type. DEFINITY systems use ISDN PRI trunks with CBC to gain this efficiency. You might also want to put your on-network and off-network data capabilities on CBC trunk groups. For example, if you have an SDN network, you can use the Software Defined Data Network (SDDN) service, which is a subset of SDN, for all your on-network data and use ACCUNET Switched Digital Services for your off-network data applications, and combine the two on CBC trunk groups. In addition, G3V2 systems have three added capabilities that further enhance CBC. These capabilities are as follows:

- Usage allocation plan (administered in the trunk group form)
- Incoming call handling table (administered in the trunk group form)
- Per-service trunk measurements within a trunk group

## Usage Allocation Plan in G3V2 Systems

CBC with the usage allocation plan implemented gives the user the ability to dynamically reconfigure the available bandwidth used for network services in a manner that is transparent to the network.

Without the usage allocation plan, calls of each service type are treated equally, making it possible for one type of service to dominate a trunk group if many more calls of that service type are made. This may not be desirable, however. For example, if you have a telemarketing application making use of MEGACOM 800 service to take customer orders, you do not want your outgoing MEGACOM service used by your employees for long distance calls to block incoming MEGACOM 800 calls during hours in which customers can call. You also, however, may want to save money by using CBC in order to avoid the need to purchase another DS1 board and pay extra access charges to put your MEGACOM 800 service on dedicated trunks. The usage allocation plan solves this problem by allowing you to set minimum and maximum usage of a CBC trunk group on a service-specific basis.

The following list summarizes the capabilities of the usage allocation plan:

- You can define up to three different usage allocation plans per CBC trunk group.
- Each plan allows you to control how much of a CBC trunk group you have dedicated to a particular service. This is analogous to putting services on dedicated trunks and having them overflow to a common pool of CBC trunks. Without the usage allocation plan, a CBC trunk group is simply a pool of CBC trunks to be shared by any service on a first come first served basis.
- Transitions from one plan to another can be scheduled to be made up to six times a day, seven days a week. You can also fix a single schedule.
- Because you have total control of your available bandwidth, you do not incur the re-arrangement costs The AT&T network charges for reconfiguring your service/trunk group usage.
- Note that calls not containing a valid Network Specific Services (NSF) cannot make use of the usage allocation plan. Direct inward dial (DID) calls, for example, do not have NSFs.

### Incoming Call Handling Table in G3V2 Systems

In addition to the usage allocation plan, G3V2 systems have another enhancement designed to take advantage of CBC called the incoming call handling table. Like the usage allocation plan, the incoming call handling table is administered in the trunk group administration form. The incoming call handling table allows you to treat individual calls in special ways. For example, all incoming MEGACOM 800 calls to a certain extension after business hours can be routed to a particular destination by adding and/or deleting the delivered digits and/or specifying night destination treatment. The incoming call handling table is well suited for use with the Dialed Number Identification Service (DNIS) feature provided by MEGACOM 800 service. With the DNIS feature, the network delivers station digits to the G3V2 systems allowing exact identification of the number called. Another feature of the incoming call handling table is CPN/BN request option. Depending on how this option is administered you can request either the calling party number or the calling party's billing number (formerly called ANI) to be delivered from the 4ESS.

Note that the incoming call handling table is not limited to CBC trunk groups because individual calls all of the same service type can receive special treatment based only on the received digits. Also note that the digit modification performed by the incoming call handling table occurs before any AAR or ARS digit analysis or modification.



## Per Service Trunk Measurements

A variety of measurements can be taken on call-by-call trunk groups on a per-service and per-member basis. For example, you can measure the performance of a call-by-call trunk group and compare that to your desired performance. You can then use the results of the comparison to alter the usage allocation plan parameters to achieve the desired performance.

## ACCUNET Switched Digital Services and Switched 56 Service

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ACCUNET Switched Digital Services and ACCUNET Switched 56 service are measured digital data communications services that use the 4ESS to switch calls between endpoints subscribing to the service. The DEFINITY systems connect directly to the 4ESS via digital trunks without being switched through the LEC office. This type of access to the 4ESS is called special access. The difference between Switched 56 service and Switched Digital services is in the types of trunks required. ACCUNET Switched 56 service requires robbed bit trunks while ACCUNET Switched Digital Services requires DS1 ISDN PRI trunks. The primary application of these services on the DEFINITY systems is to allow communications between various data endpoints on the DEFINITY systems and data endpoints accessible through the AT&T switched digital network. The switched digital network is an end-to-end digital network accessed by dialing numbers of the form 700-737-XXXX (to endpoints on ISDN access) or 700-56X-XXXX (to endpoints on robbed bit access) over trunks connected to the 4ESS. With Switched 56 (S56) service, only 56 kbps or voice calls are possible because robbed bit trunks are used. Because Switched Digital Services (SDS) uses ISDN PRI trunks, however, 64 kbps calls and multiples of 64 kbps calls are possible, meaning voice, mode 0, mode 1, mode 2, mode 3, and wideband calls are possible. At present, the only wideband rates supported by the 4ESS<sup>®</sup> are 384 (6X64) kbps, called the H0 rate, and 1536 (24X64) kbps, the H11 rate. When you order SDS or S56, the AT&T service providers assign a 700 number to the endpoints. Thus, you would typically dial 700 plus the 7-digit number to access the endpoints in the U.S. The call is then routed over digital facilities in the AT&T network. Endpoints connecting to this network with ISDN trunks receive 64 kbps or multiples of 64 kbps facilities while endpoints connected with robbed bit trunks receive 56 kbps facilities.

Following are some additional points to consider when using SDS and S56 with the DEFINITY systems:

- The cost of SDS and S56 has been declining recently. It is presently priced very close to that of analog private line services.
- SDS and S56 are measured services whose primary applications are for batch data or file transfers that require only a certain amount of usage each month. If the usage is very high each month, then a private line data service might be more economical. If the usage is for file transfer during one time period per day, on the other hand, SDS or S56 might be more economical because the customer is charged only for the usage. Private

## 2 Applications

### *Public Network Applications in the United States*

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line service, on the other hand, is billed on a flat rate. This type of application is well suited for use with call-by-call service selection in conjunction with the usage allocation plan in G3V2 systems. For example, you can reschedule your usage allocation plan to give higher priority to your batch data transfers after business hours.

- You can network AUDIX systems using 64 kbps mode 3 communications over ISDN PRI trunks.
- Other important applications are for high speed facsimile, video, and inquiry/response. These types of applications need the high bandwidth but do not continuously use the same communications link, and thus do not require dedicated lines. Video teleconferencing via SDS or S56 is becoming a popular application.
- CAD/CAM or graphics terminals switched through the DEFINITY systems is another application for this service.
- The RS-449 physical interface can also be used with SDS and S56, but applications for this are rare.

AT&T also offers ACCUNET Switched Digital International (SDI) service, which is the international version of SDS. SDI offers 56 kbps or 64 kbps ISDN PRI service on a per-call basis between the U.S. and other countries. Note that if the 64 kbps version is used, the data must be coded as unrestricted in the information transfer capability (ITC) codepoint of the Bearer Capability IE.

SDS and SDI calls use the same Network Specific Facilities values (**accunet** in the network facilities administration form).

## MEGACOM Service

MEGACOM service is a WATS-like long distance service that uses special access to the 4ESS via either robbed bit trunks or DS1 ISDN PRI trunks. Analog trunks can also be used, but these calls are converted to digital by a D4 channel bank before reaching the 4ESS. This service is used when users on a PBX have a high volume of outgoing long distance calls.

Because the billing is different for WATS service and MEGACOM service, if the volume approaches 800 to 1000 hours of calls per month, MEGACOM service might be more economical than WATS service. An international version of MEGACOM, called International MEGACOM service is also available. This service allows direct distance dialing to other countries. If ISDN PRI trunks are used, both MEGACOM and International Megacom share the same NSF value. An important application of MEGACOM service over ISDN PRI trunks is that the 4ESS has the ability to keep track of the calling party numbers for billing purposes because each call has a calling party number information element in its SETUP message identifying the caller. Without ISDN PRI trunks, the 4ESS can bill only on a trunk group basis, forcing the PBX to keep track of call details.

## MEGACOM 800 Service

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MEGACOM 800 service is similar to Advanced 800 service (800 WATS). Megacom 800 customers have the same options available with Advanced 800 service, such as customer controllable rerouting of incoming calls. The biggest difference between the two services is that MEGACOM 800 uses trunks directly connected to the 4ESS through special access. These can be robbed bit trunks or DS1 ISDN PRI trunks.

The primary reason to use MEGACOM 800 with ISDN PRI trunks is for delivering the calling party's billing number (BN, formerly called ANI) to telemarketing applications.

A call detail feature, orderable through the local sales office, is available with MEGACOM 800. With this feature, a call summary can be obtained on paper or a more detailed version can be obtained on magnetic tape.

Dialed Number Identification System (DNIS) is available at no extra cost with MEGACOM 800. This feature allows you to differentiate one 800 call from another on the same trunk group by providing zero to seven digits, to the DEFINITY systems for each 800 call. This is especially useful in telemarketing applications. For example, all incoming calls to one type of number can be answered with one message and calls to other numbers can be answered with a different message. To use this feature, the DEFINITY systems should incorporate special equipment and/or software, such as display phones, ACD, call management system, or call detail recording.

DNIS is especially well suited for use with the incoming call handling table, administered in the trunk group form. The incoming call handling table can screen each call based on the digits received and do any of the following:

- Add and/or delete digits to route the call to a specific destination, such as a hunt group or an AAR pattern.
- Request CPN/BN be delivered for selected calls.
- Provide special night treatment for selected calls.

An international version of MEGACOM 800 service, called International 800 service, is also available. Unlike the other services, the NSF values for MEGACOM 800 and International 800 are different. Thus, if you use both International 800 and MEGACOM 800 over ISDN PRI trunk groups, you must put them on call-by-call trunk groups or on separate trunk groups.

## Software Defined Network and Software Defined Data Network

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Software Defined Network (SDN) service allows endpoints on the DEFINITY systems to communicate with endpoints on other PBXs as if the PBXs were connected in a private network arrangement such as Electronic Tandem

Network. SDN can be accessed by robbed bit trunks or DS1 ISDN PRI trunks directly connected to the 4ESS through special access. SDN can also be accessed by being switched through the LEC office to the 4ESS. This type of access, though, is not practical for a PBX because each extension on the PBX is charged for the access. Following are some relevant SDN issues:

- SDN supports either a 7-digit or a 10-digit private network dial plan.
- SDN does not tandem traveling class marks (TCMs) on calls over robbed bit trunks but does tandem them on ISDN PRI trunks.
- SDDN with ISDN provides 56 kbps, 64 kbps, 384 kbps, and 1.536 mbps digital service end-to-end. You must tell the 4ESS in the order form which extensions are to receive the all-digital service. The called party number is used by the network to route the call.
- When temporary signaling connections (TSCs) are tariffed, G3V2 systems will be able to form a DCS network by putting the DCS signaling channel on an ISDN PRI D channel and using SDN for the network trunks. This will enable those not having a DEFINITY private network (a network based on AAR software in G2.2 and G3V2 or Main/Satellite software in G2.2) the ability to have a DCS network.
- The Lookahead Interflow feature, which also normally requires AAR software, can be implemented using DS1 ISDN PRI trunks with SDN service.

For data applications, Software Defined Data Network is available. This service employs the same features as SDN, but uses all-digital facilities and also provides an auto restoration feature that automatically restores a connection that has been broken. The G3V2 systems implements this auto-restoration capability in the administered connection form. If you administer a connection to SDDN over an ISDN PRI trunk with a service type of `sddn`, you can select the auto-restoration capability. An international version of SDN, called Global SDN is also available. Global SDN allows customers to create virtual private networks spanning many countries, currently including Australia, the U.K., Japan, France, and Canada. It does this by interworking SDN with the virtual private networks offered in these other countries. Another international SDN service is SDN International (SDN-I). SDN-I is not a global network like Global SDN, but is SDN with the ability to call over 177 other countries via the SDN.

## **Private Network Applications**

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Any private network applications utilizing tie trunks can be implemented with digital trunks. These include applications such as Electronic Tandem Networks (ETN) and ETN with Distributed Communication System (DCS). Facilities supporting CEPT1 CAS trunks or CEPT1 ISDN PRI trunks are limited in most areas of the U.S. If CEPT1 facilities are not available, the only way to form a private network with CEPT1-based trunks is by directly connecting the systems or by using private microwave systems that support the CEPT1 standard. Tie trunks requiring only 56 kbps can be implemented with robbed bit signaling or

ISDN PRI signaling while those requiring 64 kbps must be implemented with CAS trunks, DS1 common channel trunks, or ISDN PRI trunks. DCS signaling links can be implemented with CAS trunks, with ISDN PRI trunks, and over ISDN PRI D channels. If a DCS signaling link is implemented over an ISDN PRI D channel, public network ISDN PRI trunks can be used to carry that signaling information to the far end system. For example, if several systems are networked together using SDN (AT&T's virtual private network service) over DS1 ISDN PRI special access trunks, DCS signaling links can be installed over the D channels for those trunks, thus providing DCS functionality without the need to install private lines, as in an ETN. Other advantages of using the D channel to carry the DCS signaling are as follows:

- This method saves processor interface links on G3i systems. These links are precious resources since there are only a maximum of eight per system.
- The signaling channel on an ISDN DCS link can hop from one link to any other link whereas the signaling channel on a G3i X.25 DCS link can hop only to a channel on one of the four links on the same PI board.
- The problems encountered when trying to keep the DCS trunks numbered the same at each end go away. This is because DCS over the D channel keeps track of its associated trunks with the call reference value information element in an ISDN PRI message.
- A trunk that would otherwise have to be used for the DCS signaling link can now be used as a voice or data trunk.

**NOTE:**

The G3V2 systems support dialing with trunk access codes to ISDN PRI trunk groups, but G2.2 does not.

## Equipment and Software Requirements

# 3

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This chapter provides ordering information for equipment and software required in typical configurations using DS1 and CEPT1 facilities. It also provides connectivity information and hardware switch settings.

The following tables summarize the required equipment and software. Note that when a suffix appears, that is the earliest suffix and/or vintage required. For example, TN464C means all TN464s with suffix C or later will work.

**Table 3-1. Equipment and Software Requirements**

<b>Item</b>	<b>Systems</b>	<b>Remarks</b>
TN464C	G3V2	Universal DS1/CEPT1 board. It is required for all CEPT1-based trunks. It is also required for ISDN PRI D channels on G3r. It is also required for wideband switching. The TN464D or later is required for applications in Belgium, the Netherlands, Mexico, Argentina, Czechoslovakia, and Russia.
TN767	G3V2, G2.2 universal module	DS1 board. Cannot be used for ISDN PRI D channels on G3rV2. For this board to contain an ISDN PRI D channel on the G2.2 universal module it must be accompanied by the TN555 packet adjunct.
TN722	G3V2	DS1 trunk board. Cannot be used for ISDN PRI signaling on any system.
TN555	G2.2 universal module	DS1 Packet Adjunct. ISDN PRI signaling on a D channel on a TN767 requires this board in the adjacent slot.
ANN11C	G2.2 traditional module	ISDN PRI D channel is not supported on this board. If you use the ANN11 for 24 B channels in an NFAS arrangement, maintenance tests (e.g., procedure 620) on these boards will fail.
ANN35	G2.2 Traditional Module	This board supports ISDN PRI signaling only.
TN765	G3iV2	Processor interface
TN768	G3V2	Tone/clock. This board can also be used in the G2.2 universal module but only for tones.

*Continued on next page*

**Table 3-1. Equipment and Software Requirements**

Item	Systems	Remarks
TN780	All G3V2 systems	Tone/clock. Required for Stratum 3 clock.
TN463	G2.2 traditional and universal modules	System clock synchronizer. One TN463 is required per system. It is located in the TMS carrier for multi-module systems or in the module control carrier for single module systems.
TN771B/C	G3V2, G2.2 universal module	Maintenance/test board. This board is required for ISDN PRI test calls. On G3V2 systems, a TN771 is required in each port network from or to which ISDN test calls will be made. On G2.2, the TN771B and later will work. On G3V2 systems, you must have the TN771C or later.
SN261B	G2.2 universal module	Analog/digital facility test board. This board is required for ISDN PRI test calls using procedure 648 test 2 and test 3.
ESF T1 CSU	All systems	A CSU is required by all systems when connecting via copper to public network facilities in the U.S. The model sold by AT&T is the ESF T1 CSU.
Number 8 TR631 Digital Line Unit	G3iV2, G3rV2	Used for CSU function at 2.048 mbps rate. Currently available from AT&T Network Systems International.
Cable DS1 – board-to-CSU	G2.2 universal module, G3V2	H600307 cable. Eight groups are available (G-1 through G-8) differing in length (25 feet to 650 feet). Extender cables are also available by specifying a length attribute (Ing1 through Ing5). By default, a group 2 cable (50 feet) is shipped with the DS1 board (TN722, TN767, TN464C).

*Continued on next page*



**Table 3-1. Equipment and Software Requirements**

Item	Systems	Remarks
Synchronization cable	G2.2 universal and traditional modules	<p>The group 334 cable is wired from the synchronization source DS1 board to the TN463 in a multimodule system when the DS1 board is in a traditional module.</p> <p>The group 361 cable is wired from the synchronization source DS1 board to the TN463 in a single module system when the DS1 board is in a traditional module.</p> <p>The group 503 cable is wired from the universal bus interface to the TN463 in a multimodule system when the DS1 board is in a universal module.</p>
Cable – ANN11/ANN35-to-CSU	G2.2 traditional module	Group 380 cable
Cable – CSU-to-network interface	All	
ISDN PRI software	All	All systems require ISDN PRI software for ISDN PRI trunks.

## **ANN11C and ANN35 Line Compensation Jumper Settings**

Unlike the TN722, TN767, and TN464C boards, the ANN11 and ANN35 have a switch that must be set for the length of the cable from the board to the CSU. Following are the settings:

Old Toggle- Type Switches			New Slide- Type Switches			Distance to CSU
SW1	SW2	SW3	SW1	SW2	SW3	
D	D	U	C	C	O	0 - 133 Feet
D	U	D	C	O	C	133 - 266 Feet
D	U	U	C	O	O	266 - 399 Feet
U	D	D	O	C	C	399 - 533 Feet
U	D	U	O	C	O	533 - 655 Feet

D=down  
 U=up  
 C=closed  
 O=open

## TN464C Jumper Settings

If the TN464C or later is used, two jumpers on the board must be installed correctly. These jumpers are on the lower left quadrant of the board as you look at the board with the front panel in your right hand. One jumper controls the bit rate and the other controls the impedance. The 75-Ohm option is for use with coaxial cable. The following figure illustrates these jumpers:

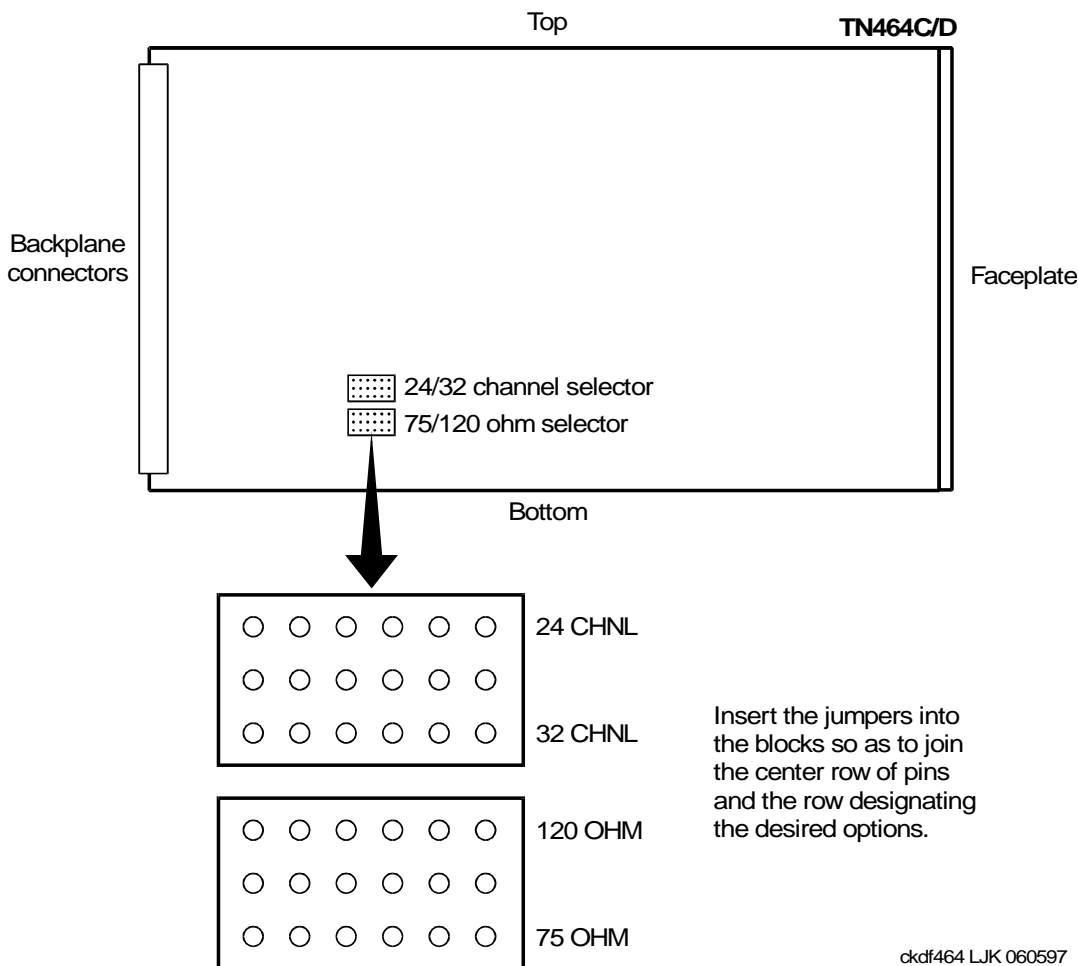


Figure 3-1. Bit Rate and Impedance Jumpers on the TN464C

## **DS1/CEPT1 Board Cable to CSU**

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A standard cable is provided with the DS1/CEPT1 board for connecting to a CSU or other network terminating equipment, such as a T1 multiplexer or a T1 microwave. This cable is 50 feet in length and comes equipped with a 25-pin connector at the G3V2 end and a 15-pin connector at the CSU end. Extender cables can also be ordered if the CSU is more than 50 feet from the DS1/CEPT1 board.

## **75 Ohm DS1/CEPT1-to CSU Cable**

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If the TN464 (C or later) board is used and is optioned for 75 Ohms, a coaxial cable with a 75 Ohm connector is required. Presently, the distributor makes this cable using coaxial cable and a coax-to-25 pin adaptor conforming to the CCITT G703 standard for 75 Ohm interface.

## **ESF T1 Channel Service Unit**

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A channel service unit is required if the application requires connection to the public network with copper wire. AT&T presently sells the ESF T1 CSU for these applications. The DS1 cable from the DS1 board on the switch connects to the CSU at one end. The CSU then connects to the network interface, which is usually a smart jack, at the other end. Thus, the CSU is an interface between the customer premises equipment and the network T1 facility. The primary purpose of the CSU is as follows:

- The CSU acts as a line repeater so that the network interface can be located at varying distances from the nearest repeater in the network and still maintain the correct signal level.
- The CSU provides loopback test capabilities both from the customer side and from the network side.
- The CSU isolates the customer premises equipment from the network, providing network equipment protection against electrical damage from the customer equipment. This function is not required anymore because of changes in the network equipment.
- The CSU provides automatic 1s density requirement to the network in the event that the customer premises equipment is disconnected.

User optionable switch settings on the CSU provide these functions.

## ESF T1 CSU Switch Settings

The ESF T1 CSU should be optioned to agree with the switch administration. Thus, if the system is optioned for ESF framing format, for example, so should the CSU. The ESF T1 CSU should also be set to pass ESF and CRC-6 information transparently through the CSU to and from the system.

## ESF T1 CSU DIP Switch Settings

Following are the typical DIP switch settings for the ESF CSU when connected to a T1 facility. Note that these settings are assuming ESF framing and zero code suppression (ZCS) line coding format in the switch.

Table 3-2. ESF T1 CSU DIP Switch Settings

Switch		Settings	Remarks	
Stand-alone	Multi-line			
SW1-1	SW5-1	closed	This is the CSU's address. This setting will work in most applications. When CSUs are networked with each other, the addresses might have to be unique.	
SW1-2	SW5-2	closed		
SW1-3	SW5-3	closed		
SW1-4	SW5-4	closed		
SW1-5	SW5-5	closed		
SW1-6	SW5-6	closed		
SW1-7	SW5-7	closed		
SW1-8	SW5-8	open		
SW2-1	SW4-1	open	This switch sets the bit error rate threshold. These settings are the default settings, which set the threshold at 1 error in one million bits.	
SW2-2	SW4-2	closed		
SW2-3	SW4-3	open		
SW2-4	SW4-4	open		
SW2-5	SW4-5	open		not used
SW2-6	SW4-6	open		not used
SW2-7	SW4-7	open		not used

Table 3-2. ESF T1 CSU DIP Switch Settings

Switch		Settings	Remarks
Stand-alone	Multi-line		
SW3	SW3		This switch is unused. All eight switches are factory set to open.
SW4	SW2		This switch is unused. All eight switches are factory set to open.
SW5-1	SW1-8	open	This setting indicates that the switch is ESF framed. ESF framing must also be set in the DS1 circuit pack administration form. If the switch is closed, D4 framing is selected.
SW5-2	SW1-7	closed	This setting indicates that the network line coding format is AMI (ZCS in DEFINITY terminology). At present, the network does not support B8ZS end-to-end. Thus, AMI (ZCS) is usually the correct option for connections to the public network. Note that if you are using unrestricted facilities, you must use B8ZS. The open position selects B8ZS.
SW5-3	SW1-6	closed	This setting indicates that the switch is administered for ZCS line coding format (AMI in network terminology). Since the network does not in general support B8ZS end-to-end, ZCS should normally be administered in the DS1 circuit pack administration form for connections to the public network. This switch setting must agree with the SW5-2 setting. For example, if one is AMI (ZCS) then the other must also be AMI (ZCS), and similarly for B8ZS. The open position selects B8ZS.
SW5-4	SW1-5	closed	This setting allows the CRC-6 error correction code from the network to be passed through unaltered to the switch. If the switch is optioned for ESF, this is the correct setting. If the switch is optioned for D4, this switch is ignored. The open position terminates the CRC-6 from the network.

*Continued on next page*

Table 3-2. ESF T1 CSU DIP Switch Settings

Switch		Settings	Remarks
Stand-alone	Multi-line		
SW5-5	SW1-4	closed	This setting allows CRC-6 code generated by the switch to be passed through the CSU unaltered to the T1 facility. Again, this is the correct setting if the switch is optioned for ESF framing. The open position terminates the CRC-6 from the switch.
SW5-6	SW1-3	open	This is the default setting. This setting enforces the FCC part 68 ones density requirement. If set to the closed position, the CSU enforces the more stringent requirement of AT&T Technical Publication 62411.
SW5-7	SW1-2	open	This is the default setting. This setting does not allow polling of the far-end CSU for alarms.
SW5-8	SW1-1	open	This is the default setting. This switch is unused.
SW6-1	SW7-1	open	This is the default setting. It sets all ones (AIS) keep-alive to the switch if set to open or the T1 facility if set to closed during manual loopback testing.
SW6-2	SW7-2	open	This is the default setting. This setting is for decoding AMI (ZCS) line coding from the switch. If set to closed, the CSU decodes B8ZS. The switch should normally be administered for ZCS because B8ZS is not universally supported by the local exchange companies. This option must be set the same as for the switch, for example, if one is set to AMI (ZCS), so must the other.
SW6-3	SW7-3	open	This is the default setting. This setting is for decoding AMI (ZCS) from the network side. It should be set the same as the switch. Thus, if the switch is set for AMI (ZCS), then so should the network. If set to the closed position, B8ZS is selected.

*Continued on next page*

Table 3-2. ESF T1 CSU DIP Switch Settings

Switch		Settings	Remarks
Stand-alone	Multi-line		
SW6-4	SW7-4	closed	This setting is for ESF framing format from the network side. The switch should also be optioned for ESF framing. To select D4 framing, set to open.
SW6-5	SW7-5	closed	This is the default setting. It is used to default to the switch configuration on powerup.
SW6-6	SW7-6	open	This switch is not used
SW6-7	SW7-7	open	This switch is not used.
SW6-8	SW7-8	open	This is the default setting. It sends all ones during keep alive to the switch. Closed = to the network.

Switches SW7 on the stand-alone unit and SW8 on the multiline unit should be set for the length of the cable from the switch to the CSU. The settings for the two CSUs are different, however. Following are the settings for the standalone unit:

	sw 7-1	7-2	7-3	(7-4 to 7-9 not used)
0 - 133 ft	O	O	O	
134 - 266	C	O	O	
267 - 399	O	C	O	
400 - 533	C	C	O	
534 - 655	O	O	C	

Following are the settings for the multiline CSU:

- For a distance from zero feet to 285 feet, switches SW6-1 through SW6-7 should all be open, and switch SW6-8 should be closed.
- For a distance from 285 feet to 500 feet, switches SW6-1 through SW6-8 should be set as follows:
  - SW6-1 set to open
  - SW6-2 set to open
  - SW6-3 set to closed
  - SW6-4 set to open
  - SW6-5 set to closed



- SW6-6 set to open
- SW6-7 set to closed
- SW6-8 set to open
- For a distance from 500 feet to 655 feet, switches SW6-1 through SW6-8 should be set as follows:
  - SW6-1 set to open
  - SW6-2 set to closed
  - SW6-3 set to open
  - SW6-4 set to closed
  - SW6-5 set to open
  - SW6-6 set to closed
  - SW6-7 set to open
  - SW6-8 set to open

### ESF T1 CSU Artificial Line Option Settings

Set the XMT (artificial line option) switch as follows:

- 0 dB if the network interface is an 8-pin jack
- 15 dB if the distance to the nearest facility repeater is between 2000 and 3000 feet
- 7.5 dB for a distance of 1000 to 2000 feet
- 0 dB for a distance of 0 to 1000 feet

The facility provider is obligated to provide you with the distance to the nearest repeater. If you cannot get this information, you can measure the T1 signal level to determine the correct XMT option setting. This requires a T1 test set. The following table shows the correct settings based on the T1 signal level:

T1 Voltage	Cable Length in Feet to Nearest Repeater (22 gauge)	CSU Setting
< 1.68	> 3000 feet	The CSU is located too far from the nearest repeater.
1.68	3000	15 dB
2.03	2500	7.5 dB
2.47	2000	7.5 dB
3.05	1500	7.5 dB
3.76	1000	0 dB
4.51	500	0 dB
> 4.51	< 500	0 dB

## Other ESF T1 CSU Settings

Following are additional ESF T1 CSU switch settings:

- Leave the unit memory address code alarm option (rocker switch SW1) to the default (factory) setting. This switch allows ESF diagnostic test sets to address up to 256 ESF T1 CSUs. This switch does not have to be set unless you are using diagnostics and testing more than one CSU in a network.
- Leave the BER threshold alarm option (rocker switch SW2) in its default setting.
- Leave the transparency option (strap option W1) in its default setting (not installed). This switch is used to accommodate older T1-type DTEs that send unframed bit streams.
- Option the CSU for local power dry loop.

## Smart Jacks

"Smart jack" is the common term used for the loopback units installed by the T1 facility providers at the network interface to which the CSU is connected. They are becoming much more common and should become the standard network interface in the future. Following is an article excerpted from the July 1989 *AT&T NTO Technical Monthly* describing the Westell loopback units:

With the introduction of the Westell type "smart jacks" by some facility providers, there has been some confusion that results in long installation and trouble learning intervals. Included here are some facts about the Westell T1 Facility

Loopback Units. There are two basic families of these jacks, the 3100-XX and 3101-XX series. Each family contains 16 versions of the jack. The only difference in the two families are the loopback activate and deactivate codes. The 3100-XX series has a 5 digit code, 11000 to activate and 11100 to deactivate. The 3101-XX series has a 4 digit loopback code, 1100 to activate and 1110 to deactivate. The reason for 16 versions of each series is to provide combinations of four options:

1. DC loopback ability
2. Shorting or non shorting customer interface jacks (RJ48)
3. Local powering
4. Bantam jacks and terminations for order wire and fault locate pairs

These units are equipped with LBO circuitry for 0dB, 7.5dB and 15dB which allows us to set our CSUs for zero and have the owner of the facility make the proper adjustments. Where these units are properly installed there should be no more guessing about the distance to the last repeater!

The units have a built in 8-pin mini-modular connector. The receive tip and ring are on pins 2 and 1 and the transmit tip and ring are on pins 5 and 4. This configuration conforms to TR 62411 DEC 1988, FCC Part 68 and ANSI T1E1 for RJ48C and RJ48X jacks. There is one exception to this and it is a unit coded 3101-00. The transmit tip ring of this unit are on pins 8 and 1 and the receive tip and ring are on pins 5 and 4. This unit conforms to the old PUB 62411, OCT 1985, in reference to the ISDN standard for an 8 pin mini-modular connector. Westell states that this is the first unit they made and it was built to specifications provided by a customer.

In most cases the facility provider will option the above units to loop (switch 4) the span power. This will allow them to power the unit from the span and provide sealing current in the facility segment to the customer premises but avoid resenting hazardous potentials on the customer side of the network interface.

## **CEPT1 Channel Service Unit**

Most countries providing E1 service provide the CSU function as part of the central office. Other countries do not have any public network services. In these cases, the customer must supply the CSU. Presently, AT&T uses the number 8 TR631 Digital Line Unit, provided by AT&T Network Systems International for these 2.048 mbps CSU applications.

## **Multiplexers and Other Customer Premises Equipment**

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**NOTE:**

Equipment such as T1 multiplexers, bit compression multiplexers, and echo cancellers can corrupt the DS1/CEPT1 bit stream. This is especially true of echo cancellers. Some T1 multiplexers, for example, have built-in echo cancellers that will corrupt the bit stream. Thus, if you are have problems isolating a problem with establishing an ISDN PRI D channel link, check to see if any of these types of equipment are in the circuit.

## Physical Layer

# 4

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This chapter discusses how various aspects of the physical layer protocols for DS1 and CEPT1 trunks have been designed into the DEFINITY systems. It discusses these subjects as they relate to narrowband (64 kbps) switching.

For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

In the cases where a relationship exists, this chapter discusses how physical layer subjects relate to system administration. For a complete guide to administering narrowband DS1 and CEPT1 capabilities, however, you should refer to [Chapter 6, "System Administration"](#). The physical layer aspects of digital trunks on the DEFINITY systems include those subjects involved with transmitting bits from one DS1/CEPT1 interface to the far-end interface. Many functions of the physical layer are governed by administration options in the DEFINITY systems. This chapter covers those subjects.

## Bit Rate

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Bit rate is the number of bits per second transmitted by a digital facility interface circuit pack. DEFINITY systems support two digital trunk bit rates, DS1 (digital signal level 1) and CEPT1 (Conference of European Postal and Telecommunications Rate 1). The DS1 rate is 1.544 mbps. The CEPT1 rate is 2.048 mbps.

G2.2 supports the DS1 rate only. G3V2 supports both the DS1 and the CEPT1 rates on the TN464C or later DS1/CEPT1 board.

## G2.2 Bit Rate Implementation

No special administration is required to implement the bit rate in these systems.

## G3V2 Bit Rate Implementation

To implement the desired bit rate in G3V2 you must do the following:

- Determine the required bit rate for your application. For example, you might be connecting to the public network in a country that supports only the CEPT1 bit rate. You might, on the other hand, be directly connecting to another DEFINITY system in which case you could choose to use the either the DS1 rate or the CEPT1 rate. Both ends of the interface must use the same rate.
- You must have a TN464C or later to implement the CEPT1 bit rate. You must have a TN464C or later or a TN767 or a TN722 to implement the DS1 bit rate.
- Enter the correct option in the DS1 circuit pack form in the `Bit Rate` field.

### NOTE:

The title of the DS1 circuit pack form is misleading because it is used to administer both DS1 and CEPT1 circuit packs.

- Set the bit rate jumper on the TN464C to the correct rate.

### NOTE:

A system can consist of both DS1 and CEPT1 interfaces. Thus, a call incoming on a CEPT1 facility can be switched to a trunk on a DS1 facility and vice versa.

## Framing Format

Framing is a concept common to both DS1 and CEPT1 standards, though they differ in how they implement framing. A frame is the set of 24 (DS1) or 32 (CEPT1) 8-bit time slots that is treated as a single transmission unit.

Each CEPT1 frame has 32 time slots. Each DS1 frame has 24 time slots, plus 1 bit, known as the framing bit, that is inserted at the beginning of each frame.

Since each frame repeats time slots in the same sequence as previous frames, the time slots representing a single conversation or data stream form a DS0 channel.

DS1 boards support two framing formats, selectable through system administration, the D4 superframe (also called D4 framing) and the extended superframe (ESF). The ESF format is preferred because of its superior reliability.

However, either the superframe or the extended superframe format may be chosen; the decision must depend on the network equipment and application.

The framing format does not place any requirement on the type of signaling or line coding to be used. However, the type of framing used at both ends of the transmission facility must be identical, unless the signaling and framing are converted somewhere in the transmission stream (as might happen in international communication).

## The DS1 Superframe

A synchronization pattern is a continuously repeating string that orients the receiving end to a frame's boundaries during a transmission. The DS1 superframe, formerly called the D4 frame, uses a 12-bit fixed synchronization pattern (100011011100). This 12-bit pattern is formed by the framing bit (the first bit) from 12 consecutive frames. When the receiving port finds the pattern across the frames, it coincidentally has found the boundaries of each frame, because the framing bit marks a frame's beginning and end. The 12-frame unit that contains the synchronization pattern is known as the *superframe*.

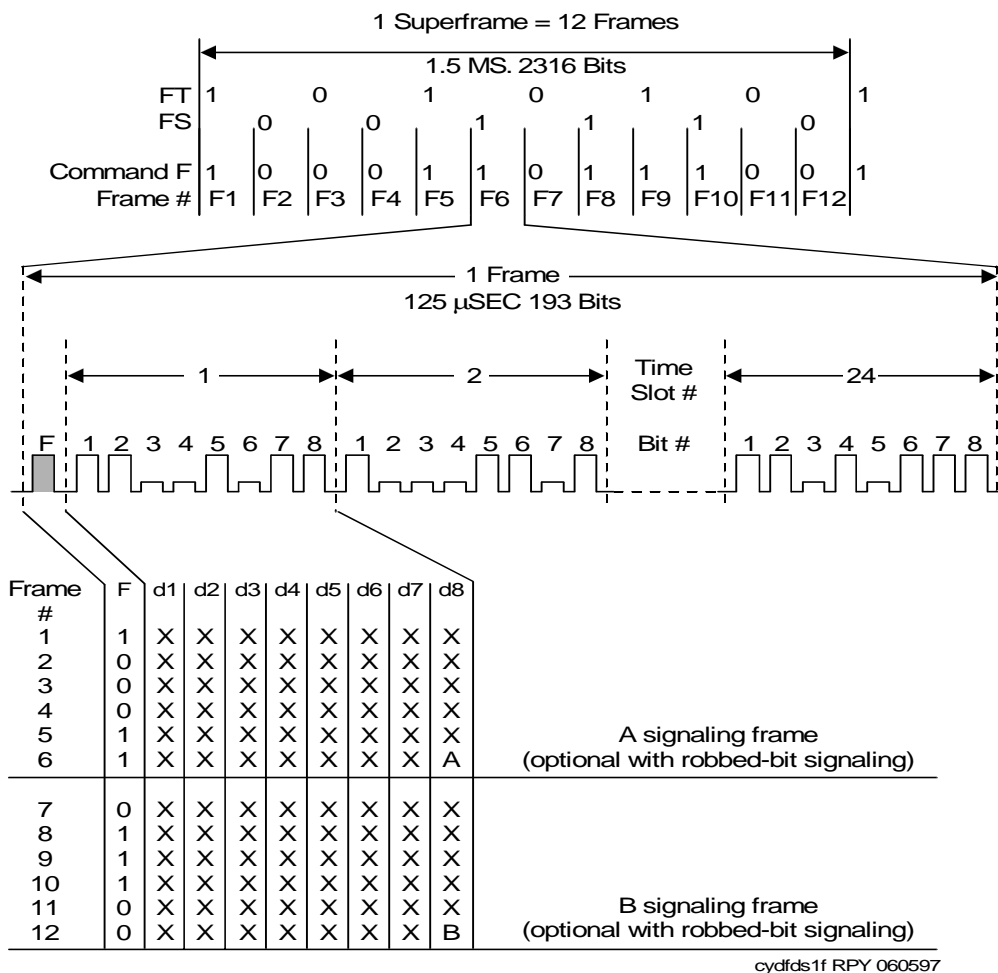


Figure 4-1. DS1 Superframe Format

### DS1 ESF Framing

The ESF framing format was developed after the superframe format. Not all equipment used with the DS1 interface supports ESF. Specifically, most D4 channel banks (unless they are configured as LIU-3ESF or equivalent) and CDMs do not currently support ESF framing.



Frame number	Frame bit definitions	Frame bit		Channel 1		Channel 2	
		→	←				
1	Data link F bit (DL)			8-Bits			
2	CRC-6 F bit			8-Bits			
3	Data link signal			8-Bits			
4	Frame sync pattern	0		8-Bits			
5	Data link signal			8-Bits			
6	CRC-6 F bit			7-Bits	A	Robbed bit (optional)	
7	Data link signal			8-Bits			
8	Frame sync pattern	0		8-Bits			
9	Data link signal			8-Bits			
10	CRC-6 F bit			8-Bits			
11	Data link signal			8-Bits			
12	Frame sync pattern	1		7-Bits	B	Robbed bit (optional)	
13	Data link signal			8-Bits			
14	CRC-6 F bit			8-Bits			
15	Data link signal			8-Bits			
16	Frame sync pattern	0		8-Bits			
17	Data link signal			8-Bits			
18	CRC-6 F bit			7-Bits	C	Robbed bit (optional)	
19	Data link signal			8-Bits			
20	Frame sync pattern	1		8-Bits			
21	Data link signal			8-Bits			
22	CRC-6 F bit			8-Bits			
23	Data link signal			8-Bits			
24	Frame sync pattern	1		7-Bits	D	Robbed bit (optional)	

cydfesfr RPY 060597

Figure 4-2. The Extended Super Frame

The synchronization pattern for the ESF format is formed by the framing bit from 24 consecutive frames. Unlike the 12-bit synchronization pattern for D4, which utilizes all of the available framing bits for synchronization, ESF employs only 6 of the available 24 framing bits to carry a synchronization pattern. The other 18 framing bits form a 6-bit error-detection code, called the *cyclic redundancy check* (CRC) sum, and a 12-bit facility data link signal. Each 24-frame entity, spanning one ESF cycle, is referred to as an *ESF superframe*.

**⇒ NOTE:**

The facility data link is a 4-kbps data link designed to maintain and supervise the DS1 facility. However, this 4-kbps data link is not used by DEFINITY systems.

The CRC is used at the receiving end to detect transmission errors, as follows: The CRC is calculated at the transmitting end and multiplexed into the DS1. At the receiving end, the CRC is recalculated using the data in the received ESF superframe and then compared with the received CRC. If the recalculated CRC and received CRC do not match, a *misframe* is declared. The DS1 interface counts misframes and uses the count for processing DS1 facility performance indicators, such as bit-error rates, major alarms, and minor alarms.

The ESF reframing algorithm can find the synchronization pattern even if the time slots for the 24 channels carry a bit sequence identical to it.

## CEPT1 Framing

CEPT1 framing is used on 2.048 mbps CEPT1 32-channel (0-31) links. It is supported only on G3V2 systems on the TN464C or later. With CEPT1 framing, the 0 channel contains all the framing information. With CEPT1 framing, the framing information is cycled through sixteen (0-15) frames (each containing channels 0-31).

Within the 16-frame cycle, bit 1 of channel 0 cycles through three functions:

- When the CRC-4 error checking scheme is used, a CRC bit is encoded as the first position of all the even-numbered frames. CRC-4 is a 4-bit error detection code. Each 16-frame cycle contains two CRC-4 error codes. When CRC-4 is not used, the first-bit of even-numbered frames is unassigned.
- The first bit of frames 1, 3, 5, 7, 9, and 11 contains a framing-pattern bit. In the 16-frame cycle, the framing pattern is "001011."
- The first bit of frames 13 and 15 contain remote-end error bits. In the receive direction, a 0 indicates an error. In the transmit direction, the detection of an error is indicated by changing the 1 to a 0.

Note that the TN464C does not check the received remote end error bits and always transmits ones in the remote end error bits. The Tn464D and later circuit packs will perform remote end error reporting.

In addition, bits 2 through 8 of even-numbered frames contain the following framing pattern: 0011011. In odd-numbered frames:

- Bit 2 is always 1.
- Bit 3 contains a remote frame alarm bit. When this bit is equal to 1, the alarm is set.
- Bits 4 through 8 are unassigned.

Table 4-1 illustrates these points:

Table 4-1. 2.048 Mbps CEPT1 in Channel 0

Frames	Bits in channel 0							
	1	2	3	4	5	6	7	8
0	C1	0	0	1	1	0	1	1
1	0	1	Yf	U	U	U	U	U
2	C2	0	0	1	1	0	1	1
3	0	1	Yf	U	U	U	u	U
4	C3	0	0	1	1	0	1	1
5	1	1	Yf	U	U	U	U	U
6	C4	0	0	1	1	0	1	1
7	0	1	Yf	U	U	U	U	U
8	C1	0	0	1	1	0	1	1
9	1	1	Yf	U	U	U	U	U
10	C2	0	0	1	1	0	1	1
11	1	1	Yf	U	U	U	U	
12	C3	0	0	1	1	0	1	1
13	E	1	Yf	U	U	U	U	U
14	C4	0	0	1	1	0	1	1
15	E	1	Yf	U	U	U	U	U

Notes:

1. C1 through C4 = CRC-4 bits
2. U = Unassigned bit
3. Yf = Remote frame alarm bit
4. E = Remote end block error bits

## G2.2 Framing Format Implementation

In G2.2 you select either ESF or D4 framing in procedure 260, word 1, field 6.

## G3V2 Framing Format Implementation

If you administer the DS1 bit rate, the G3V2. supports D4 and ESF as options in the S1 circuit pack form. You should use ESF if possible. The primary reason for this is for reframing after a misframe. ESF automatically reframes whereas D4 does not. This ability to reframe is especially crucial in digital data communications. You must specify ESF framing on the service order form if you are using a Network service in the U.S. You must also option ESF on the CSU. If D4 framing is used, the far end and the CSU must also use D4-framing for that DS1 interface.

To administer framing, enter either **esf** or **D4** in the *Framing Mode* field on the DS1 Circuit Pack form.

If the 2.048 mbps option is administered, no option appears on the form, meaning CEPT1 framing is automatically administered.

## Companding

Companding is a method of improving the signal-to-noise (S/N) ratio resulting from the pulse code modulation (PCM) process on voice calls. It is available as an administration option only on G3V2 systems. Furthermore, it can be administered for lines and for trunks. This document considers only the implementation of trunk companding.

To understand companding, you must first understand PCM. During PCM, samples of the signal amplitude are taken at regular intervals. The amplitude of each sample is first digitized (quantized) and then rounded up. This rounding operation causes quantization noise. The quantization noise is proportionately greater at lower amplitudes.

With companding, the analog signal's amplitude range is compressed before it is quantized and transmitted. The quantized signal is expanded by a special PCM decoder after it is received. With digitized transmission, companding amounts to assigning a small unit of quantization noise to lower amplitudes and larger units to higher amplitudes. This reduces the amount of quantization noise.

Either of two algorithms are used to compand voiceband signals: A-law and mu-law. A-law is generally used in countries that use CEPT1 transmission at 2.048 mbps; while mu-law companding is used in countries with DS1 transmission at 1.544 mbps. When transmitting internationally, the A/mu-law conversion is performed at the same time the DS1/CEPT1 conversion is done. The following tables summarize the companding support in different countries at this time:

**Table 4-2. Countries Supporting A-Law Companding at the CEPT1 Bit Rate**

**European**

Belgium	Czechoslovakia	France
Germany	Greece	Hungary
Italy	Netherlands	Russia
Spain	Switzerland	U.K.

**Pacific Rim**

Australia	China	India
Indonesia	New Zealand	Philippines
Singapore	Thailand	

**Americas**

Brazil	Costa Rica	Mexico
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**Middle East**

Egypt <sup>1</sup>	Saudi Arabia
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1. Except Cairo, which uses mu-law companding at the CEPT1 bit rate.

**Table 4-3. Countries Supporting mu-Law Companding at 1.544 Mbps Only**

**Pacific Rim**

Hong Kong
Taiwan

**Americas**

Canada	Dominican Republic	Puerto Rico
United States	Venezuela	

**Table 4-4. Countries Supporting mu-Law Companding at both DS1 and CEPT1 Bit Rates**

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Japan  
Korea  
Venezuela

Any DEFINITY system using any DS1 interface board other than the TN464C or later is mu-law by default and cannot be changed in administration. If a TN464C or later is used on a G3V2, however, companding is administrable. The following field appears on the DS1 circuit pack form:

Interface Companding: This field can be set to either **alaw** or **mulaw**. Both ends of the DS1 or CEPT1 span must have the same companding.



**NOTE:**

A system can consist of both A-law and mu-law interfaces. Thus, calls incoming on A-law facilities can be switched to outgoing mu-law facilities and vice versa.

## **Channel Structure and Signaling**

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The physical layer aspects of channel structure and signaling are implemented in the digital trunk boards in the DEFINITY systems. The DS1 bit stream is time-multiplexed into 24 64 kbps channels. The CEPT1 bit stream is time-multiplexed into 32 64 kbps channels. Within this basic channel structure, variations in signaling exist. Following are the types of signaling available on DS1 boards:

- Bit-oriented signaling, which is further divided into the following types:
  - Robbed bit signaling
  - Common channel signaling, which is further divided into the following types:
    - AT&T Proprietary common channel signaling
    - DMI-BOS common channel signaling
- ISDN PRI signaling

Following are the CEPT1 signaling types:

- Bit oriented common channel signaling, which includes only one type called channel associated signaling (CAS)
- ISDN PRI signaling

## Robbed-Bit Signaling

Robbed-bit signaling (RBS) may be used over DS1 1.544 mbps facilities. With RBS, in every 6th frame the signaling algorithm replaces (that is, “robs”) the least-significant bit (LSB) of each channel. It replaces this bit with the signaling information for that channel. For the superframe format, the 6th and 12th frames carry RBS; for ESF, the 6th, 12th, 18th, and 24th frames carry RBS.

Each signaling frame alternates between the A bit and the B bit. Thus, the 6th frame carries the A bit, the 12th the B bit, and so on.

Because the signaling information is carried embedded within each channel, RBS signaling is also called *inband signaling*.

Since not all eight bits of every byte can be used but seven bits of every byte can be used, robbed bit channels administered as trunks can carry information of no more than 56 kbps. This allows voice, voice-grade data and mode 1 digital data to be transported on robbed bit facilities.

## DS1 Common Channel Bit Oriented Signaling

Common channel signaling on DS1 facilities places the signaling bits (the A and B bits) into the 24th channel. This permits the channels to use their full 64 kbps bandwidth capacity because no bits are robbed from the information-bearing channels (the trunk channels). Thus, this type of signaling provides 23 64-kbps channels for voice or data transmission, with the 24th channel reserved for signaling only.

The format used to carry signaling information requires 24-frames, a requirement met by ESF. For the D4 superframe format to meet this requirement, however, two D4 superframes are linked together to form the required 24-frame superframe. Within 24th-channel bit-oriented signaling, there are two variations:

- AT&T proprietary signaling
- DMI BOS (bit-oriented signaling)

AT&T proprietary signaling was the first type of 24th-channel signaling provided by System 75 and System 85. It was developed to carry DCP-formatted data (in digital form) between System 75 and/or System 85 switches. AT&T proprietary signaling is described in the initial release of the DMI technical specification (select code 500-029).

For AT&T proprietary signaling, a complete set of signaling information is sent every 24 frames. This 24-frame period is not synchronized to the 12-frame superframe (D4) format or to the 24-frame extended superframe (ESF) format. Each signaling byte contains the equivalent of a channel identification number and the signaling state for that channel. The channel identification number is necessary since the channel signaling information may not be synchronized with the voice or data channel that it describes.

Some types of public network equipment were incompatible with this type of 24th-channel signaling and, as a result, another type of 24th-channel signaling, called DMI bit-oriented signaling (DMI-BOS), was developed. For DMI-BOS, specific 24th-channel bit locations carry framing and alarm data, and signaling information for the other 23 channels. Unfortunately, DMI-BOS and AT&T proprietary signaling are not compatible. DMI-BOS must be used for connections to host computers and other vendors' equipment that meets the DMI technical specification for BOS. [Table 4-5](#) illustrates the channel structure of a DMI-BOS interface:

**Table 4-5. 1.544 Mbps DMI-BOS in Channel 24**

Frames	Bit in channel 24							
	1	2	3	4	5	6	7	8
1	A13	A1	B1	X	X	X	1	X
2	A14	A2	B2	X	X	X	1	X
3	A15	A3	B3	X	X	X	1	X
4	A16	A4	B4	X	X	X	1	X
5	A17	A5	B5	X	X	X	1	X
6	A18	A6	B6	X	X	X	1	X
7	A19	A7	B7	X	X	X	1	X
8	A20	A8	B8	X	X	X	1	X
9	A21	A9	B9	X	X	X	1	X
10	A22	A10	B10	X	X	X	1	X
11	A23	A11	B11	X	X	X	1	X
12	1	A12	B12	X	X	X	1	X
13	A1	A13	B13	X	X	X	1	X
14	A2	A14	B14	X	X	X	1	X
15	A3	A15	B15	X	X	X	1	X

*Continued on next page*



**Table 4-5. 1.544 Mbps DMI-BOS in Channel 24 — Continued**

Frames	Bit in channel 24							
	1	2	3	4	5	6	7	8
16	A4	A16	B16	X	X	X	1	X
17	A5	A17	B17	X	X	X	1	X
18	A6	A18	B18	X	X	X	1	X
19	A7	A19	B19	X	X	X	1	X
20	A8	A20	B20	X	X	X	1	X
21	A9	A21	B21	X	X	X	1	X
22	A10	A22	B22	X	X	X	1	X
23	A11	A23	B23	X	X	X	1	X
24	A12	1	1	1	0	RMA	0	1

Notes:

1. .X = Reserved for future use. Set to 0.
2. RMA = Remote multiframe alarm (0 = alarm; 1 = normal)
3. Bit 7 = Primary bit pattern for signaling integrity check
4. Bits 3, 4, 5, and 8 in frame 24 = Secondary bit pattern for signaling integrity check
5. A and B = Signaling bits for indicated channels.
6. The TN722 supports only AT&T proprietary signaling. However, the TN722B can be administered to support either AT&T proprietary signaling or DMI-BOS.
7. The TN767 on G3iV2. can be administered for either DMI-BOS or ISDN-PRI signaling. For the G3rV2, the TN767 is reserved for DMI-BOS signaling, while the TN464C can be administered for either ISDN-PRI or DMI-BOS signaling.

**CEPT1 Common Channel Bit-Oriented Signaling**

CEPT1 bit oriented signaling uses the 16th channel to carry signaling information for the other 30 channels (robbed bit signaling does not exist in CEPT1). This permits the channels to use their full 64 kbps bandwidth capacity. CEPT1 facilities use only one type of bit oriented signaling, called channel associated signaling (CAS). With CAS, channels 1 through 15 and 17 through 31 are used for voice and data transmissions and channel 0 is used for framing (see CEPT1 Framing).

Like CEPT1 framing, CAS signaling is cycled through sixteen (0-15) frames (each containing channels 0-31), as shown in [Table 4-6](#):

**Table 4-6. 2.048 Mbps CAS in Channel 16**

Frames	Bit in channel 16							
	1	2	3	4	5	6	7	8
0	0	0	0	0	X	Y	X	X
1	A1	B1	C1	D1	A17	B17	C17	D17
2	A2	B2	C2	D2	A18	B18	C18	D18
3	A3	B3	C3	D3	A19	B19	C19	D19
4	A4	B4	C4	D4	A20	B20	C20	D20
5	A5	B5	C5	D5	A21	B21	C21	D21
6	A6	B6	C6	D6	A22	B22	C22	D22
7	A7	B7	C7	D7	A23	B23	C23	D23
8	A8	B8	C8	D8	A24	B24	C24	D24
9	A9	B9	C9	D9	A25	B25	C25	D25
10	A10	B10	C10	D10	A26	B26	C26	D26
11	A11	B11	C11	D11	A27	B27	C27	D27
12	A12	B12	C12	D12	A28	B28	C28	D28
13	A13	B13	C13	D13	A29	B29	C29	D29
14	A14	B14	C14	D14	A30	B30	C30	D30
15	A15	B15	C15	D15	A31	B31	C31	D31

Notes:

1. X = unused bit to be set to 1.
2. Y = bit used to indicate multiframe alignment.
3. 0000 = In bits 1 through 4 of frame 0. Multiframe alignment signal.
4. Bits 1, 2, 5, and 6 are the A and B bits used for forward and backward signaling in time slots numbered against them.
5. Bits 3 and 7 are the C bits. All C bits are set to 0 in transmission and ignored by the receiver.
6. Bits 4 and 8 are the D bits. All D bits are set to 1 in transmission and ignored by the receiver.

Note that except for frame 0, the 16th channel of each frame holds the signaling for two voice/data channels. The signaling is held in positions A through D. For example, the 16th channel of frame 2 holds the signaling bits (bits A through D) for voice/data channels 2 and 18. The 16th channel of frame 0 carries the multiframe alignment signal (0000) in bits 1 through 4 and an alarm indication in bit 6.

## ISDN PRI Signaling

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ISDN PRI signaling is a form of message oriented signaling in which a common signaling channel carries multibyte messages for signaling.

Both DS1 and CEPT1 reserve a common channel for ISDN PRI signaling. In DS1 facilities, the 24th channel is reserved for ISDN PRI signaling while in CEPT1 facilities the 16th channel is reserved. Unlike bit-oriented signaling, this channel is left unformatted at the physical layer so that it can be used by higher level protocols to carry messages.

### ⇒ NOTE:

The public network ISDN PRI in Australia (Country option 2) maps CEPT1 channels 1-31 to ISDN PRI B channels 1-30. This means that systems interfacing to the public network in Australia will be incorrectly mapped from channels 17-31. Using country option 2 compensates for this mapping. For details on this subject, see the section [“Channel ID IE”](#) in [Chapter 5, “Layers 2 and 3”](#).

## G2.2 Signaling Implementation

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G2.2 implements the physical layer aspects of DS1 signaling in procedure 260, word 1, fields 7, 8, 14, and 19 as follows:

- For trunks using robbed bit signaling, field 7=**blank**, field 8=**1**, field 14=**0**, field 19=**dash**.
- For trunks using AT&T proprietary common channel bit-oriented signaling, field 7=**blank**, field 8=**0**, field 14=**0**, 19=**1**.
- For trunks using DMI-BOS common channel bit-oriented signaling, field 7=**blank**, field 8=**0**, field 14=**1**, 19=**0**.
- For trunks using ISDN PRI signaling, field 7=**0** if it is a FAS board or **1** if it is an NFAS board with all B channels, field 8=**0**, field 14=**5**, 19=**dash**.

### ⇒ NOTE:

On Generic 2.2 traditional modules, the ANN11B and ANN11C support only AT&T proprietary signaling. The ANN11D and ANN11E support both AT&T proprietary signaling and DMI-BOS. They default to DMI-BOS, but automatically switch to AT&T proprietary signaling whenever the distant end is using AT&T proprietary signaling.

## G3V2 Signaling Implementation

The following field appears in the DS1 circuit pack form:

Signaling Mode: Enter either **robbed-bit**, **common-chan**, or **isdn-pri**, **CAS**, or **isdn-ext**. Administering robbed bit signaling on a DS1 interface yields 24 information channels capable of carrying voice or 56 kbps data. You can administer some channels on a DS1 interface to be robbed-bit channels and the rest of the channels on the interface as ISDN PRI channels. To do this, you must administer the DS1 Circuit Pack form as **isdn-pri**. When you subsequently add ports on the interface to a trunk group, those ports that are added to non- ISDN PRI trunk groups automatically become robbed bit trunks. Note, however, that this capability is not supported on the CEPT1 interface.

If you administer common channel signaling, you must also complete the following field on the DS1 circuit pack form:

DMI-BOS? If you enter **y** here, you get DMI-BOS signaling. If you answer **n**, you get AT&T proprietary signaling. In either case, you get 23 64 kbps information channels per DS1 interface that can each be administered as trunks to be used for voice, mode 0, mode 1, mode 2, or mode 3 data. CAS is channel-associated signaling (CAS), which is a form of common channel signaling. The option **isdn-ext** designates that the D channel signaling for this board is on another board and that this board contains all B channels. [Table 4-7](#) summarizes how to administer the circuit packs to generate the type of signaling indicated:

Table 4-7. DS1/CEPT1 Port Boards Signaling Summary

Board Code	No. Voice/ Data Channels	Bit Rate (mbps)	Companding	Signaling	Trunk Type
TN722	23	1.544	mu-law	comm-chan	Tie
	24			robbed-bit	Tie
TN722B	23	1.544	mu-law	comm-chan	
	24			robbed-bit	Tie
TN767	23	1.544	mu-law	comm-chan	CO/DID/Tie
	24			robbed-bit	CO/DID/Tie
	23			isdn-pri	ISDN (G3iV2)
	24			isdn-ext	ISDN
TN464C	23	1.544	mu-law	comm-chan	Tie
	24	1.544	mu-law	robbed-bit	CO/DID/Tie
	23	1.544	A-law/mu-law	isdn-pri	ISDN
	24	1.544	A-law/mu-law	isdn-ext	ISDN
	30	2.048	A-law/mu-law	isdn	ISDN
	31	2.048	A-law/mu-law	isdn-ext	ISDN
	30	2.048	A-law/mu-law	CAS	CO/DID/Tie

Notes:

1. CO is any of the following trunk types: CO, FX, and WATS.
2. Tie is any of the following trunk types: access, tie, tandem, RLT, aplt.
3. If CAS is used on a CO trunk type, the country protocol must be correct for that country.
4. The TN767 cannot be used for ISDN PRI signaling on a G3rV2. It can be used as an NFAS board, however, containing all B channels (isdn-ext).

## Line Coding

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Line coding is the pattern that data assumes as it is propagated over a communications channel. Digital trunks on DEFINITY systems use the following line codings:

- Alternate Mark Inversion (G3 V2 only, CEPT1 interfaces only)
- Alternate Mark Inversion with Zero Code Suppression (all systems, DS1 interfaces only)
- Alternate Mark Inversion with Bipolar 8 Zero Substitution (all systems, DS1 interfaces only)
- Alternate Mark Inversion with High Density Bipolar 3-bit Substitution (G3 V2 only, CEPT1 interfaces only)

Since all of these line coding schemes employ Alternate Mark Inversion (AMI) line coding, the rest of this document refers to AMI with zero code suppression (ZCS) as ZCS, AMI with bipolar 8 zero substitution (B8ZS) as B8ZS, and AMI with high density bipolar 3-bit substitution (HDB3) as HDB3.

Governing line coding is a set of parameters that must be defined for all digital transmissions. These transmission parameters specify the voltage levels and patterns in which 1s and 0s can appear on the line.

The parameters chosen for a given transmission stream must meet the requirements set by the hardware through which the data is to be transmitted. Most notable among these requirements are two established by the AT&T network. The first of these requirements states that the voltage on the line should be a net DC 0. *Alternate mark inversion* (AMI) was adopted to fulfill this requirement. The second requirement, known as the *ones density requirement*, states that in every stream of 15 consecutive bits, a one must appear. If the density of 1s is not great enough, loss of synchronization results. *Zero code suppression* (ZCS), *binary 8-zero substitution* (B8ZS), and *high density bipolar* (HDB) line coding were adopted to meet this requirement. [Figure 4-3](#) shows the representation of 0s and 1s in AMI line coding:

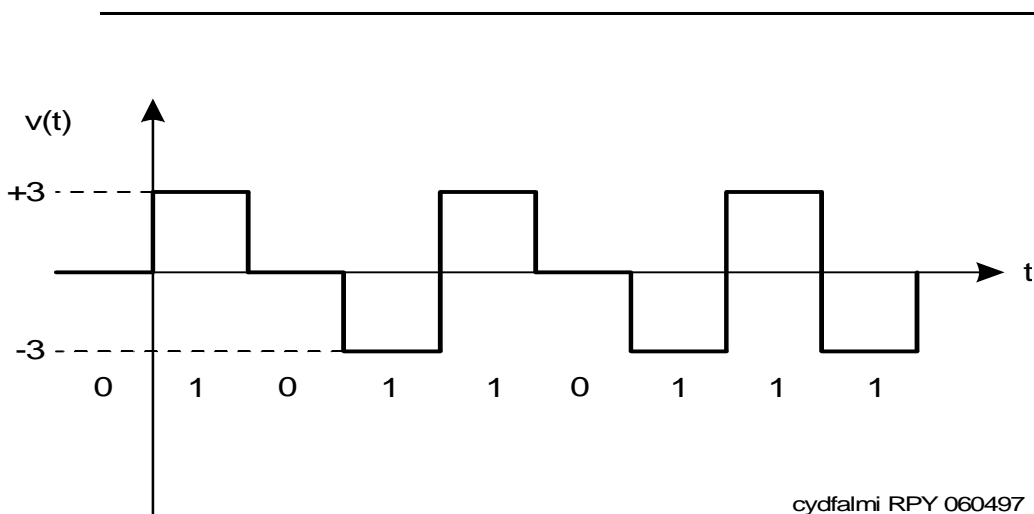


Figure 4-3. Alternating Mark Inversion

### Alternating Mark Inversion Line Coding

All transmissions generated by digital trunk ports are encoded in AMI. AMI was designed to fill the line repeater's need for dependable and recurring voltage changes on the line. With AMI, every 1 in the transmission stream changes the line state alternately to either +3 volts or -3 volts. That is, every other 1 is represented as +3 volts, with the following 1 being represented as -3 volts. A zero is always represented as 0 volts. Note that AMI line coding does not guarantee the proper density of 1s in the transmission. The AMI option is available on G3V2, however, by entering **none** in the *Line Coding* field in the DS1 circuit pack form.

### ZCS Line Coding

Zero Code Suppression (ZCS) line coding is AMI line coding combined with a scheme to ensure the proper density of 1s in the transmission. It ensures that each transmitted AMI byte contains at least one 1. DS1 ports that are administered for ZCS line coding examine each byte, one time slot at a time, and arbitrarily substitute a 1 for the second least-significant bit of any all-zeros byte they find. Note that replacing a 0 with a 1 will not affect voice communications but will corrupt digital data communications.

### B8ZS Line Coding

Like ZCS, Bipolar 8 zero substitution (B8ZS) line coding is AMI line coding combined with a scheme to ensure the proper density of 1s in the transmission. B8ZS line coding is used only on DS1 interfaces in DEFINITY systems. B8ZS line

coding substitutes a predetermined bit string for every group of eight consecutive zeros that it finds in the transmission stream. The predetermined substitute string contains intentional bipolar pulse violations so that it can be recognized at the receiving end. Thus, unlike with ZCS, B8ZS line coding will not corrupt digital data because the far end recognizes the substitution so that it can be restored to its original data.

B8ZS works as follows:

1. The transmitting DS1 board (or other B8ZS line equipment) detects 8 consecutive 0s.
2. If the value of the last 1 transmitted was a + voltage, the string of 8 0s is replaced with the following string: 000+-0-+. The first + in this string is a bipolar violation because the + of the last 1 is followed by another +. Similarly, the second - in this string is a bipolar violation because it follows the first -.
3. If the last 1 transmitted was a - voltage, the string of 8 0s is replaced with the following string: 000-+0+-. Here, the first - and the second + are bipolar violations.
4. At the receiving end (assuming the receiver understands B8ZS) this string is recognized because of the bipolar violations and is restored to 8 0s.

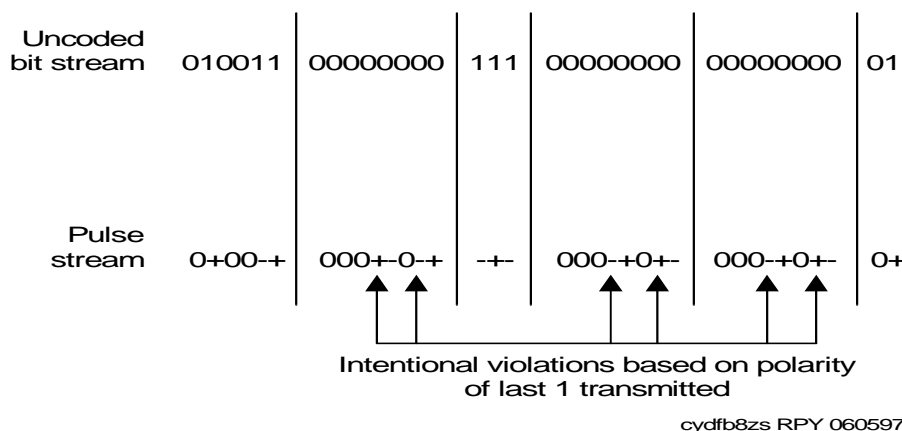


Figure 4-4. Example of B8ZS Line Coding

### HDB3 Line Coding

High density binary 3 substitution, HDB3, line coding, like ZCS and B8ZS, is AMI line coding combined with a scheme to guarantee 1s density. HDB3 line coding replaces any string of 4 consecutive zeros with one of the following two sequences:



1. 100V if there has been an even number of 1s since the last substitution. V means a bipolar violation. For example, if the last 1 was a +, the V would be a +.
2. 000V if there has been an odd number of 1s since the last substitution.

To illustrate HDB3, consider the following string:

Input bit stream	1011	0000	01	0000	0000
HDB3-coded bit stream	1011	100V	01	000V	100V
HDB3-coded levels	-0+-	+00+	0-	000-	+00+

When the receiver detects the 100V string or the 000V string, it replaces it with 0000.

Note that HDB3 is the line coding technique used by most CEPT1 countries with a 2.048 mbps primary rate. HDB3 encoding and decoding is performed by CEPT1 DACS, MX3 multiplexors, ASSET III, and 2.048 mbps satellite modems at the earth stations.

## Restricted and Unrestricted Facilities and Data

A restricted facility is a DS1 or CEPT1 span, including the interface boards at each end, that performs zero code substitution at some point in the span. For example, in the U.S., many T1 facilities have line repeaters that use zero code suppression. These facilities are called restricted because they restrict the type of information that can be transported on them without being corrupted. Specifically, digital data that contains an all 0s byte cannot be transported over restricted facilities without being corrupted. All other facilities, i.e., facilities having line coding other than ZCS, are unrestricted. Terms often confused with restricted/unrestricted facilities are restricted/unrestricted data.

Unrestricted data is data that must be transported over unrestricted facilities to remain uncorrupted because it does not meet the 1s density requirements. For endpoints on the DEFINITY systems, mode 0 data, which is 64 kbps data with no protocol packaging, mode 3, which is 64 kbps data packaged in non-inverted LAPD protocol, and wideband, which is the same as mode 0 but at rates that are multiples of 64 kbps, are the only types of unrestricted data. Furthermore, endpoints on mode 0 data modules can package the data in an HDLC protocol that can be inverted and the mode 3 bit stream can be inverted with an option or a cable, both of which result in restricted data.

Restricted data is any data that meets 1s density requirements by never sending an all zero byte, and thus can be transported over either restricted or unrestricted facilities. For endpoints on the DEFINITY systems, mode 1 and mode 2 meet the 1s density requirements and thus are restricted data. Mode 1 data meets 1s density requirements because one control bit exists in every byte and this bit is always 1. Mode 2 data meets 1s density requirements because the user data is packaged in inverted HDLC protocol. When HDLC or LAPD is inverted (all 0s changed to 1s and all 1s changed to 0s), 1s density is always

achieved. Mode 3 data is restricted if it is inverted because it is packaged in an un-inverted LAPD protocol.

**⇒ NOTE:**

The terms restricted data and unrestricted data are confusing because restricted data is data that can be transported over any facility and is thus less restricted (in an intuitive sense) than unrestricted data, which is restricted to being transported over unrestricted facilities.

The following table shows the relationship between restricted/unrestricted facilities and data:

	Restricted Facility (ZCS administered)	Unrestricted Facility (B8ZS, HDB3, or none administered)
Restricted Data (mode 2, mode 1 inverted mode 3)	<b>Uncorrupted</b>	<b>Uncorrupted</b>
Unrestricted Data (mode 0, mode 3, wideband)	<b>Corrupted</b>	<b>Uncorrupted</b>

**⇒ NOTE:**

If you administer B8ZS or HDB3 at the endpoints but send the data over facilities that are restricted somewhere between the endpoints, the data will be corrupted because the line repeaters will not pass the bipolar violations through unaltered.

[Table 4-8](#) summarizes the capabilities of various narrowband data endpoints supported on DEFINITY systems:

**Table 4-8. Data Modules Capabilities**

Data Module	DMI Mode	User Data Rate	Sync	Async	Bit Invert	Protocol Packaging	Handshake	Comments
7400 HSL	0	64 kbps	yes	no	option	none	none	
	1	56 kbps	yes	no	no	DDS	none	
7400 series	2	to 19.2 kbps	No	Yes	Yes	HDLC	Mode 2	
DTDM	2	to 19.2 kbps	Yes	Yes	Yes	HDLC	Mode 2	
AUDIX CMS MPDM	2	to 19.2 kbps	Yes	Yes	Yes	HDLC	Mode 2	
Other MPDMs	0	64 kbps	Yes	No	Yes	No	None	Note 2
	1	56 kbps	Yes	No	No	DDS	None	Note 2

**Table 4-8. Data Modules Capabilities — Continued**

Data Module	DMI Mode	User Data Rate	Sync	Async	Bit Invert	Protocol Packaging	Handshake	Comments
3270 A	2	to 9.6 kbps	Yes	Yes	Yes	HDLC	Mode 3/2 adapt	Note 3
	3	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3/2 adapt	Note 4
3270 T	3	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3	Note 4
PC/PBX Connection with ASCII terminal emulation	2	to 19.2 kbps	No	Yes	Yes	HDLC	Mode 3/2 adapt or Mode 2	Note 5
	3	64 kbps	No	Yes	Yes	LAPD/X.25 data phase	Mode 3/2 adapt	
PC/PBX w/3270 emulation	3	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3	Note 5
7500 series BRI sets & ADM-T	0	64 kbps	Yes	No	No	None	None	Note 6
	1	56 kbps	Yes	No	No	DDS	None	
	2	to 19.2 kbps	Yes	Yes	Yes	HDLC	Mode 3/2 adapt	
	3	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3/2 adapt	
	3/2	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3/2 adapt	
PC/ISDN Platform with 3270 emulation	3	64 or 56 kbps	Yes	No	Yes or No (option)	LAPD/X.25 data phase	Mode 3	Note 9
PC/ISDN Platform with ASCII terminal emulation	2	to 19.2 kbps	No	Yes	Yes	HDLC	Mode 3/2 adapt or Mode 2	Note 10
	3	64 or 56 kbps	Yes	No	Yes or No (option)	LAPD/X.25 data phase	Mode 3	Note 10
Constellation	3	64 kbps	Yes	No	Yes	LAPD/X.25 data phase	Mode 3	

Notes:

1. The mode-2 handshake will not work over other than 64-kbps facilities (for example, robbed-bit facilities).
2. Other MPDMs are the High Speed Synchronous MPDM and the Video Teleconferencing MPDM. The only difference between them is that the Video Teleconferencing MPDM has an RS-366 interface for keyboard dialing. Both MPDMs provide a V.35 interface for information interchange.
3. Mode 3/2 adaptive means that a mode-3 handshake is attempted first. An algorithm is then followed to determine the far-end's data mode and either switch to mode 2 or continue in mode 3.

4. Mode-3 data can only be circuit-switched in Generic 2.2 and G3V2 systems. Also, mode 3 on the 3270 A and 3270 T requires a 3270 C on the far-end.
5. Mode 2 on the PC/PBX connection is supported under the ASCII terminal emulation package. The PC/PBX connection in mode 2 uses a mode-3/2 adaptive handshake if the bit rate is set at 64 kbps. If the rate is set at 19.2 kbps or slower, a mode-2 handshake is used. 3270 emulation on the PC/PBX connection requires a 3270 C data module on the far-end. Mode-3 operation is defined as synchronous when in 3270 emulation; otherwise, it is defined as asynchronous.
6. Mode 2 on the 7500 series is implemented in the incoming (to the 7500) direction only. Outgoing calls requiring mode-2 speeds use the mode-3/2 adaptive bearer capability.
7. On outgoing mode-3 and mode-3/2 adaptive calls, the 7500 series always inverts bits. On incoming mode-3 and mode-3/2 adaptive calls, the 7500 series checks the restriction bit in the low-layer compatibility information element (IE) and either inverts or does not invert, depending on the contents of the IE. This is not done for incoming mode-0 calls, however.
8. The algorithm for the mode-3/2 handshake is different for DCP data modules and the 7500. When called, the 7500 data module starts a mode-3 handshake. If it receives a mode-3 or mode-2 handshake from the calling end within a specified number of seconds, it switches to that mode. Otherwise, it switches to mode 2. If it does not receive a mode-2 handshake within 15 more seconds, it times out and drops the call.
9. Options exist on the PC/ISDN Platform with 3270 emulation to allow the user to choose either 56 kbps or 64 kbps and to choose to invert or not invert bits. The PC ISDN Platform with 3270 emulation requires a 3270 C data module on the far-end.
10. Options exist on the PC/ISDN Platform with ASCII terminal emulation to allow the user to choose either 56 kbps or 64 kbps and to choose to invert or not invert bits. Either mode-3/2 adaptive or mode-2 handshakes are used depending on the baud-rate option setting. If the setting is 19.2 kbps or slower, a mode-2 handshake is used. Mode-3 operation is defined as synchronous when in 3270 emulation; otherwise it is asynchronous.

For complete definitions of the DMI modes 0, 1, 2, and 3, refer to *Digital Multiplexed Interface (DMI) Technical Specification*, select code 500-029. Ask for the most recent issue.

## Bit Inversion on ISDN PRI D Channels

ISDN PRI D channels are composed of digital data that must not be corrupted. When transporting the D channel over restricted facilities, however, ZCS must be administered, which will corrupt the data. To guarantee 1s density on the D channel without corrupting the data, all DEFINITY systems automatically invert the outgoing and incoming bit stream on the D channel when ZCS is administered. This works because the D channel uses the LAPD protocol, which guarantees 1s density when inverted. Except for G2.2, the D channel is left uninverted for all line codings other than ZCS. In G2.2, if B8ZS is administered you have the option in procedure 260, word 1, field 15, to invert or not invert the D channel.

**NOTE:**

It is recommended that the D channel not be inverted if B8ZS is administered.

## G2.2 Line Coding Implementation

G2.2 implements line coding in procedure 260, word 1, field 9. This administration is required for all DS1-based trunk boards, including those in the universal module. You can choose either B8ZS or ZCS in this field. If unrestricted data (data not meeting the 1s density requirement) is to be transported over any channels on the board, you must administer B8ZS and also ensure that the facility is unrestricted end-to-end. If the end-to-end facilities are restricted, ZCS must be administered, in which case you will not be able to send unrestricted data without it being corrupted. You can send restricted data over either restricted or unrestricted facilities.

## G3V2 Line Coding Implementation

In G3V2 systems, if the CEPT1 (2.048) bit rate is administered, you can also choose **none** to have AMI-only line coding, which does nothing to guarantee 1s density requirements, or you can choose **hdb3** for HDB3 line coding. If the DS1 (1.544) bit rate is administered, you can administer either **b8zs** or **zcs**. As with B8ZS, if HDB3 line coding is used, the facilities must be HDB3-compatible end-to-end, which means unrestricted facilities.

## Line Compensation

Line compensation is the method used to ensure that the shape of each pulse in the DS1/CEPT1 bit stream at the terminating end of the cable is within the specifications of PUB 62411, *ACCUNET T1.5 Service Description and Interface Specification*. Electrical characteristics of a cable plus the cable's length distort the pulse. A chip on the DS1 or CEPT1 circuit pack modifies the pulse, depending on the length of the cable, so that the pulse is the correct shape by the time it reaches the end of the cable.

G2.2 traditional modules, which use either the ANN11C or ANN35, implement line compensation as hardware switches on the boards. See the [“ANN11C and ANN35 Line Compensation Jumper Settings”](#) section in [Chapter 3, “Equipment and Software Requirements”](#) for these settings. On G2.2 universal modules that use the TN722 or TN767, line compensation is administered in procedure 260, word 1, field 18. The value entered in this field should be set to the length of the cable from the DS1 circuit pack to the CSU. If the cable is connected to another DS1 interface that also performs line compensation, the value should be set to one half the length of the cable.

In G3V2 systems, line compensation applies only to DS1 (1.544 mbps) interfaces. G3V2 systems implement this capability in the DS1 circuit pack form.

The value entered into the `Line Compensation` field of this form should be set to the length of the cable from the DS1/CEPT1 circuit pack to the CSU. If the cable is connected to another DS1/CEPT1 interface that also performs line compensation, the value should be set to one half the length of the cable.

## Idle Code

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Idle code is the eight-bit sequence that occupies the time slot on a DS1/CEPT1 trunk channel when it is not being used. In G2.2 this idle code is always 11111111. In G3V2 systems, however, this item can be administered to be any pattern of 0s and 1s. The DS1 Circuit Pack form has a field called `Idle Code` that allows you to enter the desired code. The following list shows a few examples of the idle code for specific countries; for countries that do not define the idle code, the user must decide which one to administer.

United States	11111111
Australia	11111111
Italy	01010100
Japan	at least 3 1's must be administered

### NOTE:

On DS1 boards administered for robbed bit signaling, the A or B bit, which occurs every sixth frame, will always be 0 when idle. In G2.2, you can force this bit to 1 by disabling signaling in procedure 116, word 1, field 8 (enter 1). In G3V2 systems, the only way to force this bit to 1 is to maintenance busy out the channel. When the switch is reinitialized, however, the channel will be released from its busyout state.

## The Digital Loss Plan

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Transmission loss is the total of all losses and gains (measured in decibels) from one end of a connection to the other. Distributed transmission losses as well as any connection loss inserted by the switch are included. Transmission loss is required so that talker echo is minimized. Furthermore, transmission loss must be kept low enough so that speech volume is perceived as adequately loud. Two different loss plans are available. They are known as:

- Via-net loss (VNL), which has traditionally been used to assign losses for analog circuits terminating on an analog switch
- Digital loss, which is used to assign losses for digital circuits terminating on a digital switch

The introduction of digital switching systems and digital trunk facilities permit more flexible control of the switch connection loss (insertion loss) and thereby transmission performance. From the network perspective, transmission performance becomes entirely a function of the port-to-port losses (total loss) from all switches in the transmission link.

The digital loss plan is significantly different from the VNL. Since the two loss plans do differ, it cannot be assumed that the port-to-port losses measured in an all-digital network or in a combined digital and analog network are the same as the loss measured between the same ports in an all-analog network.

G2.2 and G3V2 systems provide for implementing the digital loss plan specified by ANSI/EIA/TIA-464-A-1989. There are two versions of the digital loss plan. The early version is called *digital fixed loss plan* and the later version is called *ISL digital low loss plan*. Digital COs, such as AT&T 5ESSEs or Northern Telecom DMS 100s, and toll switches, such as AT&T 4ESSEs, also implement parts of the digital loss plan.

The digital loss plan requires a 6-dB loss (connection loss) from the switch port at one end to the switch port at the other end for private digital networks. Transmission performance for private networks using this 6-dB loss specification is very good. The public-network and digital COs have a similar 6-dB requirement.

Private-network to public-network connections result in a total connection loss of 12 dB — possibly more depending on the public network switch and factors such as whether a channel bank is used. Transmission performance for this type of connection is generally considered marginal, and if another private-network connection (another 6 dB of loss) is added, then the end-to-end transmission performance becomes unacceptable. These types of connections and their unacceptable transmission performance were the motivation for developing the ISL digital low loss plan.

For G2.2 and G3V2 systems, the administration options of the ISL low loss plan allows you to optimize transmission performance for those private network to public network types of connections at the planning and installation stage. With proper design and application, the ISL digital low loss plan makes possible a significant improvement in transmission performance for call-forwarded calls involving off-network connections.

Some quantity of connection loss is desirable and deliberately engineered into most types of transmission links. The quantity of loss (magnitude and number of dBs) depends on the loss plan that is administered and the particular type of facility involved. Each particular set of port-to-port connection losses is known as a *loss pad group*.

Connection loss serves to eliminate or significantly reduce talker echo on long-distance transmission links. User perception of transmission performance is primarily a function of the network connections most frequently used and the particular loss plan administered for those connections. Once a loss plan is selected and administered, the transmission performance becomes a fixed function of call routing. Regardless of the loss plan that is used, the operation of the other switch features will not be affected.

The digital loss plan provides for the flexible assignment of loss-pad groups on a trunk-group basis that is independent of trunk type and also of the port circuit

pack type (DS1 or analog). Before the availability of this administration capability, loss-pad-group assignment had been fixed, transparent, and dictated by the trunk type and port circuit pack type being used. For example with fixed loss, a port on a G2.2 circuit pack administered as trunk type 47 is automatically assigned the EIA digital tie trunk pad group. Conversely, with the low-loss option, a trunk group administered as trunk type 47 or 70 can be assigned one of several loss-pad groups and thus appear on either an analog or digital port. Therefore, the digital loss plan options that are administered depend on the application and the configuration of the transmission facilities. For example, application may include such items as whether the facility is a DMI-to-host link, and whether the connection is on-premises to on-premises, or on-premises to off-premises. Configuration of the transmission facilities may include:

- Whether the connection is completed via a private network or a combination of private and public networks
- Whether the end-to-end connection is completed via all digital or a combination of analog and digital switching facilities

## Loss-Plan Implementation

The digital loss plan options vary between G3V2 and G2.2 as described next.

### Generic 2.2 Loss Plan Implementation

The digital loss plan options are administered by specifying an encode that corresponds to the desired pad group. For line applications, this information is translated in field 8 of procedure 000, word 1. For trunk applications, this information is translated in field 13 of procedure 101, word 1. The permitted encodes and their corresponding loss-plan function for trunks are listed in [Table 4-9](#):

Table 4-9. Digital Loss Plan Encodes

Encode	Loss-Plan Function	ANSI/EIA/TIA-464-A-1 989 Designator
0	The digital fixed-loss plan pad loss is determined by the trunk type administered in procedure 100, word 1	—
1	ISL tie trunk S/DTT	
2	EIA tie trunk (recommended for ISDN)	D/TT
3	ISL digital CO	D/CO -3/3 loss
4	EIA digital CO	D/CO 0/6 loss
5	digital toll office	D/TO

*Continued on next page*



Table 4-9. Digital Loss Plan Encodes — Continued

Encode	Loss-Plan Function	ANSI/EIA/TIA-464-A-1 989 Designator
6	analog toll office	A/TO
7	NI2A (AUTOPLEX <sup>®</sup> NETWORK Interface V)	—
8	NI2B (AUTOPLEX NETWORK Interface Y)	—

Although the digital loss plan provides for the assignment of a loss-pad group independent of port type (analog or digital), there are certain restrictions. Administration does not provide for alternate port appearance on DS1 port circuit packs for the following labeled pad groups: analog tie trunk, analog CO trunk (terminal balanced), analog CO trunk (not balanced). The TSI arithmetic logic unit (ALU) under module processor control actually inserts (digitally) the administered quantity of loss in the connection. The TN380D module processor (or later) is required for providing the full digital low loss plan. Therefore, to implement any portion of the low loss plan, it is essential to have both the appropriate hardware (TN380D) and software issue. A network consisting of some nodes that implement the fixed-loss plan and other nodes that implement the low loss plan are permitted. However, their transmission performance is the same as for an all fixed-loss network.

### G3V2 Loss Plan Implementation

G3V2 systems implement the full digital loss plan. The appropriate loss value is administered, for the particular trunk group, by entering # in the Name field for screens on pages 2 through 5 of the trunk-group member assignments. Noted below are the minor differences in names (terminology) used for G3V2 and those used for G2.2. The following list identifies the option values:

Loss plan	<b>pbx-eia</b> — for private-network-only applications that use analog tie trunks or digital tie trunks
	<b>pbx-low</b> — for use with combination tie trunks (private networks tandemed with public networks)
	<b>toll</b> — for use with connections to an analog toll office or digital toll office
Digital conn loss	<b>normal</b> — same as the EIA options used with G2.2
	<b>low</b> — same as the ISL options used with G2.2; recommended for combination tie-trunk applications where low speech volume is a problem but echo is not a problem

## Port-to-Port Loss Values

The port-to-port loss values shown in [Table 4-10](#), can be used to determine the correct loss between two properly terminated ports of a digital switch.

To determine the correct end-to-end loss for a tandem connection (through both an analog and digital switch), simply add up the losses in each leg.

Combination tie trunks are frequently encountered when station-to-station calls are being completed. Depending on the particular facilities involved, some unexpected losses may be encountered. For the network shown in the figure, if a call is made from an on-premises station (ONS) on one of the analog switches tandeming through the digital switch to an ONS on the other analog switch, an end-to-end loss of 6 dB should be measured in each direction. However, if a call is made from an ONS on the digital switch to an ONS on either one of the analog switches, an end-to-end loss of 9 dB should be measured in each direction. This 3-dB difference is a result of analog and digital loss plan differences and should be expected.

Before specific loss information is given, the following important points should be remembered:

- There are *no* adjustable attenuators associated with DEFINITY ports. Port-to-port losses are composed of distributed losses in the ports and in the internal connection made between the ports. The loss for the internal connection is a function of the port type and the number of ports on the connection. Different port types (such as, digital CO, digital tie trunk, digital off-premises station) use the same DS1/CEPT1 hardware.

**Table 4-10. Digital Loss Plan (Port-to-Port Losses)**

Transmit Direction		Receive Direction (Values in dB loss)										
		ONS-Line Trk	OPS-Line	ANAL Tie Trk	COMB or DTT	Analog CO Trunk		EIA DCO Trk	ISL CTT	ATO Trk	DTO Trk	ISL DCO
						BAL	NBAL					
On-premises station (ONS)		6	3	3	3	0	0	3	3	6	3	3
Off-premises station (OPS)		3	0	2	0	0	0	0	2	3	0	0
Analog tie trunk (A/TT)		3	2	0	-3	0	2	2	0	0	-3	2
Combination or digital tie trunk (D/TT)		9	6	3	0	3	6	6	6	3	0	3
Analog CO trunk (A/CO)	BAL	0	0	0	-3	0	0	0	0	2	0	0
	NBAL	0	0	2	0	0	2	2	2	2	0	2
EIA digital CO trunk (D/CO 0/6 loss)		3	0	2	0	0	2	0	0	3	0	0

Table 4-10. Digital Loss Plan (Port-to-Port Losses) — Continued

Transmit Direction	Receive Direction (Values in dB loss)										
	ONS-Line Trk	OPS-Line	ANA L Tie Trk	COMB or DTT	Analog CO Trunk		EIA DCO Trk	ISL CTT	ATO Trk	DTO Trk	ISL DCO
					BAL	NBAL					
ISL digital tie trunk (S/DTT)	3	2	0	0	0	2	0	0	3	0	0
Analog toll office trunk (A/TO)	6	3	0	-3	2	2	3	3	0	-3	3
Digital toll office trunk (D/TO)	9	6	3	0	6	6	6	6	3	0	6
ISL digital CO trunk (D/CO -3/3 loss)	3	0	2	-3	0	2	0	0	3	0	0

**⇒ NOTE:**

A terminal balanced trunk is defined as meeting an ERL of greater than or equal to 18 dB and an SRL of greater than or equal to 10 dB, when measured into a quiet termination at the CO.

- Port-to-port losses in Generic 2.2 and Generic 3V2 conform to the ANSI digital loss plan standard. [Table 4-10](#) is an excerpt from this standard. If other vendors' switches are used in the same network, port-to-port loss measurements through such a switch will have value only after verification of this switch's port-to-port loss specification. Conformance with ANSI standards greatly simplifies this process and reduces the likelihood of compatibility problems.
- The loss between switches is 0 dB over digital facilities, 1 dB for combination facilities, and VNL for analog facilities.
- If the losses in a switch network have been verified correct and specific problems associated with the loss plan remain, the appropriate transmission engineering organization should be consulted.

**DS1/CEPT1 Port Losses**

All DS1/CEPT1 circuit-pack channels, regardless of the type of port for which they are used, are transparent (zero loss) and preserve digital bit integrity. All connection losses are inserted in the switch network in conformance with the digital loss plan and dependent on switch administration options.

## Terminating a DS1 at a Channel Bank

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The DS1 channels that leave the switch in digital form and are converted to analog form by a channel bank are called *E2 combination channels*. Three basic types are described below.

### Tie Trunk Ports

To obtain the required channel unit losses for combination tie trunks, extended-range E&M channel units (or their equivalent) should be used. The attenuators on this channel unit are set as follows: the transmit (A-to-D) attenuator should be set to  $(15.5-L_c)$  dB, where  $L_c$  is defined as the loss in the interconnecting cable between the channel bank and the analog switch, and the receive (D-to-A) attenuator should be set to  $(12.5-L_c)$  dB, where  $L_c$  is as above. Setting the channel unit attenuators to these values will meet the requirement for combination tie trunks. This requirement specifies a net gain of 2 dB in the A to D direction and a net loss of 4 dB in the D to A direction.

### CO DID Trunk Ports

Digital ground-start CO, loop-start CO, and Direct Inward Dial (DID) trunks may (optionally) terminate on channel banks located at a CO. If this is the case, it is the CO's responsibility to set the channel unit losses. As a guideline, the net loss should range from 1 to 3 dB. Also, the loss should be the same in both directions.

### OPS Ports

Analog off-premises station (OPS) facility requirements specify a loss not to exceed 4 dB in each direction. To provide for transmission stability (eliminate singing and echo) with D4-channel units, at least 1 dB of loss in both directions is required from the 2-wire analog hybrid terminals. Foreign exchange subscriber end channel units (FXSs) provide losses adjustable from 1.0 through 1.8 dB. This capability permits their use with analog facilities having losses as great as 3 dB, giving a net loss of 4 dB. FXS end with gain transfer channel units (FXS/GTs) make available an additional 2-wire gain of 6 dB, permitting their use with analog facilities with losses as great as 9 dB. Attenuator, equalizer, and balance settings should be made with the engineering data listed on the circuit detail record.

Refer to *D4-Channel Bank Channel Units — Application Engineering/Carrier Engineering* 855-351-105 for engineering design information as well as switch settings and application notes on D4-channel units.

## Synchronization

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The DS1/CEPT1 transmit and receive buffers for DEFINITY systems operate from a single external or internal clock. Each digital switch can accommodate multiple DS1/CEPT1 or T1/E1 spans that link multiple switches. These may include both ISDN-PRI and DS1/CEPT1 links. Since each switch can transmit at a rate determined by its internal clock, information will be lost if the digital network is not synchronized to a single clock. Furthermore, one switch should be selected as the master and all others should obtain slave-timing from it. [Figure 4-5](#) shows various DS1/CEPT1 synchronization applications.

Synchronization issues affect all network nodes. Compatibility details must be addressed, and a network synchronization plan must be developed, deployed, and verified to be installed correctly.

### The Need for Synchronization

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The term *synchronization* refers to an arrangement whereby digital facilities operate from a common clock. Whenever digital signals are transmitted over a communications link, the receiving end must be synchronized with the transmitting end to read the digital signals properly. This arrangement is called *link synchronization*. When digital signals are transmitted over a network of digital communications links, switching nodes, multiplexers, and transmission interfaces, all entities in this network must be synchronized together. This is known as *network synchronization*. With digital transmission, information is coded into discrete pulses. When these pulses are transmitted over a communications link, there must be at least three different levels of synchronization. For transmitting data, these levels are known as *bit*, *character*, and *message synchronization*. For pulse-code modulation (PCM) voice transmission, the levels are *bit*, *time-slot*, and *frame synchronization*.

Bit synchronization refers to the requirement for the transmitter end and the receive end to operate at the same clock rate so that bits are not lost. Other levels of synchronization refer to the need for the transmitter and receiver to achieve proper phase alignment so that the beginning and the end of a character, message, time slot, or frame can be identified.

For synchronous transmission, data is transmitted at a fixed rate. Each bit occupies a fixed-unit interval. All significant transitions must correspond to multiples of the fixed-unit interval. Message and frame synchronization are achieved by using special characters at the beginning and end of the message, and by knowing the number of bits contained in each frame.

[Figure 4-5](#) shows the exchange of digital bit streams between various elements that require some form of synchronization. The role of synchronization is examined in each of the three configurations.

[Figure 4-5A](#) shows one possible connection between a pair of D4-channel banks. Such a connection (using D4-channel banks) can typically be found with

a pair of analog switching systems connected by T1-carrier facilities. For this arrangement, the transmitting portion of each channel bank independently determines the clock rates. The receiving portion of each channel bank derives its clock from the incoming digital bit stream. In this arrangement, the channel banks convert the received digital signal directly to analog, and there is no requirement that the two clock frequencies precisely match as the channel bank does not interface to another digital system.

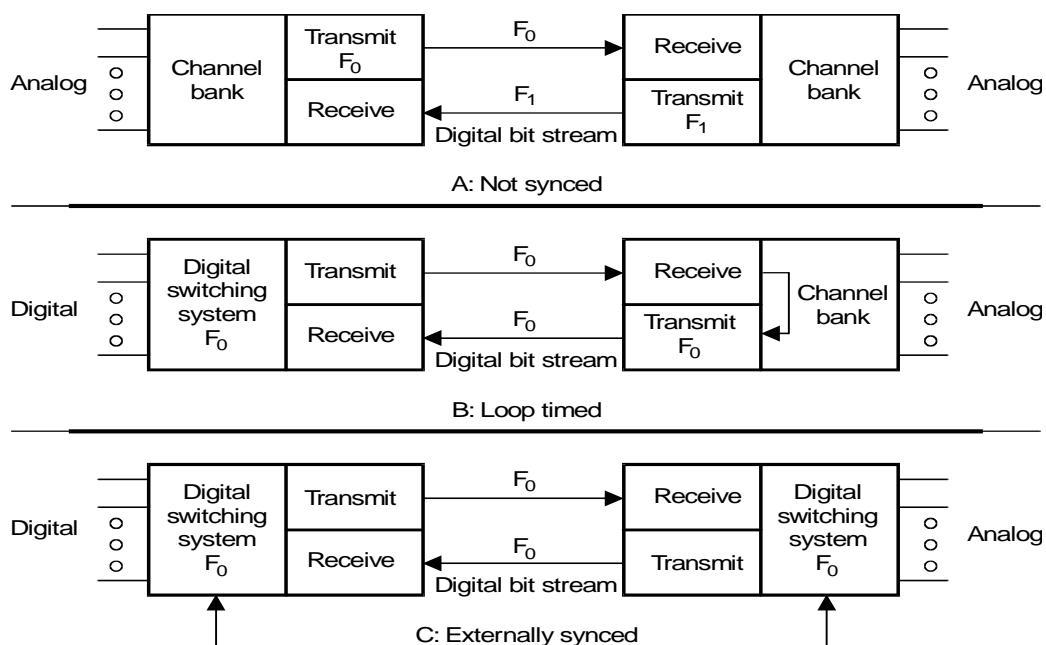


Figure 4-5. Options for Synchronization

Figure 4-5B shows a different connection between a channel bank and a digital switching system. For this configuration, the digital switch transmits a digital bit stream at the rate ( $F_0$ ) that is determined by its internal clock. The digital switch must receive the incoming digital bit stream at this same rate ( $F_0$ ). Otherwise, the switch's receiving buffer may eventually overrun or underrun.

**NOTE:**

Switching is done by placing the signals from individual time slots on one link into the time slots on other links using a process called *time-slot interchange* (TSI). For this process to work properly, bit synchronization must be maintained on all links terminating on the digital switching node, no matter where the links originate.

If the average transmit rate is faster than the average receive rate, the receive buffer will eventually overrun. If the average receive bit-clock rate is faster than

the average transmit bit-clock rate, the receive buffer will eventually underrun. It is necessary to prevent overruns (deletions) and underruns (repetitions) by synchronizing the network properly. Improper synchronization results in buffers repeating or deleting bits in 1-frame increments.

 NOTE:

The deletion or repetition of a single frame is termed a *slip* or a *controlled slip*. For an individual digital bit stream, slips are serious impairments since digital switching systems with improperly synchronized clocks will eventually suffer slips on every received digital bit stream.

Notice in [Figure 4-5B](#) that the overrun or underrun problem can be prevented by forcing the channel bank transmitter to operate at the same clock rate as the receive portion of the channel bank. This arrangement is called *channel-bank loop timing*. This becomes more complex when two digital switches terminate a digital transmission facility. [Figure 4-5C](#) shows this configuration.

In [Figure 4-5C](#) each switching system transmits at a rate determined by a reference clock. Unless the received digital bit stream arrives at the same clock rate as its internal clock rate, slips will occur. To prevent or minimize slips, it is necessary to force both switching systems to synchronize on a common reference clock rate (F0). Both will then be part of a synchronized network, and will read and write their buffers as they should.

The primary objective of network synchronization is to minimize the slip rate. This is done by synchronizing the clocks associated with the switching nodes so that all transmissions from these nodes have the same average line rate. For short-term intervals, the switching-system receive buffers absorb the difference between the line rate and the average rate. These short term variations are called *jitter*. A long-term difference will result in a slip.

The impact of slips on a customer varies with the services used. For example, voice services are fairly insensitive to slips. Slip rates as high as 20 per second are barely perceptible; therefore, speech is not considered a limiting factor in setting slip-rate standards. However, data services are much more sensitive to slips since each bit of data is a discrete piece of information. For data applications, a slip (at any slip rate) requires retransmission and will adversely affect the throughput and degrade performance of data transmission facilities.

Slips can occur for two basic reasons:

1. Lack of or loss of frequency synchronization among the network nodes (for example, when slips occur at a constant, regular rate)
2. Phase modulation of the transmitted digital bit streams due to environmental variations of the transmission facilities (such as temperature variations that affect the electrical length of a transmission line)

Therefore, even if all network nodes are synchronized, slips can still occur due to transmission impairments.

## Synchronization Hierarchy

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Within North America, all private digital telecommunications facilities that connect to the public digital network must obtain synchronization by the hierarchical method. This method is based on:

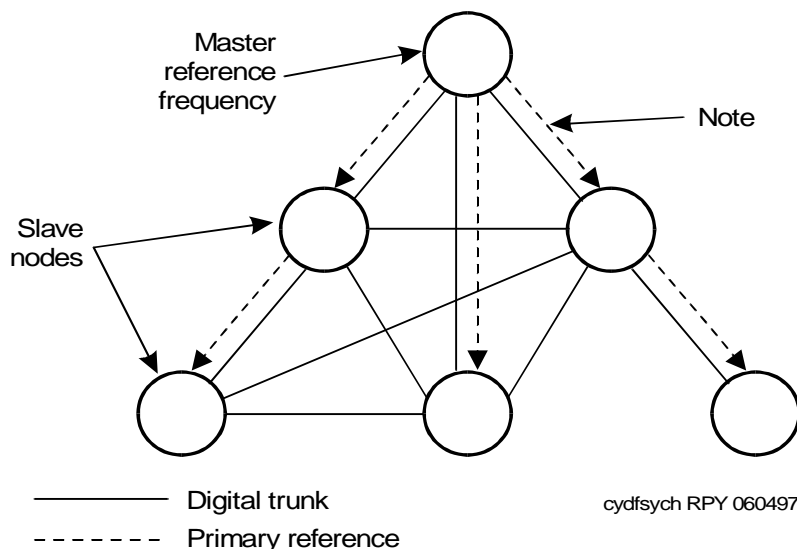
1. Controlling the slip rate to provide satisfactory service to the customer
2. Maximum reliability
3. Minimum costs
4. Ease of administration
5. Ease of maintenance

For the hierarchical method, a node containing a very stable reference frequency is identified as the source or *master reference*. The master reference is transmitted to another node that is synchronized (slaved) to this master reference. A network implementing this method is hierarchical in nature with nodal clocks supplying the synchronization frequency to certain other nodes, which in turn supply the reference to still other nodes. [Figure 4-6](#) shows a hierarchical network configuration.

With the hierarchical method, the existing digital transmission facilities are used to distribute the reference frequency. For example, with a T1-carrier, the slave nodes can derive their reference clock from the DS1 bit rate. Since the clock frequency is derived from the digital bit stream, the traffic-carrying capacity of a carrier system is not diminished (that is, the bandwidth is not used to carry a separate clock signal).

Reliable operation is an important consideration for all parts of a telecommunications network. So, the synchronization network should consist of both *primary* and *secondary* synchronization facilities. In addition, each node must be equipped with an internal clock that (with automatic switching) can bridge short disruptions of the primary and secondary synchronization reference. Therefore, if synchronization is disrupted, the internal clock will assume control. The internal clock will drift at a rate determined by its stability (also called *free run ability* or *accuracy*).





Note: The dashed lines indicate which nodes supply reference frequencies and those facilities used to transmit the reference.

Figure 4-6. Synchronization Hierarchy

Switching nodes in digital networks are divided into synchronization layers called *strata*. There are four strata, 1 to 4, where stratum 1 has the highest accuracy and stratum 4 the lowest. Public digital networks use stratum 1, 2, and 3 synchronization. Historically, private digital networks used stratum-4 clocks all synchronized together. However, to provide higher quality synchronization performance, stratum-3 clocks are now being used with customer-premises equipment in some cases.

Because of recent changes within the synchronization hierarchy, stratum-4 clocks are now defined as *stratum-4* or *stratum-4E*. The specifications for stratum-4E define limits that minimize and control timing disruptions that occur while switching from one synchronization source to another. Stratum-4 clock specifications, however, are not as stringent in avoiding timing disruptions when switching synchronization sources. All other stratum-4 specifications remain the same for both clocks. It is recommended that a stratum-4E clock be used as a synchronization source for public network connections.

Each stratum, from 1 to 4, represents a progressively less stable and less expensive clock. Within AT&T, there is a system of stratum-1 clocks. These clocks use the AT&T standard reference frequency, formerly the Bell System reference frequency. The stratum-1 output is transmitted to various public digital network nodes via either broadband analog facilities or the DATAPHONE<sup>®</sup>

Digital Service (DDS). Outside the United States, AT&T provides a stratum-1 clock through the Private Network Customer Expert System, Synchronization and Timing, Service (PRINCE — S, T).

The public digital network nodes and services that the AT&T private digital switches and digital terminal products can connect to are as follows:

- DDS
- Digital serving office (DSO), also called a digital toll office, such as a 4ESS
- Digital central office (DCO) such as a 5ESS
- Digital-access and cross-connect system (DACs)

The AT&T private digital network nodes are the following:

- System 75
- System 85
- DEFINITY Communications System Generic 1
- DEFINITY Communications System Generic 2
- DEFINITY Communications System Generic 3

The AT&T digital terminal products that interface with T1 carriers include the following:

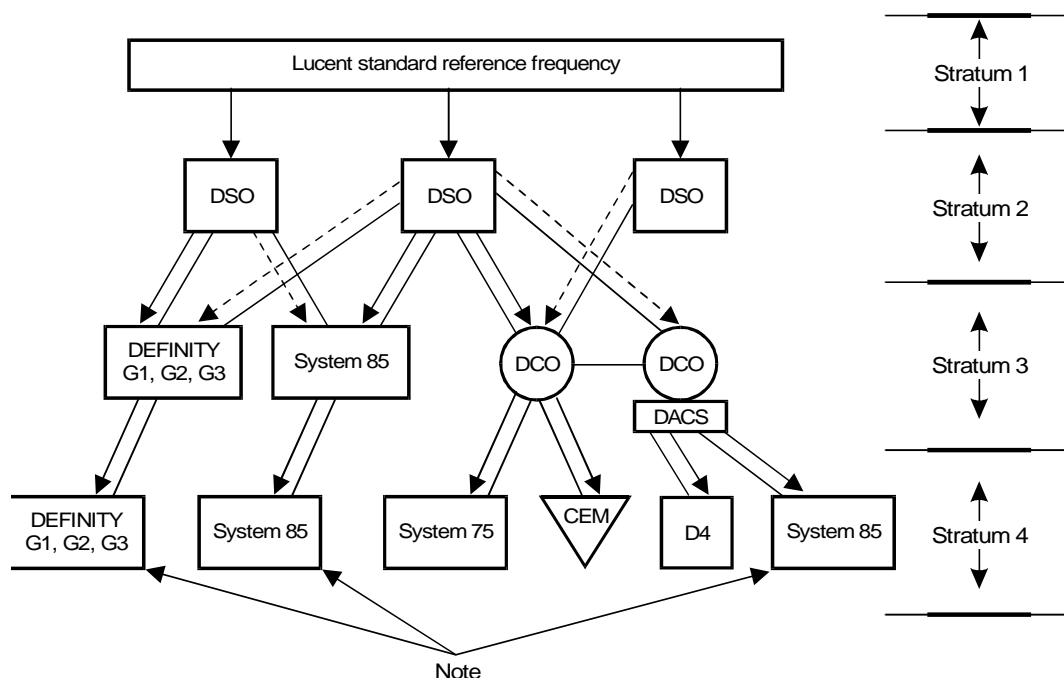
- D4- and D5-channel banks
- Channel-division multiplexer (CDM)
- Bit-compression multiplexer (BCM-32000)
- Digital data multiplexer (DDM-1000)

The digital terminal products that interface with E1 carriers include the FLEXIMUX, OPTIMUX, SLC120, and others.

All public and private digital network nodes have internal clocks. [Figure 4-7](#) shows the synchronization hierarchy and the node's internal clock stratum level. Note that the System 75 has an internal stratum-4 clock; the Generic 3V2 communications systems have an internal stratum-4E clock; while the internal clock on the System 85 and Generic 2 communications system is a stratum-4. An external clock can provide stratum-3 synchronization to the System 85, Generic 1, Generic 2, or Generic 3 communications systems.

Each node is compelled to take its timing from the following:

1. A higher stratum level
2. A node equal to its own stratum level
3. A free-running timing clock (generated internally) that meets or exceeds the requirements for its level



- Digital transmission facility
- > Primary frequency reference
- - - - -> Secondary frequency reference

Note: For the System 75, System 85, Generic 1, Generic 2, and Generic 3, the internal clock provides stratum-4 or stratum-4E synchronization. However, a stratum-3 external clock may be used instead of the internal clock.

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Figure 4-7. Stratum Levels for the Synchronization Hierarchy

The minimum clock accuracy for each stratum level is as follows:

- Stratum 1 ( $\pm 0.00001$  ppm, most accurate)
- Stratum 2 ( $\pm 0.016$  ppm, more accurate than stratum 3)
- Stratum 3 ( $\pm 4.6$  ppm, more accurate than stratum 4)
- Stratum 4 ( $\pm 32$  ppm, least accurate)

**NOTE:**

When a hierarchical public digital network is implemented (and when full network synchronization is obtained), each node clock, regardless of its stratum level, will have an average frequency identical to its master and to the AT&T standard reference frequency.

## Synchronization Architecture and Operations

The timing accuracy available to a communications system depends on communications system version and the type of synchronization circuit board it uses. [Table 4-11](#) lists the synchronization boards that are available, the versions of the switch in which they are delivered, and the level of timing accuracy that the boards provide. Note that all boards are backward compatible, so that even though a board is delivered with a particular switch version, it can be installed on earlier versions of the same switch.

**Table 4-11. Available Synchronization Circuit Boards**

Switch	Synchronization Board	Accuracy
Generic 1.1	TN768	stratum-4E
Generic 2	TN463	stratum-4
	TN2131	stratum-3*
Generic 3i	TN768	stratum-4E
	TN780	stratum-4E and stratum-3 <sup>1</sup>
Generic 3r	TN768	stratum-4E
	TN780	stratum-4E and stratum-3 <sup>1</sup>

1. External only

### Generic 2.2

Generic 2.2 communications systems use either the TN463 or the TN2131 as their internal synchronization board. The TN463 provides stratum-4 synchronization to the system in the absence of an external public-network synchronization source. The TN2131 provides synchronization from an on-premises stratum-3 clock in the absence of external public-network synchronization. The public-network synchronization source arrives at the communications system over the same DS1 links that carry voice and data to and from the system. The DS1 links function as primary and secondary synchronization sources. When service from the both of the DS1 links is disrupted, the external public-network synchronization source is also discontinued. When public-network synchronization is discontinued, switches with TN463 circuit boards use an on-board, stratum-4, high-accuracy clock for synchronization; those with a TN2131 use on-premises external stratum-3 clock. This section describes synchronization through the TN463. See [“The External \(ST3\) Synchronization Clock”](#) later in this section for TN2131 operation.

## TN463 Synchronization Architecture

When the TN463 circuit board is installed, Generic 2.2 communications systems can function as either timing slaves or timing masters. As a slave, the switch receives digital data from one or two DS1s. One interface supplies the primary synchronization reference and the other interface supplies the secondary reference. The timing source selected is determined by the system clock synchronizer (SCS) TN463 circuit pack and synchronization software. The SCS synchronizes (phase locks) to either the primary reference, secondary reference, or the internal high-accuracy clock. [Figure 4-8](#) shows the SCS circuit pack.

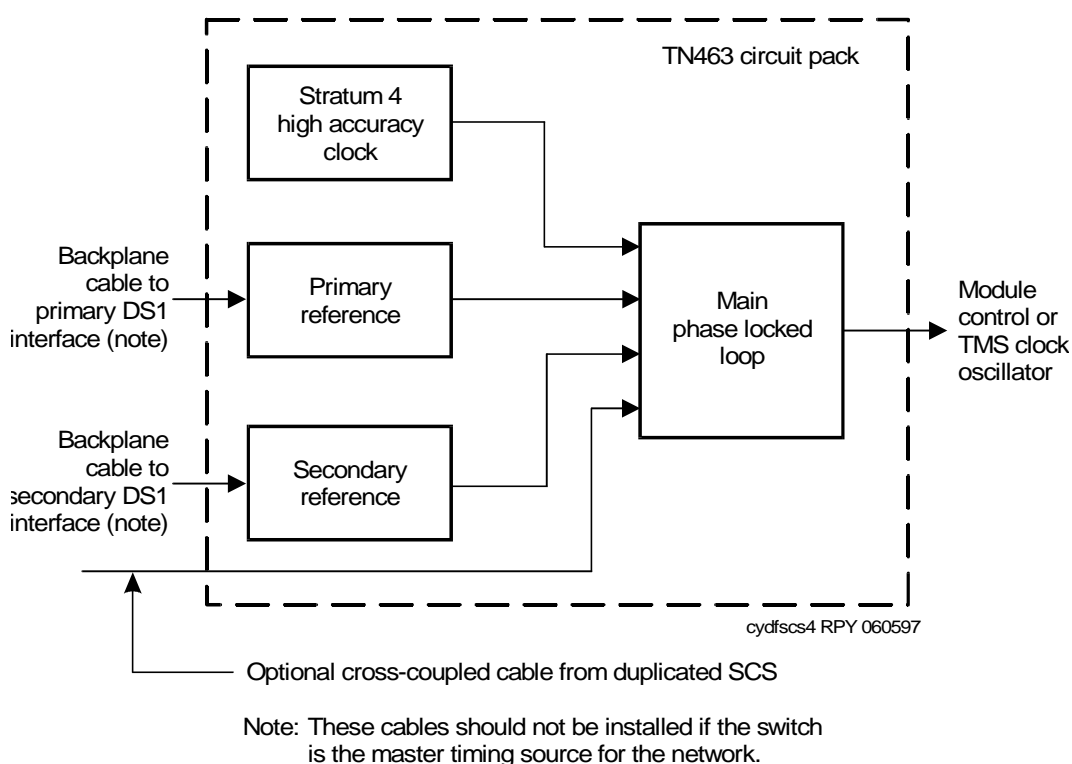


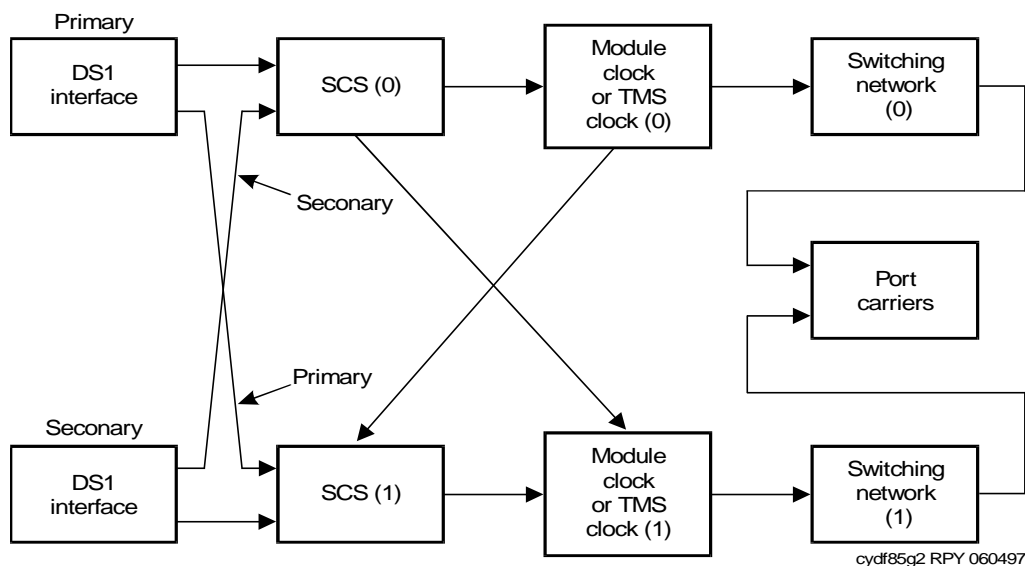
Figure 4-8. SCS (Generic 2.2 Internal Stratum-4 Clock)

Typically, the switch will be equipped with several DS1 circuit packs. The DS1 that is selected as the primary or secondary reference is dependent on the internal cable configuration and administration details. Here, each Generic 2.2 that is configured with at least one DS1 requires a SCS, including the master node. Unless synchronized to the public network the master node will not have the primary and secondary synchronization cables. A Generic 2.2 may be configured as either a single-module or multimodule system. Typically, the switch architecture is unduplicated, but it may also be duplicated for critical reliability

applications. The switch architecture determines the equipment carriers that will contain the SCS circuit packs.

For single-module applications, the SCS is located in the module control carrier. In addition to the SCS, a module clock is also required. The SCS controls the module clock. For multimodule applications, the SCS is located in the time-multiplexed switch (TMS) carrier and controls the TMS clock oscillator.

When the switch architecture is duplicated, the synchronization components and cables will also be duplicated. For duplicated systems, functioning modules are called *online*, while backup modules are called *offline*. The offline SCS phase locks to the cross-coupled clock signal from the online SCS. In a duplicated synchronization system, the same DS1 facility provides the primary and secondary reference for both duplicated halves. [Figure 4-9](#) shows a System 85 or Generic 2.2 with a duplicated architecture and cross-coupled cables.



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**Figure 4-9. System 85/G2.2 Duplicated Synchronization Architecture and Cross Coupling**

The TN767 is a DS1 circuit pack for a universal module; the ANN11 is a DS1 circuit pack for a traditional module.

The synchronization software consists of a series of tasks that monitor several system status parameters and thus maintain the best synchronization source online. (The online source is the synchronization reference currently in control. This reference can be either the primary or secondary reference, or an on-board, high-accuracy clock, sometimes called the local oscillator.) Several levels of control are maintained. One level is controlled by a 1-second software task that

uses the system status to keep the best incoming DS1 reference clock online. The other is controlled both by hardware and the 1-second software task to maintain a healthy SCS on line. If a SCS can receive a suitable reference clock from a DS1, then the best combination is chosen.

### Criteria for Switching Reference Sources

With the TN463 circuit board, any of three sources can be used as clock references for synchronization — an external primary DS1 source, an external secondary DS1 source, or the on-board, stratum-4, high-accuracy clock. The principal error conditions used to determine if a switch to a different clock reference is needed are, in order of importance:

- Loss of signal (LOS) at the SCS circuit for more than 200 ms.  
A switch is made to the high-accuracy clock (HAC) on the SCS by the SCS. A further analysis is then made to determine if the LOS is network related or switch related. A switch to a healthy reference is done if appropriate.
- Reception of a blue alarm, which means that the facility cannot be used as a reference
- An out-of-lock (OOL) condition, which means that the HAC is unable to lock onto the incoming clock from the current DS1 reference  
A switch to a healthy reference is done if one is available. Otherwise, a switch to the HAC is performed.
- Reception of a red alarm, which means that two out of four (or worse) framing patterns were received
- Slip rate of selected DS1 facilities (with respect to the primary reference) exceeds a given threshold
- Misframes at the primary reference exceed a given threshold
- Reception of a yellow alarm
- Poor SCS circuit pack health
- Insane condition of the board processor on a DS1 circuit

[Table 4-12](#) summarizes these conditions. In the table, the *PRI* is the DS1 source that is used as a primary clock reference, while the *SEC* is the DS1 source that is used as the secondary reference. Each table entry gives the timing source that is used when the primary and secondary DS1 references are in the states shown in the intersecting columns and rows. For example, when the primary reference indicates a *Yellow* alarm condition, and the secondary reference is *GOOD*, then the secondary reference is used; during all other secondary reference states, the primary DS1 reference is used although it displays a *Yellow* alarm.

The SCS circuit pack's health is examined when the system clock's health is evaluated. Error conditions of varying severity can exist on the SCS. If the fault is minor and the SCS can still lock on the current DS1 reference, a low-priority request for a soft switch to the offline side is made after an unsuccessful attempt to clear up the error condition on the SCS. If the SCS cannot lock onto the current

DS1 reference clock, a high-priority request for a soft switch is made. The offline SCS is also monitored to make sure that a switch is not attempted to an unhealthy SCS. If the SCS is not duplicated and the HAC is healthy, serious failures cause a switch to the HAC to ensure switch reliability. When the SCS can once more lock onto a DS1 reference, a switch to that reference is performed.

Table 4-12. SCS References Switches

Primary Reference Indicators	Secondary Reference Indicators						
	RED	BLUE	YEL	GOOD	LOS	MISF	BO
RED	HAC	HAC	SEC	SEC	HAC	SEC	HAC
BLUE	HAC	HAC	SEC	SEC	HAC	SEC	HAC
YEL	PRI	PRI	PRI	SEC	PRI	PRI	PRI
GOOD	PRI	PRI	PRI	PRI	PRI	PRI	PRI
LOS	HAC	HAC	SEC	SEC	HAC	SEC	HAC
MISF	PRI	PRI	SEC	SEC	PRI	PRI	PRI
BO	HAC	HAC	SEC	SEC	HAC	SEC	HAC

Notes:

- PRI Primary clock reference
- SEC Secondary clock reference
- BLUE Blue alarm
- RED Red alarm
- YEL Yellow alarm
- LOS Loss of signal
- HAC System 85/G2.2 internal high-accuracy clock
- BO Maintenance busied out
- MISF Misframe
- GOOD No alarms

### Synchronization Software Operation

Synchronization occurs at several priority levels; records are kept for perusal at the demand test level with procedure 625. In addition, several yellow LEDs on the SCS can be observed to get a current picture of how the system is configured from a reference clock point of view.

- The LED in position #4 refers to the primary DS1 reference. The LED is OFF if a synchronization signal is present and the SCS is capable of locking. The #4 LED is ON if an error condition exists and the synchronization cable is present.



- The LED in position #5 refers to the secondary DS1 reference. The LED is OFF if a synchronization signal is present and the SCS is capable of locking. The #5 LED is ON if an error condition exists and the synchronization cable is present.
- The following four yellow LEDs indicate the selected timing reference: #14 (HAC), #15 (primary reference), #16 (secondary reference), and #17 (cross-coupling). When the system is first brought up and no references are administered, the HAC LED should be lit for the online SCS and the cross-coupling LED should be lit for the offline SCS. Shortly after the DS1 references are administered, the primary reference LED should turn on and the HAC LED should turn off for the online SCS. The cross-coupling LED is the only one lit for the offline SCS.

The synchronization subsystem described above also functions as a periodic maintenance monitor. Status detected during the synchronization process is passed along to other levels of maintenance software for processing. This processing includes error logging for procedure 600 and alarming.

## Generic 3V2

The synchronization boards used on the Generic 3V2 communications systems differ from those used on the Generic 2.2. The TN768 is available on the Generic 3V2 to provide stratum-4E synchronization in the absence of a public-network synchronization source. The TN780 provides either stratum-4E or stratum-3 synchronization to the Generic 3V2 and earlier communications systems in the absence of a public-network synchronization source. Stratum-3 synchronization is provided through an on-premises unit that interfaces with the TN780 (see [“The External \(ST3\) Synchronization Clock”](#) later in this chapter). Stratum-4E synchronization is provided through an internal (on-board) high-accuracy clock.

### Synchronization Architecture

Generic 3V2 systems can function as either timing slaves or timing masters. As a slave, the switch receives digital data from one or two DS1s/CEPT1s, or timing pulses from the one or two interfaces provided on the external on-premises stratum-3 synchronization unit. One interface supplies the primary synchronization reference; the other supplies the secondary reference. The timing source selected is determined by the tone-clock circuit pack and maintenance software. The tone clock synchronizes (phase locks) to an external (off-board) primary reference, an external secondary reference, or the internal (on-board) high-accuracy clock. [Figure 4-10](#) shows the tone clock circuit.

Which DS1 or stratum-3 interface should be used as the primary or secondary reference is totally dependent on administration details. The references should be located in the first cabinet (processor port network) to maximize reliability; and both references must reside in the same cabinet for Generic 3V2 implementations. The tone clock generates the call-processing system tones and also provides the switch with the stratum-4 or stratum-4E clock in the absence of a reliable DS1/CEPT1 or stratum-3 reference.

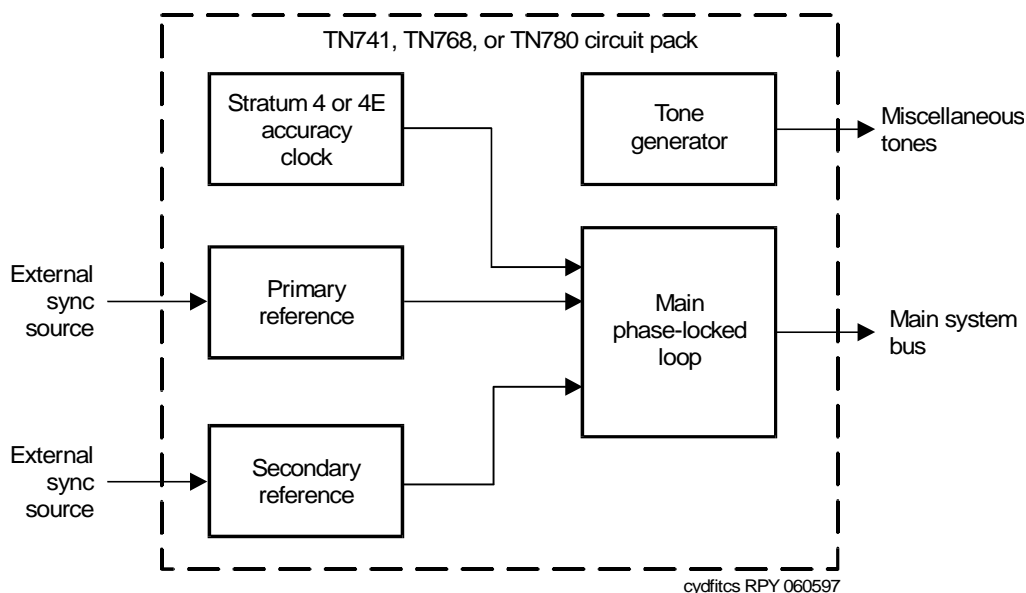


Figure 4-10. Internal Tone-Clock Synchronizer (G3V2)

### Software Operation

G3V2 synchronization software differs slightly from Generic 2.2 because of architectural differences; however, both switches provide the same overall functions. Primarily, these functions include monitoring the synchronization references and keeping the primary or other reference that has the best health online and thus providing high quality digital communications via DS1/CEPT1 facilities.

A subpart of the maintenance software monitors the synchronization circuit pack and synchronization references. Depending on the state-of-health of the references, the maintenance software provides automatic switching between the references. Switching from one reference to another can be done by any of the following conditions:

- On-line synchronization reference failure
- Primary or secondary reference restoration
- Administration reference changes, either from Initialization and Administration System (INADS) or the local terminal.
- System Technician command from a system administration terminal

The TN768 and TN780 circuit packs display edge-mounted LEDs. These LEDs indicate the following status sequences:

- Yellow LED is on 2.7 seconds and off 0.3 seconds — the tone-clock synchronizer is in “active” mode and an external synchronization source is being used as a synchronization reference.
- Yellow LED is on 0.3 seconds and off 2.7 seconds — the tone-clock synchronizer is in “active” mode and the internal (on-board) high-accuracy clock is being used as a synchronization reference.
- Yellow LED is on continuously — the tone-clock synchronizer reset properly but did not receive translations update. It is in “active” mode and is providing synchronization from the internal (on-board) high-accuracy clock.
- Yellow LED is off continuously — a duplicated tone-clock synchronizer is in standby mode. It is neither generating tones nor supplying a clock reference. (TN768 and TN780 only.)
- Yellow LED fast flash (on 0.1 seconds, off 0.2 seconds, on 0.1 seconds, off 0.4 seconds, on 0.4 seconds, off 0.4 seconds, repeatedly) — The tone clock is in the tone-generation mode. This occurs in duplicated systems on the standby clock when the **system status** command is executed during maintenance. The standby clock is the clock not currently participating in the synchronization process.

### Criteria for Switching to the Secondary DS1/CEPT1 or Stratum-3 Reference

Each occurrence of an abnormal or error condition results in incrementing the appropriate error counter. Each error counter has its own unique threshold limit. Exceeding an error counter’s threshold results in a change in operation (such as switching to a different synchronization reference).

The principal error conditions used to determine if a change to a different clock synchronization reference is needed are, in order of importance (error conditions 2 through 6 do not apply when the on-premises stratum-3 clock is used as a reference):

1. The master tone-clock synchronizer detects LOS.
2. The online reference reports a red alarm.
3. The online reference reports a blue alarm.
4. If more than 50% of those DS1/CEPT1 spans that are administered for slip-enable are experiencing slips (with respect to the primary), then a decision is made to switch to the secondary.
5. The online reference reports that its misframe threshold has been exceeded.
6. The online reference reports that its slip threshold has been exceeded.
7. The online reference reports a hyperactive angel alarm.

For switches that do not have the secondary reference, a switch to the internal (on-board) high-accuracy clock will only be made for cases 1, 2, and 3.

## Criteria for Switching Back to the Primary Reference

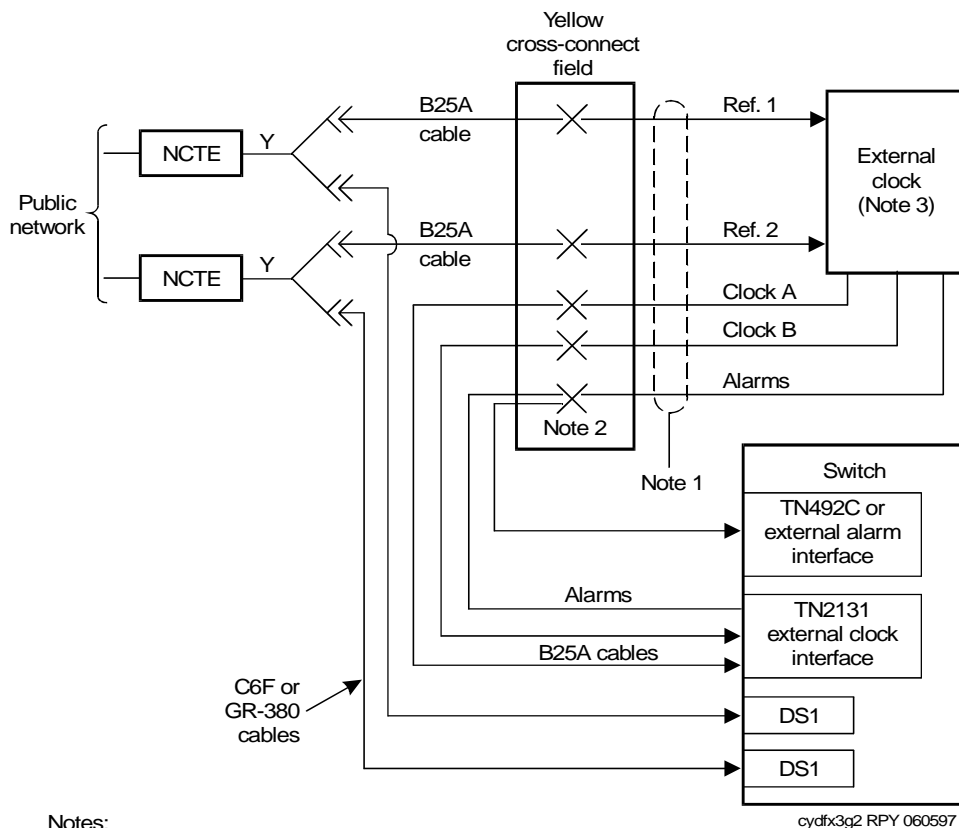
Each time the master tone-clock synchronizer reports a LOS, it increments the excessive reference switch counter. If a total of 20 switches occur within a 1-hour interval then the internal (on-board) high-accuracy clock is placed online and automatic reference switching is disabled. Automatic reference switching is only enabled by hourly maintenance or by the **enable synchronization** command.

With automatic reference switching enabled, most error counters are decremented by 1 every 15 minutes and initialized to zero on reaching the threshold value. The following conditions cause an offline reference to be restored to online (conditions 2 through 7 do not apply when using the on-premises stratum-3 as a reference):

1. The system configuration maintenance detects stratum-3 unit or DS1/CEPT1 circuit pack sanity (for example, a DS1 has been reinitialized, reinserted into the carrier, and/or replaced).
2. The DS1/CEPT1 reference determines that the LOS error no longer exists.
3. The remote loop-around test is completed.
4. The red alarm has been cleared.
5. The blue alarm has been cleared.
6. The slip error counter has cleared.
7. The misframe error counter has cleared.
8. The hyperactive angel alarm has been cleared.

## The External (ST3) Synchronization Clock

It is recommended that all customer premises switches that connect to the AT&T public network and transfer timing use a stratum-4E clock or better. Although a stratum-4 or 4E clock already exists in the DEFINITY communications systems, they can also obtain their timing from an external stratum-3 clock. One advantage of the stratum-3 clock is that it offers 24-hour holdover accuracy. Using an external stratum-3 clock, therefore, can avoid many slips when a network is severed.



Notes:

1. The external clock cabinet has one 50-pin connector. It is labeled EXT CLOCK OUTPUT. One B25A cable is required for connecting the cabinet to the cross-connect field.
2. Refer to the appropriate installation manual or wiring guide for details on how to configure the cross-connections.
3. When the external clock is used, the SCS must not be administered. Those SCS software functions are done by the hardware and firmware within the external clock.

Figure 4-11. Public-Network and External Stratum-3 Clock Connection to G2.2

By replacing the TN463 with a TN2131 in the same slot, the G2.2 may also use the external stratum-3 clock.

Most Generic 2.2 and Generic 3V2 communications systems will use the external clock. This clock is physically mounted external to the switch cabinets. The external stratum-3 clock requires duplicated -48VDC power. This power source may be an existing -48VDC power plant (which is located on customer premises), or a duplicated, cabinet-mounted power supply with battery backup. The input voltage tolerance is -45V to -52V with a worst-case current drain of 3A. The cabinet mounted power supply provides up to 10 minutes of holdover. In

terms of application, the external clock connects between the NCTEs and the switch. Cabling for the I/O and alarm connections is via 25-pair cables with 50-pin telephone connectors. The NCTE-to-external clock connection has the same distance limitations as the NCTE-to-DS1 connection (655 feet maximum).

For Generic 2.2, the cable-run from the external clock to the TN2131 circuit pack cannot exceed 3000 feet; the cable run from the external stratum-3 clock to the TN780 circuit pack cannot exceed 3000 feet. Cable connections to and from the external clock will route via the yellow cross-connect field. [Figure 4-11](#) shows a public-network connection to the external clock and the external clock connection to the Generic 2.2 communications system. Next, [Figure 4-12](#) shows how the external clock is connected to the Generic 3V2 communications system.

The external clock receives two timing reference inputs and may connect to two NCTEs. These timing reference inputs are called *Reference 1* and *Reference 2*. For the external clock, these references perform the same function as the primary and secondary references do for the internal synchronization boards. That is, they are the primary and secondary clock references, and only when these references fail is synchronization derived from the clock in the external stratum-3 unit. The same basic considerations that apply to the selection of primary and secondary references also apply to these references.

For Generic 2.2, all functions previously performed by SCS synchronization software can be provided external to the switch — by the external clock. Furthermore, the switch does not know which reference (1 or 2) is online nor can the switch change from one reference to the other.

The external clock is designed to provide stratum-3 reliability and exists in a duplex version only. This version provides *hot standby* capability (the ability to pull out circuit packs with power on) to the alternate clock and may be used in a processor port network with either simplex or duplex TN780 tone-clock circuit packs. [Figure 4-13](#) shows a functional diagram of the external clock.

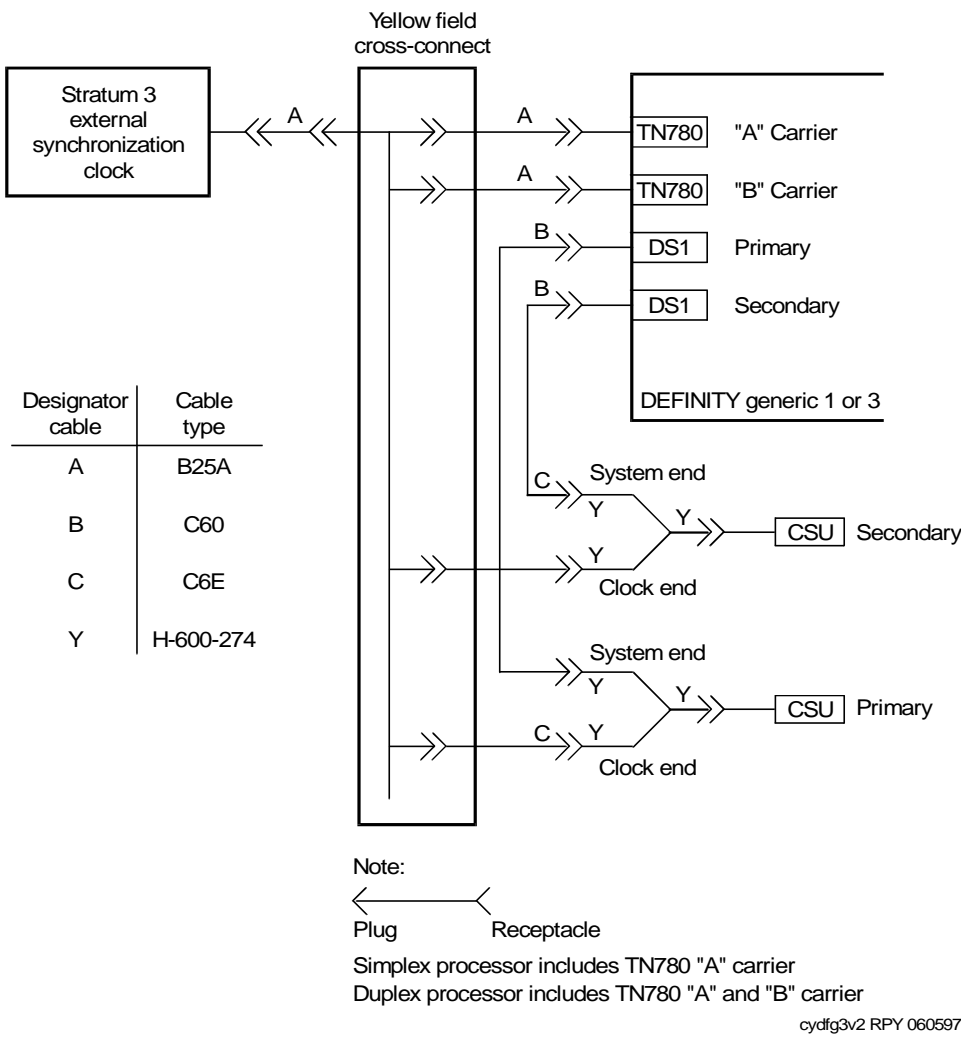


Figure 4-12. G3V2 Connections to the External Stratum 3 Synchronization Clock

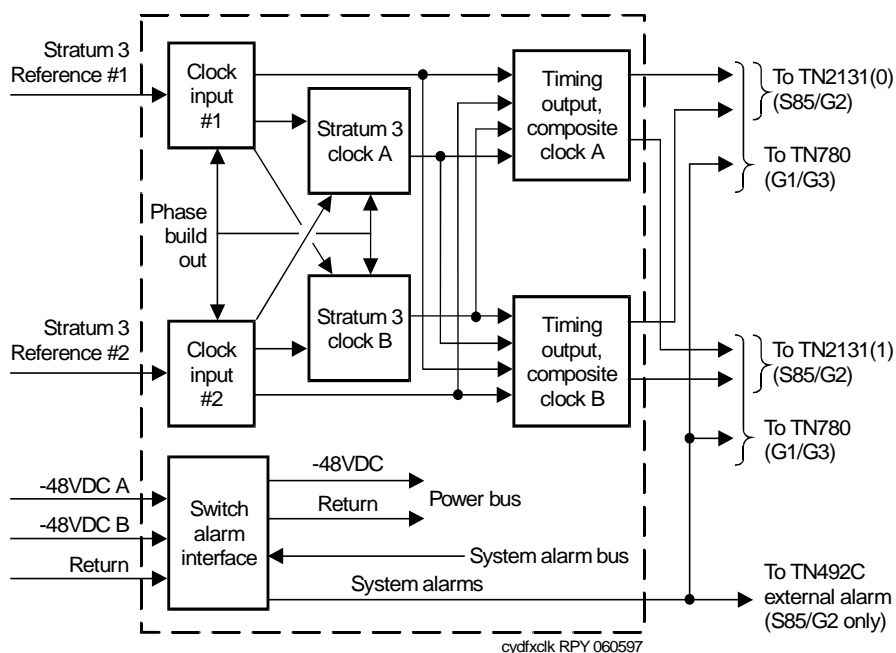
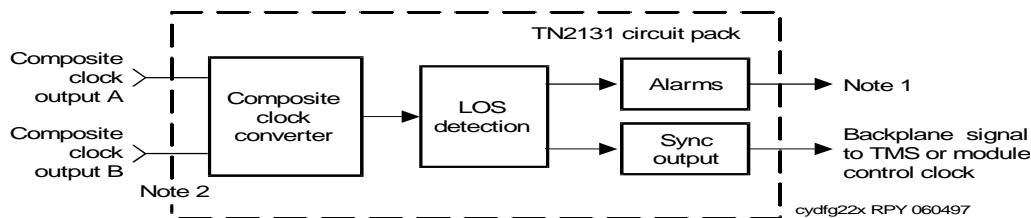


Figure 4-13. External Clock Connection to G3V2 or G2.2

Private network applications that do not have digital connections to stratum-3 or better reference sources will not provide the *Reference 1* and *Reference 2* inputs or the clock-input #1 and clock-input #2 circuit packs. These types of network applications are allowed only when they are timing masters for a private network that is not connected to the public network.

For public-network applications, the clock-input circuit pack receives a 1.544-mbps or 2.048 mbps clock signal from the reference. The clock input #1 and #2 circuit packs generate a 4-kbps stratum-3 clock signal and supply it to the clock and output boards. The *composite clock output* circuit pack monitors the 4-kbps signals from the references and clocks and, on detecting a failure or other error, automatically changes from the online reference clock to an alternate. Furthermore, an alarm signal alerting you of the problem is generated. Additionally, the composite clock output circuit pack generates a 64-kbps composite clock signal. This signal is a special bipolar (return-to-zero) signal that contains a bipolar violation every eighth bit and is cabled to the switch through the TN2131 circuit pack for G2.2 and through the TN780 circuit pack for the Generic 3V2.

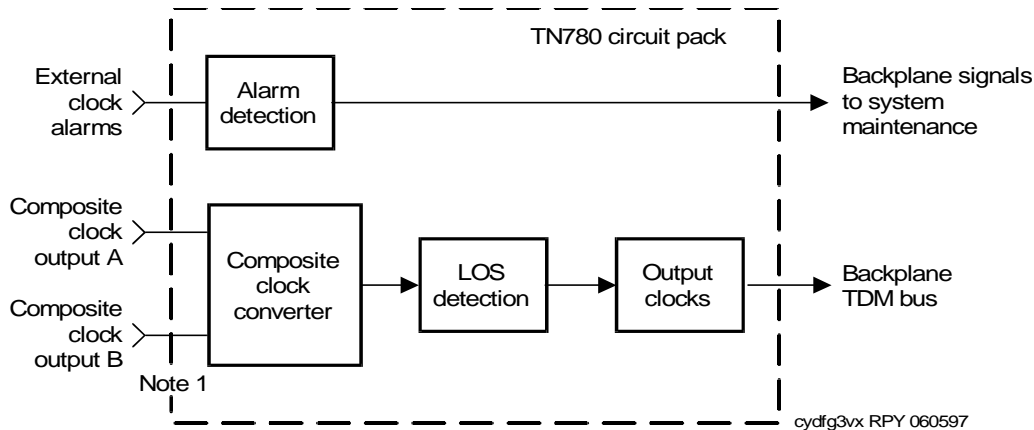




Notes:

1. Alarm signals are cabled to the cross-field. For System 85 and Generic 2, they are then cross-connected and cabled back to the TN492C or external alarm interface. They use the same cable the composite clock signals come in on.
2. System 85 and Generic 2 applications require that the composite clock synchronization signal be connected from the skin of the cabinet to the module control or TMS carrier via an intercarrier cable. TMS and module control carriers (for both System 85 and Generic 2) use the H-600-260 group 1 cable, while Generic 2 universal module control carriers use the H-600-271 group 1 cable.

Figure 4-14. G2.2 External Stratum-3 Clock Interface



Note 1: All signals use the same cable between the cabinet skin and the cross-connect field and between the cross-connect field and the control (and/or port) carrier.

Figure 4-15. G3V2 External Stratum-3 Clock Interface

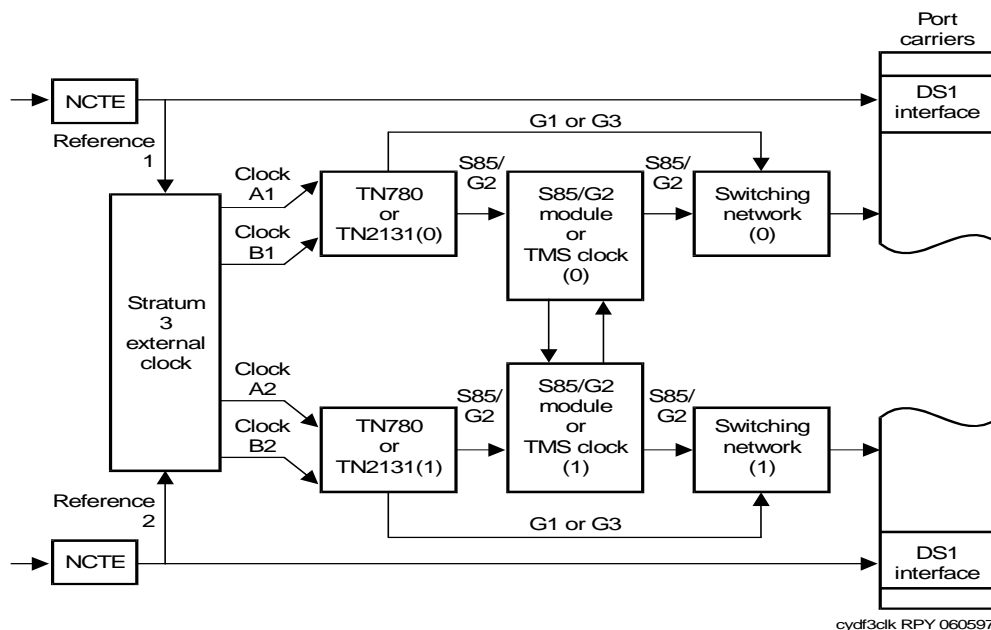


Figure 4-16. External Stratum-3 Clock Duplicated Synchronization for G3V2 or G2.2

## Network Synchronization and Engineering

The primary goals of network synchronization are:

- To keep each digital network node reliable
- To make sure that each digital termination can meet the network objectives

With the growth in the number of digital facilities and the demands that today's applications place on these facilities, designing a proper synchronization plan has become a complex and crucial process. Designing a synchronization plan can be accomplished by using the AT&T ACCUNET Synchronization Design Service available from BC Services or by following the guidelines described on the preceding pages.

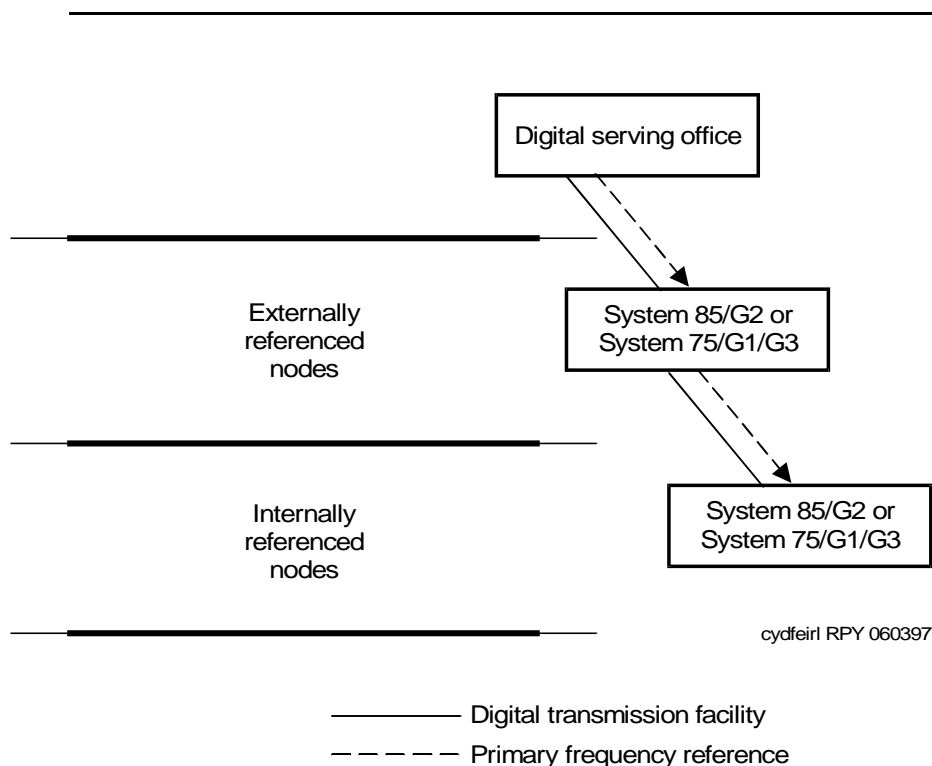
The AT&T Synchronization Design Service is an engineering consulting service designed for customers with private digital networks. This service provides a synchronization design that can be economically implemented along with an estimate of the slip performance. This service also includes an optimal synchronization design that improves the synchronization performance with cost effective network additions. Furthermore, this service reevaluates the entire private network synchronization plan each time there is a change in the customer's network.

A synchronization plan can also be designed by using the following guidelines and rules.

- Ensure that all nodes and facilities are synchronized to a single source of timing; or at the worst, to two or more stratum-2 timing sources
- Select the most reliable digital facilities to serve as synchronization references at each node
- Choose facilities with the greatest availability and least outage. For example, facilities that are located in hostile environments or that have a history of service disruptions should not be used.
- Ensure that no timing loops can be created even under failure conditions, that is, timing from one node can never serve as a source of timing back to that node, even if it is looped through several other nodes.

### Selecting a Timing Source for the Switch

Before selecting a timing source, you should draw or obtain a copy of the network topology (which indicates each node and the interconnecting digital trunk facilities). The nodes in the private network should be stratified (divided) into two levels known as *externally* referenced and *internally* referenced (sometimes called *unreferenced*). Externally referenced nodes are those within the private network that connect directly to public network timing sources. Internally referenced nodes have digital facilities that do not connect directly to public network timing sources. [Figure 4-17](#) shows a typical network topology with externally and internally referenced nodes.



**Figure 4-17. External and Internal Reference Levels**

For externally referenced nodes, the operating company personnel will specify what the source of timing is on those links. If the network does not receive timing from the public network at any of its nodes, the master-slave relationships in the network will then be determined by those persons responsible for engineering the synchronization of the network.

This internal and external referencing concept permits constraints in synchronization network layout to be expressed in terms of network layout rules. The rules constitute a procedure to select the nodes used as primary and secondary references. Two sets of reference selection rules are available: one set for internally referenced networks and the other for externally referenced networks.

### Internal Reference Selection Rules

The seven rules used to select internal synchronization references are described next.

### Rule 1:

*Select the node with the lowest stratum clock as the network reference clock master and have the rest of the nodes derive slave timing from it.*

If there are one or more clocks in the network at the lowest stratum level, the following steps can be taken to determine the clock that should become the network reference clock source.

- Step 1: If there is only one digital switch in the network, that switch is to be the network reference clock master.
- Step 2: If there is more than one digital switch in the network, rules 2 through 7 should be used to determine the switch that should be the network reference clock (master).
- Step 3: If there are no digital switches in the network, choose a digital terminal product as the network reference clock master and have the other nodes derive timing from it. Listed in order of preference, use a CEM, a D4-channel bank, or a CDM as the network reference clock master.

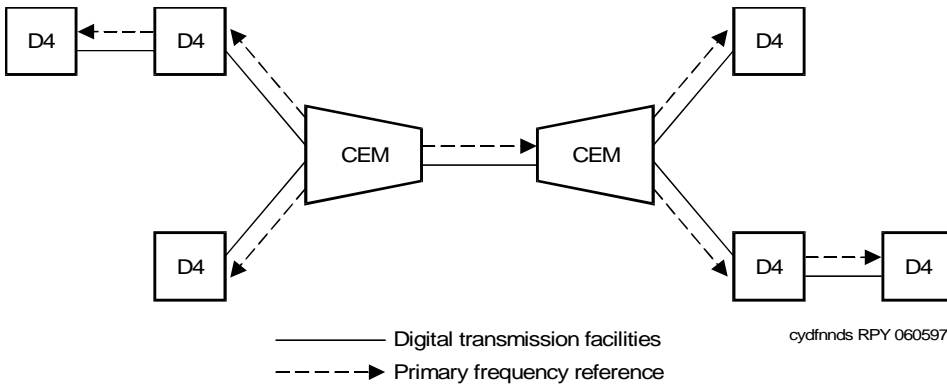
The CDMs can only be used to provide timing when they are used to emulate a D4-channel bank.

### Example For Rule 1

[Figure 4-18](#) is used to explain the application of rule 1.

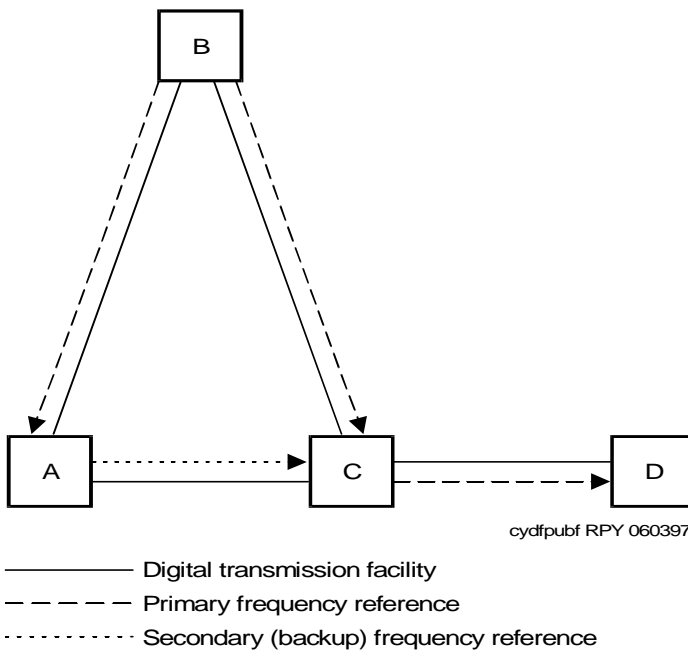
To determine the synchronization plan for [Figure 4-18](#) the following tasks were performed. First, according to rule 1, an attempt was made to find a node with the lowest stratum clock. The attempt failed because all the nodes in the illustration provide stratum-4 timing. Therefore, the steps under rule 1 must be used. Steps 1 and 2 are not applicable because there is no digital switch in the network.

Under Step 3, it was determined, according to the ranking, that a CEM should be the network source clock. Next, rules 2 through 7 were used to determine which of the two CEMs should be the network source clock. For rules 2 through 6, both CEMs were equally qualified. Therefore, an arbitrary decision was made to choose the CEM on the left.



**Figure 4-18. Nonpublic Network without Digital Switches**

The digital terminal products do not automatically switch to their internal high-accuracy clock on synchronization reference failure.



**Figure 4-19. Proper Use of Backup Facilities**

**Rule 2:**

*A node may use a facility as a backup only if the node at the other end is not using that same facility as a backup.*

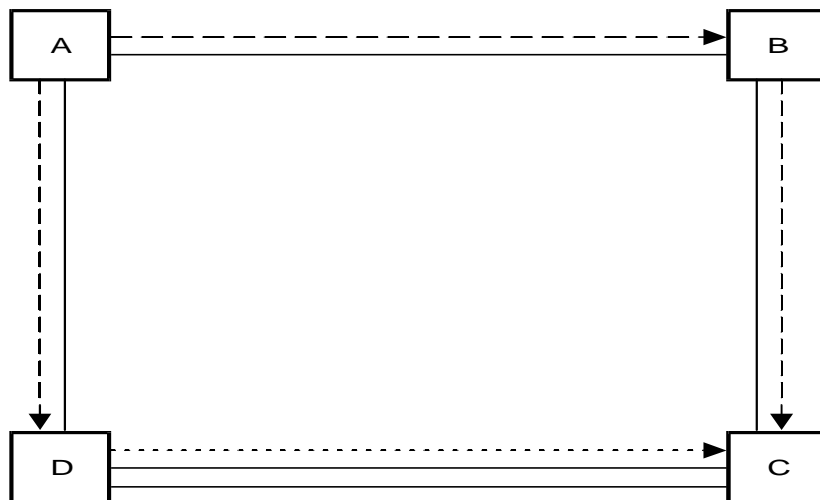
**Example For Rule 2**

[Figure 4-19](#) illustrates an application of rule 2 and proper use of a backup facility between nodes A and C.

[Figure 4-20](#) shows the same network arrangement but with improper use of the backup facility between nodes A and C. This improper arrangement would form a timing loop if node B should fail (nodes A and C would switch to their backup, which is each other).

**Rule 3:**

*The transmission facilities associated with those nodes meeting Rules 1 and 2 and having the greatest availability must be selected for primary and secondary synchronization facilities.*



cydfopdr RPY 060397

- Digital transmission facility
- - - - - Primary frequency reference
- ..... Secondary (backup) frequency reference

**Figure 4-20. Improper Use of Backup Facilities**

Availability is defined as the ratio of the mean time between failures (the average time between successive system failures, abbreviated *MTBFs*) to the sum of the *MTBFs* and the mean time to repair (the total maintenance time divided by the total number of failures during the same amount of time abbreviated *MTTR*). Low availability (poor transmission performance) is used as a criterion to reject a facility as a reference candidate or to reassign one already chosen.

Characteristics that primarily determine the availability of a transmission facility are rank-ordered as follows:

1. History record
2. Activity
3. Facility length
4. System rate (that is, whether the facility supports T1/E1 or fiber)
5. Protection switching
6. Physical type (that is, whether the facility is physically installed as an underground, buried, or aerial paired cable, a coaxial cable, or a radio link). (Satellite facilities should not be used to supply synchronization.)
7. Number and type of regenerative repeaters
8. Number of digital terminal products and other intermediate office equipment, if any

Facility rank ordering is generally based on limited technical and operational information. It is recommended that facility selections be based on local field experience where available.

#### **Rule 4:**

*Where possible, the routes for all primary and secondary synchronization facilities should be diverse.*

#### **Example For Rule 4**

[Figure 4-21](#) explains the optimal configuration when rule 4 is used. [Figure 4-22](#) shows a less than optimal application of rule 4.



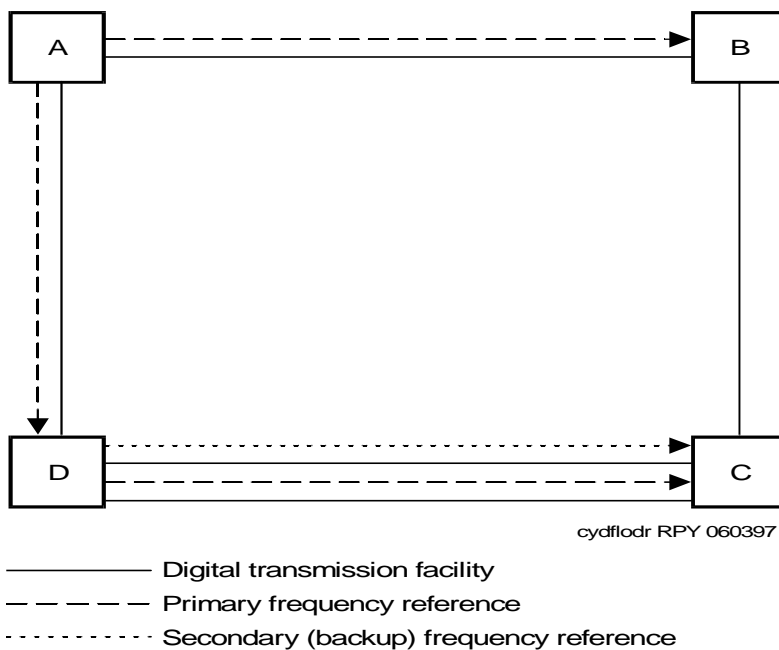
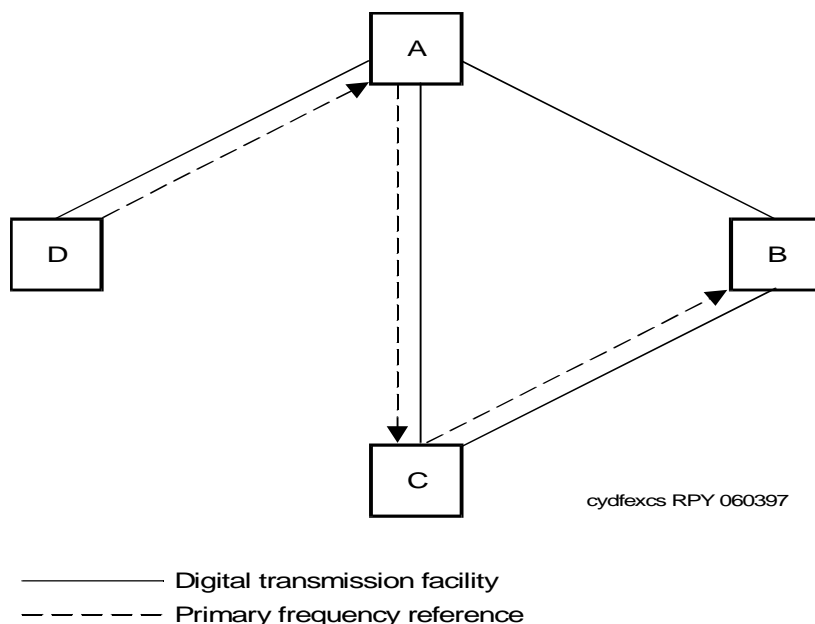


Figure 4-21. Optimal Diverse Routing

[Figure 4-22](#) shows node C deriving both primary and secondary timing from node D, via the two separate T1/E1 facilities. If node D should fail, node C would no longer receive timing that is traceable to node A. Here, node C would lose synchronization and begin to introduce slips into the network.



**Figure 4-22. Less Than Optimal Diverse Routing**

**Rule 5:**

*Obtaining both primary and secondary synchronization facilities from within the same transmission cable should be minimized.*

**Rule 6:**

*The total number of cascade node connections from the referenced node should be minimized.*

**Example For Rule 6**

[Figure 4-23](#) shows excessive cascading in that node B derives timing from a source three transmission facilities away.

[Figure 4-24](#) shows less cascading in that node B derives timing from a source two transmission facilities away. Excessive cascading is undesirable because of intermediate link vulnerability. For example, an intermediate link failure in node C of [Figure 4-23](#) would cause node B to lose timing. Such a failure increases the number of slips between nodes A and B. However, the same failure in Node C of [Figure 4-24](#) does not affect node B's synchronization.

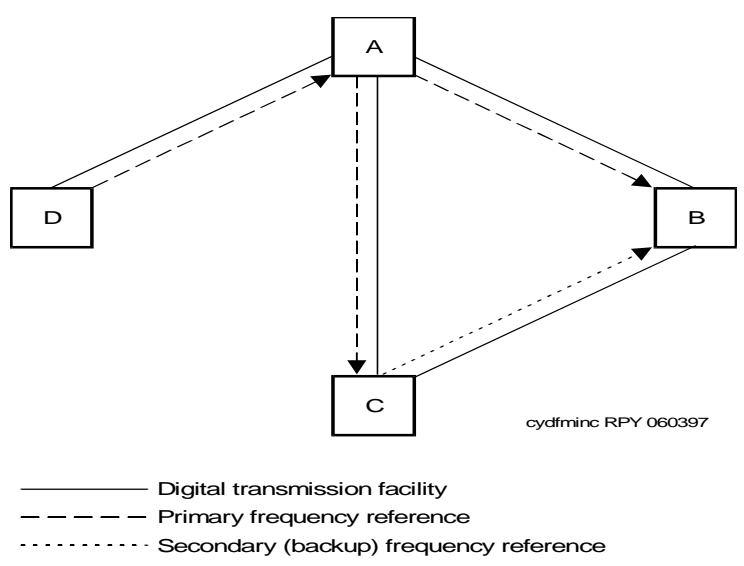


Figure 4-23. Excessive Cascading

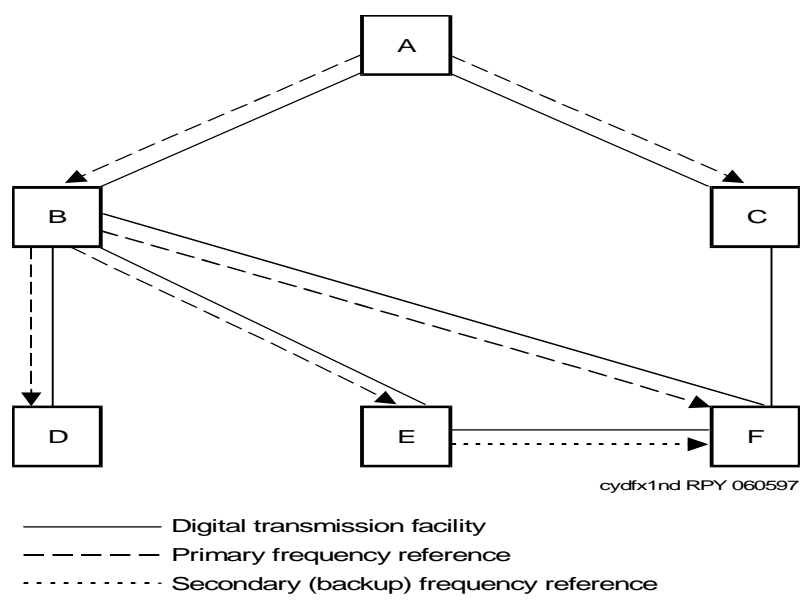


Figure 4-24. Minimized Cascading

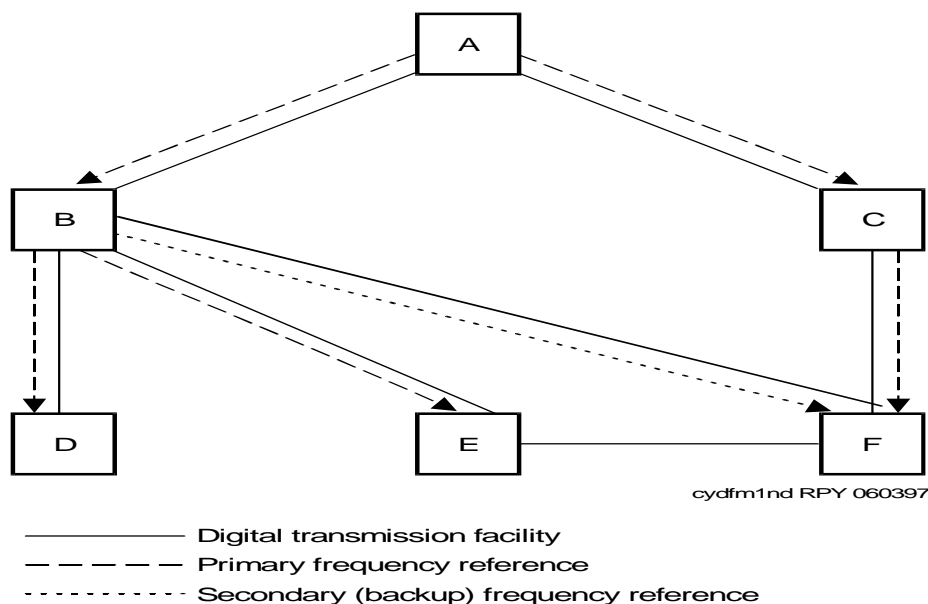
**Rule 7:**

*The number of nodes receiving synchronization reference from any given node should be minimized.*

**Example For Rule 7**

[Figure 4-25](#) shows an excess of synchronization from one node. If transmission facility linking nodes A-B fails, then nodes B, D, E, and F will lose their synchronization. However, if this same facility fails in [Figure 4-26](#) only nodes B, D, and E will lose synchronization. Node F remains synchronized to the network.

With few exceptions, it is not possible to engineer a synchronization network that will satisfy all seven rules. In general, rules 1 through 3 apply in all cases. For rules 4 through 7, use those rules that apply to your specific network and try to minimize outages based on the cases presented in the examples for each of these rules.



**Figure 4-25. Excessive Synchronization from One Node**

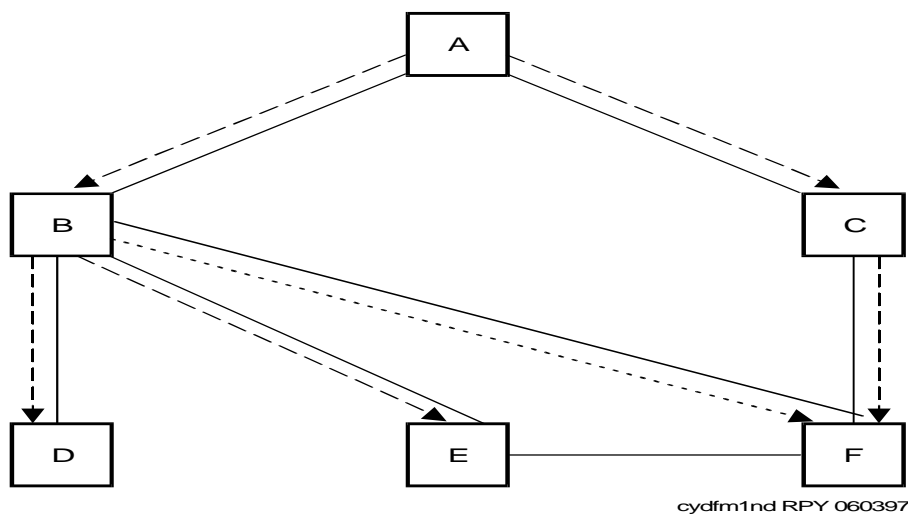


Figure 4-26. Minimized Synchronization from One Node

.PIC /ks6/lath/multiw/appb.p22 5.0i

### External-Reference Selection Rules

There are seven rules for selecting external synchronization references. These rules are described next.

#### Rule 1:

*Nodes within the externally referenced sublevel may not use as a reference source a facility from a node within the internally referenced sublevel (refer to [Figure 4-17](#) for an explanation of these terms).*

#### Rules 2 Through 7:

Rules 2 through 7 are the same for both internal- and external-reference selections.

## Availability of Synchronization Sources

- Misconception 1    The local exchange company (LEC) can always provide the synchronization source.
- Fact 1              The LECs are not always subscribers to the AT&T reference frequency.
- Many end offices still use analog switches and D4-channel banks. In the past, these channel banks have not had to be synchronized and probably have not been equipped with an office interface unit (OIU-2); therefore, they do not provide a lower- (3, 2, or 1) stratum reference.
- Even if the CO/PTT provides a lower stratum reference, a T1/E1 facility must be terminated in equipment that is clocked by the lower stratum reference to access this lower reference.
- Misconception 2    AT&T communications can provide the synchronization source.
- Fact 2              In the United States, AT&T Communications is bound by FCC tariffs that currently do not require the use of framing bits in the customer's incoming T1 bit stream. Until framing bits are required, you should not arbitrarily assume that the carrier's T1/E1 facilities provide a synchronization source.
- Misconception 3    Synchronization is not necessary for DS1/CEPT1 networks that only transmit voice.
- Fact 3              Even though voice is fairly insensitive to slips, a DS1/CEPT1 network that is improperly synchronized can cascade a small number of slips into a large number of slips. This will cause voice degradation and DS1 alarms. In fact, this cascading effect may even cause the DS1/CEPT1 facility to be taken out of service. Therefore, proper synchronization is necessary for all DS1/CEPT1 networks.

- Misconception 4 The OIU-2 is not required in a D4-channel bank since all DEFINITY models are D4 compatible.
- Fact 4 DEFINITY is (when operating in D4 mode) compatible with D4-formatted DS1 or T1 facilities. However, a DS1 was not designed to be functionally the equivalent of a channel unit. D4-channel banks use line-powered oscillators to provide their clocking. Given the normal drift in an AC line, the transmit frequency of a D4-channel bank can vary significantly. The OIU adds a stratum-4 clock to the common equipment of a D4, allowing the transmit and receive sections to be commonly synchronized to:
- The incoming line (loop timed)
  - Free-running (stratum 4 accuracy)
  - With external references that can be applied to both DS1 spans, you can select either DS1 span as the reference.

## Conclusions on Synchronization

Make no assumptions regarding synchronization. Reverify items such as the availability of a synchronization source, the clock stratum, and compatibility of every T1/E1 span. The best guarantee is written confirmation that the local exchange carrier, AT&T Communications, or other vendor will either synchronize to a System 75, System 85, Generic 1, Generic 2, or Generic 3 or provide an appropriate synchronization reference.

Develop a diagram showing the network synchronization plan. Make multiple copies of this diagram and keep a copy at each switch site. This diagram is essential for installing, administering, and *tuning up* a DS1/CEPT1 network. Such a diagram can also be used by maintenance personnel to troubleshoot network problems associated with synchronization.

A properly designed synchronization plan will improve the quality and reliability of a digital private network. If designing a synchronization plan becomes too complex or if many applications have a crucial dependency on the digital facilities, then the AT&T Qualnet Synchronization Design Service should be consulted.

## Use of G2.2 as a System Clock Reference

To provide increased reliability, it is recommended that (for all cases) the primary and secondary system clock references be placed in different modules. Tips on how best to use a DS1 as a clock reference are provided next.

## ISDN-PRI Trunk Facilities

ISDN-PRI trunks may terminate on a 4ESS toll office, 5ESS digital CO, System 85 R2V4, DEFINITY communications systems, or compatible vendor's switch. Depending on other considerations, any of these terminating connections may be selected as either a primary or secondary synchronization reference. ISDN-PRI configurations may be established with an ANN35, with a TN464C, or with a TN767 with or without a TN555, depending upon the D channel configuration of the TN767. A brief description of these boards and their general use for ISDN-PRI is given next.

The ANN11 is the DS1 board used with traditional modules in Generic 2.2. The ANN35 is the ISDN-PRI board used with Generic 2.2 traditional modules. The TN767 is the DS1/ISDN-PRI board used with Generic 3V2, and Generic 2.2 universal modules. The TN555 is the packet adjunct used with Generic 2.2 universal modules. If the TN767 has a D channel on it, it needs a TN555 located in the adjacent virtual slot. The TN464C is the universal DS1/CEPT1 board used in the Generic 3r and Generic 3i-Global for all DS1 and CEPT1 applications, including ISDN PRI.



### NOTE:

The Generic 3iV2 communicates with the D channel via a TN765 (PI) interface circuit and does not use the TN555.

## Line-Only Mode DS1/DMI-BOS (ANN11 or TN767)

When using a line-only mode interface for synchronization purposes, the following facts should be known:

- Since the D4-channel bank (or equivalent) at the far end will be timed to the signal received from a DS1, no slips should occur on a line-only mode DS1 facility. Because of this, slip counts from line-only mode DS1s should not be used to determine the health of a clock reference (that is, they would tend to make the reference appear to be in better condition than it may be).
- Line-only mode DS1s should not be used as system clock references unless it is known for certain that the incoming DS1 is locked to the public network reference frequency. Normally, a DS1 facility terminating directly on a far-end D4-channel bank is not locked to the AT&T reference frequency.



## **Line+Trunk Mode DS1/DMI-BOS (ANN35 or TN767 with TN555)**

Regarding the use of a line+trunk mode DS1/DMI-BOS for synchronization, the following point should be noted. Since it would be expected that a line+trunk mode DS1 would terminate at a class-5 or higher CO or at another switch, the line+trunk interface should be suitable for use as a primary or secondary clock reference (or to be the timing master for another switch).

The slip count provided by the interface should also be used in the process of choosing a healthy clock reference. However, when the interface terminates on a D4-channel bank (or equivalent) that is not locked to the AT&T reference frequency for its timing, then the interface should not be used for synchronization.

## **Use of G3V2 as a System Clock Reference**

Tips on how best to use DS1/CEPT1 as a clock reference are provided next.

### **Trunk-Mode ISDN-PRI**

ISDN-PRI trunks may terminate on a 4ESS toll office, 5ESS digital CO, System 85 R2V4, Generic 1, Generic 2.2, Generic 3V2, or compatible vendor's switch. Depending on other considerations, any of these terminating connections may be selected as a synchronization reference, either primary or secondary.

### **Trunk-Mode Interface (ISDN-PRI + Robbed Bit)**

Since it is expected that a trunk mode DS1 would terminate at a class-5 or higher CO or at another switch, the trunk interface should be suitable for use as a primary or secondary clock reference (or to be the timing master for another switch).

The slip count provided by the interface should also be used in the process of choosing a healthy clock reference. However, when the interface terminates on a D4-channel bank (or equivalent) that is not locked to the AT&T reference frequency for its timing, then the interface should not be used for synchronization.

### **Line-Only Mode DS1/DMI-BOS**

When using a line-only mode interface for synchronization purposes, the following facts should be known:

- Since the far-end D4-channel bank (or equivalent) is timed to the signal received from a DS1/DMI, no slips should occur on a line-only mode DS1/DMI facility. Because of this, slip counts from line-only mode DS1/DMI should not be used in the process of determining the health of a clock reference (that is, they would tend to make the reference appear to be in better condition than it may be).

- Line-only mode DS1/DMI should not be used as system clock references unless it is known for certain that the incoming DS1/DMI signal is locked to the AT&T reference frequency. Normally, a DS1/DMI facility terminating directly on the far-end D4-channel bank is not locked to the AT&T reference frequency.

## G2.2 Synchronization Implementation

To implement synchronization on a G2.2, you must do the following:

- Wire the TN463 correctly depending on whether the system is single module or multi module and depending on whether the DS1 board to be used as a source is on a traditional or universal module as follows:
  - The group 334 cable is wired from the synchronization source DS1 board to the TN463 in a multimodule system when the DS1 board is in a traditional module.
  - The group 361 cable is wired from the synchronization source DS1 board to the TN463 in a single module system when the DS1 board is in a traditional module.
  - The group 503 cable is wired from the universal bus interface to the TN463 in a multimodule system when the DS1 board is in a universal module.
  - If the source is on a universal module in a single module system, a synchronization cable is not required.
- Administer the board as a timing source in procedure 260, word 1, fields 12 and 13, as follows:
  - Enter a **1** in field 12 if this board is to be used as a timing source (meaning it is deriving timing from the far end source connected to the board, such as a CO or toll switch).
  - Enter a **1** in field 13 if this board is the primary source or **2** if it is the secondary source.



**NOTE:**

Remote modules cannot serve as timing sources.

## G3V2 Synchronization Implementation

The following list summarizes some of the implementation issues involved with synchronization:

- In a network of DEFINITY systems connected by DS1/CEPT1 facilities, one master timing source exists. This timing source, if on a G3V2 system, is one of the following:
  - A DS1/CEPT1 circuit pack connected to a T1/E1 facility (such as a 4ESS). If this is the case, this is the most desirable source for master synchronization.
  - If a T1/E1 facility is not available, the next best master source is a stratum 3 clock connected to a port network.
  - If neither of the above two options is available, the master timing source defaults to the tone/clock board on one of the systems in the network.

Synchronization is implemented in the synchronization plan form, as follows:

- All slave systems in the network must have at least a primary source administered from which it derives timing. This is done by assigning the location of a DS1/CEPT1 circuit pack to the primary reference in the form. This means that the system derives timing from the system or facility connected to that circuit pack. If the connection fails, then that system will derive timing from the free-running clock on the circuit pack, which is a stratum 4 or 4E clock.
- If a system is to be a master to the rest of the network, you must administer either a stratum 3 clock on that system or let a tone/clock board serve as the master source.
  - To administer a stratum 3 clock you must enter the stratum and the location of the TN780 in the form.
  - To administer a tone/clock as the master source, you can leave the form blank. This will cause the tone/clock in the port network that was last used as a timing source to become the timing source. If no other port network has been used as a timing source, the tone/clock in the PPN is the default. You can also administer the tone/clock of any port network to be the timing source by doing the following:
    1. **disable sync**
    2. **set sync [location of tone/clock]**
    3. **enable sync**
    4. **stat sync** (to display the location of the new synchronization source)

Following are recommendations for choosing a synchronization source in G3V2 systems:

- If you have a choice, use a TN767 or TN464C before using a TN722 as a timing source.
- If at all possible, the primary and secondary sources should be located in the PPN.
- You cannot locate a timing source in a remote port network in G3rV2.

## Layers 2 and 3

# 5

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This chapter discusses how various aspects of layer 2 and layer 3 protocols have been designed into the DEFINITY systems. It discusses these subjects as they relate to narrowband (64 kbps) switching.

For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

In the cases where a relationship exists, this chapter discusses how layer 2 and layer 3 subjects relate to system administration. For a complete guide to administering narrowband DS1 and CEPT1 capabilities, however, you should refer to [Chapter 6, "System Administration"](#).

[Chapter 4, "Physical Layer"](#), shows that at the physical layer, DS1 and CEPT1 trunks use two basic types of signaling to control calls — bit oriented signaling and ISDN PRI signaling (a type of message oriented signaling). The physical layer does not cover how these signaling schemes actually control calls. Call control requires higher protocol layers. The International Standards Organization (ISO) has defined a model called the Open Systems Interconnect (OSI), which defines layers of protocols that communicate with each other. The lowest layer is the physical layer and the highest layer is the application layer. Basic call control, which defines how calls are set up and torn down, conforms roughly to three layers of protocol, the physical layer (layer 1), the link layer (layer 2), and the network layer (layer 3).

## Bit Oriented Signaling Layers 2 and 3

The discussion of bit-oriented signaling in [Chapter 4, "Physical Layer"](#) described how the signaling bits are multiplexed into either a common signaling channel or robbed from the trunk channel. It does not discuss, however, the protocol that controls calls, which can be thought of in the Open Systems Interconnect (OSI)

model as layers 2 and 3 protocols. ISDN PRI signaling, for example, by definition uses the layers 2 and 3 concepts to define its call control signaling. Although much less complicated, bit-oriented signaling has its analogous call control structure (although the concept of the link layer (layer 2) is hard to fit into bit oriented signaling since the OSI model was developed for message-oriented signaling). For example, in ISDN PRI signaling, the layer 3 protocol sends a SETUP message to seize a trunk and send digits, thus initiating a call. Similarly, bit-oriented signaling relies on a protocol that seizes a trunk and sends digits to initiate a call. To illustrate this point, the following list shows the sequence of events used by bit-oriented signaling to initiate a call on a wink-start tie trunk using dual tone multifrequency (DTMF) digit sending:

1. Both ends of the trunk are initially on hook, meaning the A and B bits being transmitted from both ends are 0.
2. The near end PBX goes off hook. This results in the near end sending 1s on the A bit and 1s on the B bit to the far end.
3. The far end returns a wink, which means sending 1s on the A bit for a specific period of time then switching back to 0s on the A bit. The B bit is ignored.
4. If the near end receives the correct wink, it means the far end is ready to receive digits. The near end then outpulses the digits in the form of DTMF tones over the trunk channel.
5. After receiving the digits, the far end answers by going off hook and returning 1s on the A bit. The B bit is ignored.

This sequence describes only one aspect of a call, the outgoing call initiation, on one specific type of trunk, a wink start tie trunk with DTMF sending. In general, a call using bit oriented signaling requires the following sequences to be described by a protocol:

- Outgoing call initiation sequence
- Incoming call initiation sequence
- Disconnect sequence

To cover all bit-oriented protocols, these sequences must be described for calls on the following types of trunks:

- Tie trunks with various combinations of start-dial sequences (wink start, delay dial etc.) and DTMF or dial pulsing.
- CO trunks with either loop start or ground start signaling and DTMF or dial pulsing.
- DID trunks, with either wink start or immediate start signaling and DTMF or dial pulsing.

In all of these cases, the call control signaling protocol emulates the historical analog case. For example, a wink on a digital trunk is a stream of 1s on the A bit for a period of time equal to the time a certain voltage level is maintained defined

by the wink on a 4-wire E&M analog trunk. When digital trunks first appeared, the decision was made to define the signaling such that it emulated all the existing analog cases. Though describing the detailed protocols are beyond the scope of this document, you can order the following documents that describe these protocols:

- *Private Branch Exchange (PBX) Switching Equipment for Voiceband Application, EIA/TIA-464-A*, February 1989. Published by Electronics Industry Association, Engineering Department, 1722 Eye Street, N.W., Washington, D.C. 20006.
- AT&T Technical Publication TR41458 *Special Access Connections to the AT&T Network for Nodal Service Applications*.

On all DEFINITY systems, the call control protocols for bit-oriented signaling (as well as for ISDN PRI signaling) are implemented primarily in a combination of trunk group administration and firmware on the DS1/CEPT1 interface board. The firmware on the board is capable of performing all the various types of winks, delay dials, DTMF, dial pulsing, etc. All it requires is a command from the software telling it what kind of trunk it is. Thus, the basic instructions for bit-oriented call control signaling come from trunk group administration.

## G2.2 Implementation

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The G2.2 implements bit-oriented signaling call control in procedure 100, word 1, field 6 and in procedure 100, word 3, field 2. Word 1, field 6 defines the trunk type, which for the most part are different flavors of the CO, Tie and DID standard types. For example, if you administer trunk type 41 on a trunk group, the DS1 board will signal according to the EIA tie trunk standard for that channel. Since default signaling type for a type 41 trunk is signaling type 26, which is wink start, the board will use the standard definition of a wink to know when to begin outputting digits. Word 3, field 2 allows you to change the signaling type from its default if you want. For example, if you want calls on a trunk to be treated by the feature software in the system as CO calls but the trunk is actually a 4-wire E&M type of interface, you can administer the trunk type as CO but change the default signaling to type 29, which is an E&M wink start signaling. Not all signaling types are valid with all trunk types, however. The G2.2 administration manual lists the compatible signaling-to-trunk types in procedure 100, word 3.

### NOTE:

The trunk type administered in word 1 implements more than just the bit-oriented signaling call control protocol. System features are also based upon this trunk type administration. For example, to gain access to ETN features, you must administer a tie trunk type.

## G3V2 Implementation

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Implementing the bit-oriented call control protocol in the G3V2 systems is analogous to that of G2.2. The protocol is implemented in the trunk group form. The group type is analogous to the trunk type of G2.2. Thus, you can enter types such as tie, CO, and DID. Like the G2.2, you can administer many variations of the types listed in the EIA standard. For example, group type tandem is a variation of a tie trunk that allows access to special system networking features. The trunk type in G3V2 systems is analogous to the signaling type in G2.2. If you enter **wink/wink**, for example, the board is told to signal like a 4-wire E&M wink start trunk on channels belonging to that trunk group. Unlike the G2.2, however, some of the bit-oriented protocols implemented conform to a particular country's standard rather than the EIA standard. For example, if the country protocol on the DS1/CEPT1 board is 4 (Italy), CO signaling will conform to Italian standards. Whereas in the U.S., only the A and B bits are defined for trunk signaling, in other countries, the A, B, C, and D bits might all be used.

## ISDN PRI Layer 2

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Layer 2 in ISDN PRI uses the link access control procedure for the D channel (LAPD), which is the link layer protocol used to transport the D channel end-to-end. The primary functions of LAPD are as follows:

- ISDN PRI layer 3 message packets are sent in LAPD layer 2 frames.
- Error correction and retransmission is provided by LAPD.
- LAPD provides a method to multiplex signaling on many logical channels on the single D channel.

The DEFINITY systems implement layer 2 according to the CCITT Q.921 recommendation. The layer 2 implementation is mostly transparent to anybody implementing or supporting ISDN PRI in the DEFINITY systems.

Significant differences exist in how the LAPD protocol is terminated among the systems, however. In G2.2 traditional modules, the DS1 interface (the ANN35) terminates the LAPD protocol. This is why this board can only be used for ISDN PRI signaling. In G2.2 universal modules, the module processor terminates the LAPD protocol. In G3iV2 the ISDN PRI LAPD protocol is terminated by the processor interface board. In G3rV2, however, the ISDN PRI LAPD protocol is terminated by the packet interface board, which also terminates all LAPD links in the system, including internal system links to the ports. In all cases, an internal protocol is used to communicate between the board terminating the LAPD and the processor, which terminates the level 3 protocol. Differences also exist between G2.2 and G3V2 in the protocol determining which end of an interface is user and which one is network (or slave and master in a peer protocol) and also in the way layer 2 timers are administered.



## G2.2 Layer 2 Termination

G2.2 traditional modules use a special DS1 board, the ANN35, to terminate ISDN PRI layer 2 signaling. Firmware on this board does all the layer 2 processing. Because this board is designed specifically to process ISDN PRI layer 2 signaling, however, it cannot be used for DS1 bit oriented signaling protocols. Thus, the ANN35 is called an ISDN PRI board. When a DS1 facility connected to the ANN35 contains an ISDN D channel (a facility associated signaling arrangement), the 24th channel is processed separately by the board. The other 23 channels are put on the PCM bus (the G2.2 traditional module name for a TDM bus) to be switched to their destinations. The ANN35 terminates the LAPD protocol on the 24th channel and puts the remaining data on the I/O bus for processing by the module processor and common control processor.

Universal modules, on the other hand, use the TN767, which does not perform any layer 2 processing. If the DS1 facility connected to the TN767 contains an ISDN PRI D channel, a TN555 packet adjunct board must be present in the adjacent slot. In this case, the entire 24 channels incoming to the DS1 board are routed to the TN555 via a short cable from the TN767 to the TN555. The TN555 then places the 23 B channels on the TDM bus to be switched to their destinations. The TN555 relays the LAPD frames of the D channel directly to the LAN bus and ultimately to the downloadable module processor, which terminates the LAPD protocol and sends the remaining data to the common control processor.

No special administration is required in G2.2 to terminate the layer 2 ISDN PRI protocol.

## G3iV2 Layer 2 Termination

In G3iV2, administration must be performed to set up communication between the SPE and the PI board. This allows the layer 2-terminating board, the processor interface, to deliver the data on the D channel to the SPE, which then interprets the data using the level 3 ISDN PRI protocol. This operates as follows:

- The DS1/CEPT1 bit stream enters the DS1/CEPT1 circuit pack.
- The DS1/CEPT1 circuit pack terminates the layer 1 protocol and relays these bits to the TDM bus. The administration for this is all done on the DS1 circuit pack form.
- The bit stream on all timeslots except for timeslot 24 (DS1) or 16 (CEPT1), which is the ISDN PRI D channel, remain on the TDM bus and are switched to their destinations (ports). The D channel bits, however, are routed to the processor interface board. This routing is done by setting up a connection between the D channel on the DS1/CEPT1 circuit pack and a port on the processor interface board. To set up this connection, you do the following:
  - Administer the signaling group form for the desired D channel.

- Add a data module of the type **procr-intf**, and its extension and assign it to the port (physical channel) on the PI board(s) (ports 1-8) to which you want the D channel to communicate.
- Use the command **change communication-interface links** to display the interface links form. Administer the link corresponding to the physical channel of the processor interface data module. By entering the extension of the processor interface data module and the board address of the DS1/CEPT1 board containing the D channel, a path is set up over which the PI board and the D channel can communicate. When enabled, the two boards will communicate.
- Before enabling the connection, you must administer the link in the processor channel assignment form. This tells the system that the link is being used for ISDN applications.
  - The D channel from the DS1/CEPT1 board is now communicating with a port on the PI board. The PI board then terminates the LAPD protocol of the D channel and sends the information, via an internal protocol, to the processor for layer 3 termination.
  - The administration performed in the processor channel assignments form and the signaling group form provide the necessary information to the SPE for the layer 3 protocol to be processed.

## G3rV2 Layer 2 Termination

In G3rV2, it is not necessary to set up a connection between the DS1/CEPT1 board and the layer 2-terminating board because the D channel is put directly onto the LAN bus by the TN464C. The address field of the LAPD frames of the D channel are changed to an internal address and relayed to the packet interface board, which then terminates the layer 2 protocol. The packet interface uses the LAPD address to know for which DS1/CEPT1 board the D channel is signaling. Unlike the processor interface board in the G3iV2, which was originally designed for BX.25 applications and retrofitted (so to speak) for ISDN PRI operation, the packet interface was designed to understand ISDN PRI capabilities. Thus, it is not necessary to assign a processor channel to tell it that it is an ISDN PRI application. The packet interface only needs the information supplied by the signaling group form to correctly supply the D channel information to the ISDN PRI layer 3 software in the SPE.

## Layer 2 User-Network and Master-Slave Protocol

The LAPD protocol used in DEFINITY G2.2 and G3V2 ISDN PRI requires one side to be identified as a master and the other side as a slave. A command/response bit (CR bit) is set to 0 or 1 depending on whether the command/response is sent/received by the master side or the slave side. If both sides act as master or both sides act as slave, a layer 2 connection between the two ends cannot be made. In G2.2 and in the G3V2 user-network protocol, the master side is called

the network side and the slave side is called the user side. If the ECMA layer 3 peer protocol is used, the layer 2 terms are master and slave in G3V2. In all DEFINITY systems administration exists to control the master-slave/user-network status of the interface. In G2.2, you administer the layer 2 user-network protocol in procedure 262, word 1, field 6.

In G3V2 systems, when you administer the user-network protocol, both the layer 2 and layer 3 user/network identification is administered. For example, in a G3V2 system, if you administer the system as user, it is user at both layer 2 and layer 3. For information on the layer 3 user-network protocol, see the section ["User-Network and Peer Protocols"](#) later in this chapter.

The following list explains the administration for the layer 2 user-network and master-slave protocols for G3V2 systems:

- If administered as `host` in the `Connect` field of the DS1 circuit pack form, the G3V2 is the network side at layers 2 and 3. The connect field indicates what the far end system is.
- If administered as `network` in the `Connect` field, the G3V2 system is the user side at layers 2 and 3. Connected to network usually means trunks on this interface are connected to the public network, which by convention is always the network side.
- If the system is administered as `pbx` in the `Connect` field, the other end is another PBX. This requires one side to be defined as user and the other side defined as network. Thus, in this case, another field, `Interface` appears. This field identifies whether the near end system (the one being administered) is network or user. The system must be administered as either `network` or `user` in this field.

Beginning with G3V2, the European Computer Manufacturers' (ECMA) standard for PBX-PBX interfaces, which is a peer protocol as opposed to a user-network protocol, has been added as an option. Thus, you can administer a G3V2 to use a user-network protocol or a peer protocol. The following list explains this administration:

- If administered as `host` in the `Connect` field of the DS1 circuit pack form, the G3V2 is the network side at layers 2 and 3. The connect field indicates what the far end system is.
- If administered as `network` in the `Connect` field, the G3V2 system is the user side at layers 2 and 3. Connected to network usually means trunks on this interface are connected to the public network, which by convention is always the network side.
- If the system is administered as **pbx** in the `Connect` field, the other end is another PBX. In this case, you have a choice of whether you want to administer a user-network protocol or a peer protocol. If you choose either `peer-master` or `peer-slave`, the system will operate with the ECMA peer protocol. If you choose `peer-master`, the layer 2 operation is the same as if you administer `network`. Similarly, if you administer

`peer-slave`, the layer 2 protocol operates the same as `user`. See the section "[User-Network and Peer Protocols](#)" for further explanation on the layer 3 protocol.

**⇒ NOTE:**

When a G3V2 DS1/CEPT1 interface administered with a user-network protocol is connected to a G2.2 interface, the G3V2 interface must be administered as network and the G2.2 interface as user. This is because the user-network administration on the G2.2 is only implemented for layer 2. The layer 3 user-network relationship in G2.2 is user by default, which means the layer 3 user/network identification must be network in the G3V2, which in turn means the layer 2 user/network is also network, which in turn means the layer 2 user/network on the G2.2 must be user. [Table 5-1](#) shows the recommended ways to administer the user-network and peer protocols when a G2.2 is connected to a G3V2:

**Table 5-1. Administering the User-Network and Peer Protocols**

G2.2			G3V2		
Administered as	Layer 2	Layer 3	Administered as	Layer 2	Layer 3
user	user	user	network	network	network
user	user	user	peer-master/side A (G3V2 only)	master	side A
network	network	network	peer-slave/side B (G3V2 only)	slave	side B

**⇒ NOTE:**

When connecting two DEFINITY systems via ISDN PRI, you should use the user-network protocol and country option 1(G3V2) if you want the extra features supported by option 1.

**Layer 2 Timers and Counters**

LAPD defines several timers and counters that are administrable in G2.2 but not in G3V2 systems. The G2.2 administration for these timers and counters is in procedure 262, word 1, fields 9 through 12. In general, the default settings will work.

**ISDN PRI Layer 3**

This section describes those aspects of layer 3 of ISDN PRI signaling having relevance to customers or AT&T field personnel involved in implementing or supporting ISDN PRI on DEFINITY systems. For example, several ISDN PRI information elements used in DEFINITY ISDN PRI systems are populated directly from options set in system administration and are thus relevant to customers or

AT&T personnel attempting to implement ISDN PRI capabilities. The subjects covered in the CCITT, AT&T network, and other global ISDN PRI specifications serve as the template for the subjects in this chapter.

ISDN PRI layer 3 is the protocol defining the procedures for using a set of messages to establish, maintain, and terminate circuit switched connections between ISDN PRI endpoints and to exchange user-to-user information between endpoints. The ISDN PRI specifications also describe procedures for packet switched connections and for the exchange of maintenance messages, but this document does not cover these subjects. The protocol for establishing, maintaining, and terminating connections is called call control. The protocols for exchanging user-to-user information can be divided into two types:

- Call control message associated user-to-user information
- Temporary signaling connections

Both call control signaling and user-to-user information signaling can be accomplished by the D channel controlling only the B channels on its physical interface (facility associated signaling) or by the D channel controlling B channels on up to 20 interfaces (non-facility-associated signaling). In all cases, a set of messages are used to convey call control and user-to-user information between the endpoints. The messages are composed of information elements (IEs), which are the conveyors of the information exchanged between the endpoints of the ISDN PRI link. The DEFINITY systems implement this protocol according to the CCITT Q.931 specification with variations depending on the system. G2.2 and G3V2 with country option 1, for example, use the layer 3 procedures specified by the AT&T standard *Technical Reference 41449*, whereas G3V2 country protocol options other than 1 implement this layer according to the CCITT Q.931 specification with variations depending on which country protocol is in effect for the interface board (country protocol is administered in the DS1 circuit pack form).

#### NOTE:

Country protocol can be administered in two forms in G3V2, the DS1 circuit pack form and the system parameters - country options form. The administration in the country options form is for line ports in the system and thus does not have relevance to digital trunks in this document.

Since this document only discusses those elements of the layer 3 protocol having relevance to field personnel, the details of the protocol are not covered. For those details, refer to the CCITT Q.931 standard or the standard applicable to the country being administered.

### Country-Specific Layer 3 in G3V2

Depending on the system connected to the G3V2 or on the country in which the G3V2 is being used, some aspects of call control vary from the CCITT specification by adhering to a different specification. Following is a list of the various ISDN PRI specifications supported by G3V2:

- AUSTEL (the Australian Standards Institute) TS 014.1/1990; PRI Connection Volume I: Interface Specification for Layers 1,2, and 3.LI
- ECMA 143 Basic Circuit Switched Call Control
- ETSI (the European Telecom Standards Institute) ETS 300102-1; ISDN User-Network Interface Layer 3 Specification for Basic Call Control Applications of CCITT Recommendations Q.930/l.450 and Q.931/l.451
- AT&T ISDN Primary Rate Interface (TR41449)
- ANSI T1.607 (ISDN Circuit-Switched Call Procedures)
- Digital Access Signalling Standard II/Digital Private Network Signalling Standard (DASSII/DPNSS) {via the 3NET converter} Telephonica ISDN PRI specification for Spain
- NTT INFS 1500 (ISDN PRI specification for Japan)

These variations from the CCITT specification are administered in the `Country Protocol` field in the DS1 circuit pack form. If, for example, you enter **2** in that field, the AUSTEL specification will be used for ISDN PRI layer 3 signaling.

## Facility-Associated and Non-Facility Associated Signaling

Signaling on ISDN PRI trunks consists of messages transported over the D channel, which is channel 24 on a DS1 interface or channel 16 on a CEPT1 interface. Two methods exist for providing this signaling:

- The D channel can provide signaling for the other B channels on the same interface. This is called facility associated signaling (FAS).
- The D channel can provide signaling for B channels on more than one interface. This is called non-facility associated signaling.

In addition, in NFAS signaling arrangements, the capability exists to designate a D channel on one interface to be a backup to a D channel on another interface in case of failure. This is called D channel backup.

### G2.2 FAS/NFAS Implementation

In G2.2, facility associated signaling is implemented through administration in procedure 260, word 1, field 14 and procedure 100, word 3, field 2. Procedure 260, word 1, field 14 sets the application type for the DS1 interface as ISDN PRI and procedure 100, word 3, field 2 sets the signaling type for the trunk group as ISDN PRI signaling. Implementing NFAS on G2.2 requires additional procedures. Following are guidelines for implementing NFAS on G2.2 systems:

- If NFAS is administered, a single D channel can control up to 479 B channels on any combination of interfaces anywhere in the rest of the system. For example, a D channel can be administered to control only the other 23 B channels on the same interface, yielding the same results as if NFAS is not administered, or it can control B channels on combinations of both ANN35s and TN767s in other universal and traditional modules.
- A D channel on an ANN35 interface can control B channels on TN767s and a D channel on a TN767 interface can control B channels on ANN35s.
- If a TN767 has a D channel, a TN555 must be located in the virtual slot next to the TN767. If the TN767 contains only B channels, no TN555 is required.
- An interface can be administered for 24 B channels in an NFAS arrangement. In fact, this is always the case except for the interfaces containing a D channel.
- An interface can have no more than one D channel.
- A D channel can be designated as either a primary or a backup if NFAS with D channel backup is used.
- The backup D channel controls only those B channels controlled by the primary D channel.
- The backup D channel does nothing at layer 3 until the primary D channel fails.
- If the primary D channel fails, the backup D channel becomes active and the primary becomes inactive.
- All B channels controlled by a single D channel (a D channel group) must terminate at the same system at which the D channel terminates. This is true on a point-to-point basis only. For example, if a G2.2 is connected to another G2.2 through the 4ESS with ISDN PRI access on both systems, the B channels of each system's D channel groups must terminate at the 4ESS, but not necessarily at the far-end system (some may go to MEGACOM, others to SDN for example).
- The terminating ISDN facility interface IDs must match the originating interface IDs.
- Without administering NFAS for a trunk (B channel), the interface ID in the channel ID information element will not be populated for any calls made on that trunk. For example, if an ANN35 is not administered for NFAS, it is a 23B + D interface but no interface ID will be sent on the D channel messages for those trunks. If, however, this same interface is administered for NFAS and the D channel controls the B channels on the same board, it is still a 23B + D board but now the interface ID will be sent.

The following list describes administration procedures for initially implementing NFAS:



1. Administer the ISDN interface (circuit pack) locations in procedure 260, word 1.
  - If you want this interface to contain 24 B channels, assign a **1** in field 7.
  - If you want this interface to contain a D channel, assign a **0** in field 7.
2. Assign the D channel group numbers in procedure 262, word 2. There will be one group number per interface containing a primary D channel. If a D channel has a backup, assign the backup to the same group number in this procedure. For reliability purposes, you can assign backup D channels from different carriers or modules than the primary D channels.
3. For each ANN35 and TN767 containing a D channel in an NFAS arrangement, assign an interface identifier in procedure 262, word 1, field 13. This field is used to populate the ISDN interface ID in the channel ID information element. The following list suggests a convention for doing this:
  - Assign interface identifier 0 to each board containing a D channel.
  - Assign interface identifier 1 to each board containing a backup D channel.
4. For each ANN35 and TN767 containing 24 B channels, assign an interface identifier in procedure 262, word 1, field 13. Assign identifiers sequentially starting with 2 if the D channel group has a backup D channel, or 1 if it does not. In other words, all boards in a D channel group should be numbered sequentially starting with 0 and not skipping any numbers.
5. Assign the individual trunks (channels) to each D channel group in procedure 116, word 1.

**⇒ NOTE:**

A DS1 board is defined as being a member of a signaling group if any of the B channels on the board are in the signaling group. For example, if channels 1-10 on a board are assigned to signaling group 1 and 11-24 are assigned to signaling group 2, then the board is a member of both signaling groups 1 and 2. This is important because an interface identifier cannot be duplicated within a signaling group. Thus, if another board in the above example contained all its B channels from signaling group 2, it could not have an interface identifier of 1 because that identifier has already been used. For this reason, and in general for ease of administration and maintenance, you should not mix B channels from different signaling groups on a board.



## G3V2 FAS/NFAS Implementation

FAS and NFAS in G3V2 is implemented in the DS1 circuit pack form, the signaling group form, and the ISDN PRI trunk group form. If you administer **isdn-pri** in the *Signaling Mode* field on the DS1 circuit pack form, then the channels on that interface will consist of 23 DS1 or 30 CEPT1 bearer channels and a D channel. If **isdn-ext** is administered, all channels on the board will be B channels, with their associated D channels located on different boards determined by administration in the signaling group form and the ISDN PRI trunk group form.

The signaling group form further defines the ISDN PRI signaling by assigning D channels as signaling channels for B channels. The D channel can be assigned to B channels on its own board (facility associated signaling, or FAS), or it can be assigned to B channels on its own board and/or other boards (non-facility associated signaling, or NFAS). In addition, a D channel can be assigned to back up another D channel in the case of failure of that D channel. A signaling group comprises all the B channels controlled by a unique D channel (and its backup, if applicable). Eight signaling groups are allowed in G3iV2 and 166 in G3rV2. Thus, in G3iV2 for example, if all signaling groups are FAS groups on DS1 interfaces, a total of  $23 \times 8 = 184$  (1.544 rate) B channels can be used as trunks. A D channel, however, can provide signaling for up to 20 interfaces. A DS1 interface contains 24 NFAS B channels. Thus, a single D channel can signal for  $(20 \times 24) - 1 = 479$  B channels (the 1 is subtracted because one of the channels is the D channel). In G3iV2, however, a maximum of 400 trunks of any kind can exist on any system, making this upper limit academic.

Not all B channels on an NFAS board have to be controlled by the same D channel. For example, channels 1, 3, and 4 could be controlled by one D channel and the rest by another. This is made possible by the fact that a DS1 board can appear in more than one signaling group and that individual ports of the board are assigned to signaling groups in the trunk group form. If an NFAS DS1 board appears in only one signaling group, however, all ports on that board are automatically controlled by the associated D channel.

### NOTE:

You should assign all B channels on a given interface (circuit pack) to the same D channel group. If this advice is not followed, identifying the physical board associated with the trunk for maintenance purposes could become difficult.

When a secondary D channel is assigned, it is used as a backup to the primary channel. It remains in a standby state (layer 2 remains active) until the primary channel fails or until a maintenance command is issued to switch the channels. When either of these happens, the secondary channel becomes active. When the failed primary channel recovers its layer 2 capability, it enters the standby state. If the secondary subsequently fails, the primary again becomes active, and so on. If both channels fail, the new active one will be the one to first recover its layer 2 capability. If both recover simultaneously (roughly), the primary will become the active channel.

The following list describes how to implement ISDN PRI signaling in G3V2:

- NFAS and D channel backup are not supported unless the country protocol is **1** (U.S.) in the DS1 circuit pack form for the boards containing the primary and secondary D channels.
- Administer the signaling mode in the DS1 circuit pack form. Use **isdn-pri** if the B channels on the board are to be FAS B channels. Enter **isdn-ext** if the B channels are to be in NFAS signaling groups. If the D channel on this board is going to be a backup to a primary D channel on another board, the `line coding`, `connect`, and `interface` fields must be the same for the two boards.
- Use the command **add signaling group**, **change signaling group**, or **remove signaling group** and the group number that you want to add, change, or remove. If you want to remove a signaling group, you must first remove all its trunk members from any trunk groups and remove all trunk boards in the signaling group.
- If the group number is to be a FAS signaling group, the `Associated Signaling?` field is **y**. Enter the circuit location of the D channel in the `Primary D channel` field. Remember the D channel on a DS1 interface is circuit 24 and circuit 16 on a CEPT1 interface.
- If the group number is to be an NFAS group, enter **n** in the `Associated Signaling` field.
  - Enter the location (down to the circuit) of the primary D channel in the `Primary D channel` field. The circuit number is 24 for a DS1 interface or 16 for a CEPT1 interface. This D channel cannot be administered in any other signaling group.
  - If you want to have a D channel to back up the primary D channel in case it fails (power goes out in the carrier, for example), enter the location of another D channel in the `Secondary D channel` field. This D channel cannot be on the same board as the primary D channel. This D channel cannot appear in any other signaling group. Thus, it is only used when the primary D channel fails. If the primary D channel fails, the secondary becomes active. The secondary D channel should be placed in a different port network from the primary, if possible.
  - Enter the board location (down to the slot number) of each DS1 board containing the B channels for which the D channel is going to signal in the `Trunk Brd` fields. A board location cannot appear more than once in the same signaling group. You cannot remove this signaling group without first removing these board locations from the form. The B channels on these boards are later assigned as members in ISDN PRI trunk groups.
  - Enter a different number in the range 0-31 for each trunk board in the `Interface ID` field. This field is used to populate the interface ID field in the channel ID information element. The following list suggests a convention for doing this:

1. Assign interface identifier 0 to each board containing a D channel.
2. Assign interface identifier 1 to each board containing a backup D channel.
3. For each board containing all B channels, assign an interface identifier. Assign identifiers sequentially starting with 2 if the D channel group has a backup D channel, or 1 if it does not. In other words, all boards in a D channel group should be numbered sequentially starting with 0 and not skipping any numbers.

Both ends of a trunk must terminate on boards with the same channel ID. For example, if a call from a G3V2 goes out a trunk on an NFAS board to the 4ESS, the 4ESS knows from the information in the D channel that a call is coming in on channel 10, say. But, since this is an NFAS call, the 4ESS must know which channel 10 the call is incoming on. It gets this information from the interface ID. Obviously, the two sides must agree at provisioning time to number their interfaces the same on both sides. In other words, if trunk n on one system is on interface m, trunk n must also be on interface m on the other system.

**NOTE:**

A DS1/CEPT1 board is defined as being a member of a signaling group if any of the B channels on the board are in the signaling group. For example, if channels 1-10 on a DS1 board are assigned to signaling group 1 and channels 11-24 are assigned to signaling group 2, then the board is a member of both signaling groups 1 and 2. This is important because an interface identifier cannot be duplicated within a signaling group. Thus, if another board in the above example contained all its B channels from signaling group 2, it could not have an interface identifier of 1 because that identifier has already been used. For this reason, and in general for ease of administration and maintenance, you should not mix B channels from different signaling groups on a board.

- Some countries support the field `Trunk Group for Channel Selection`. You can enter a valid ISDN PRI trunk group here. If the country supports this feature, a B channel from this trunk group will be selected when a `SETUP` message is received that does not explicitly indicate the B channel to be used for the call.
- In the `Group Type` field of the trunk group form enter the group type **isdn-pri**.

- In the Group Member Assignments page of the ISDN PRI trunk group form, put the desired signaling group of the trunk into the `Sig Grp` fields. The entry in this field must be a signaling group containing the board containing this trunk member. If the members on a board are in only one signaling group, this information is filled in automatically by the system.

## Call Control Signaling

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The layer 3 protocol describing the procedures for establishing, maintaining, and clearing circuit switched calls is called call control. The call states, procedures, messages, and information elements for this protocol are described in the various specifications. The DEFINITY systems implement this protocol based on these specifications.

## User-Network and Peer Protocols

The DEFINITY systems employ two types of layer 3 protocols, user-network and peer. A user-network protocol means that one side of the interface is designated as the user and the other side as the network. A peer protocol means that both sides of the interface act as user. Connections between a DEFINITY system and another PBX, a public network switch, or a host can all use a user-network protocol. A peer protocol is designed for use between two PBXs. The G2.2 and G3V2 systems employ varying protocols, as follows:

- G2.2 systems employ a peer protocol as defined in the AT&T ISDN PRI specification.
- G3V2 systems employ both the user-network protocol (with variations for each country protocol option) and the peer protocol specified by the European Computer Manufacturers Association (ECMA). The option exists in administration to use either protocol.



### NOTE:

The ECMA protocol does not support the following information elements:

- Network Specific Facilities
- Display
- Transit Network Selection
- Distributed Communication System
- DCS AUDIX Messaging
- Lookahead Interflow
- Traveling Class Mark

Some of these IEs can be suppressed by administration. For example, in the trunk group form if `Send Name` is set to **no**, the display IE will not be sent. If administration allows these IEs to be sent, however, no harm will occur — the far

end will simply drop them. If you need these IEs, however, you should use the user-network protocol.

For more information on these information elements and how they are used, see the section [“Call Control Messages”](#) later in this chapter.

Because the peer protocol does not support these information elements and for other reasons, some features available with the user-network protocol are not available with the ECMA peer protocol. [Table 5-2](#) shows the availability of important features using the peer protocol:

**Table 5-2. Feature Availability using the Peer Protocol**

Feature	Functional over Peer Interface?
DCS over PRI	no
Traveling Class Mark	no
Uniform Dial Plan	yes
Main/Satellite	yes
Wideband	no
NFAS	no
D-Channel Back-up	no
LookAhead Interflow	no
Name Delivery	no <sup>1</sup>
Calling Party Number Delivery	yes
Connected Number Delivery	yes

- 
1. ECMA supports Name Delivery as a supplementary service. Although D92 supports Name delivery, it does not support the feature using the ECMA implementation.
- 

 **NOTE:**

When connecting two DEFINITY systems via ISDN PRI, you must use the user-network protocol and country option 1 if you want the extra features supported by option 1.

The details of these protocols and their differences are largely transparent to users. Their primary purpose is to define the call states each end should be in depending on the message received. One aspect of these protocols the user does see, however, is the way in which glare is handled. Glare is the

simultaneous seizing of a trunk by both ends. In general, glare can be handled in one of the following ways:

- One side wins and seizes the trunk while the losing side call fails. In this case, the losing system can take actions such as automatically retry the call or simply apply reorder tone.
- One side wins and seizes the trunk and sends a message to the losing side requesting it to negotiate its call to a different B channel. This is called channel negotiation on glare. The losing system must support this capability by holding the call long enough to receive the message requesting it to negotiate the call to another B channel.

## G2.2 Protocol and Glare Handling

In the G2.2 peer protocol, the G2.2 is always the user side at layer 3 and is not controllable by administration. In a glare situation the G2.2 uses the layer 2 network-user bit setting in procedure 262, word 1, field 6 to determine if it wins or loses. If it is set to network, it wins and attempts to negotiate the other side's call to another B channel. If this bit is set to user, it loses and supports the far end's attempt to negotiate the call to another B channel. This is true only if the call was destined for a preferred channel, which is always the case unless the call is a DCS call. If the call is a DCS call or if no B channels are available, the call will fail unless procedure 100 word 3 field 4 is set to retry the call.

## G3V2 Protocol and Glare Handling

The G3V2 systems can be administered for either the user-network protocol or the ECMA peer protocol. In G3V2 systems, when you administer the user-network protocol, both the layer 2 and layer 3 user-network protocol is administered. For example, in a G3V2 system, if you administer the system as user, it is user at both layer 2 and layer 3.

You can also administer the ECMA peer protocol in G3V2 systems. At layer 3 in the ECMA peer protocol, the G3V2 is either side A or side B. For purposes of resolving glare, side A is roughly equivalent to the network side in a user-network protocol and side B is roughly equivalent to the user side. Thus, administering peer-master side A is roughly equivalent to administering network at layer 3 and network at layer 2. Administering peer-master side B is roughly equivalent to administering network at layer 3 and user at layer 2. Administering peer-slave side A is roughly equivalent to administering user at layer 3 and network at layer 2. Administering peer-slave side B is roughly equivalent to administering user at layer 3 and user at layer 2.

In the user-network protocol in a glare situation, the outgoing call from the network side always wins. In the peer protocol, the winning side depends on whether it is side A or B and also whether the outgoing call has requested a preferred or exclusive channel in the channel ID IE. The following table summarizes which outgoing call wins in a peer protocol:

Side A	Side B	
	preferred	exclusive
preferred	A wins	B wins
exclusive	A wins	A wins

In both the user-network protocol and the peer protocol, once the winner has been determined, the following events take place:

1. If the G3V2's outgoing call wins and the incoming (losing) call is coded as preferred, the G3V2 attempts to negotiate the incoming call to an alternate B channel as follows:

- If the G3V2 finds an alternate B channel it sends a response to the incoming SETUP message indicating the alternate B channel.
  - If the G3V2 cannot find an alternate B channel it drops the incoming call.
2. If the G3V2's outgoing call wins and the incoming (losing) call is coded as exclusive, the G3V2 drops the incoming call.
  3. If the G3V2's outgoing call loses, even if the winning side has negotiated the call to an alternate B channel, it will drop the call and retry the call on another B channel.

**⇒ NOTE:**

When connected to a G2.2 system and using the user-network protocol, the G3V2 system must be administered as network and the G2.2 system as user. This is because the user/network administration on the G2.2 is only implemented for layer 2. The layer 3 user/network relationship in G2.2 is user by default, which means the layer 3 user/network protocol must be network in the G3V2. If administered as user on both sides, the G3V2 system will tear down calls during the call setup phase if it detects an inappropriate call state during an audit of the G2.2's current call state status. In G3rV2 the frequency of the audits is much greater than in G3iV2 and service disruption will be apparent if both sides are user. Thus, since the G3V2 must be administered as network, the layer 2 user/network is also network, which in turn means the layer 2 user/network on the G2.2 must be user. If both sides are administered as network or as user at layer 2, the call will always fail because a layer 2 connection cannot be made.

For information on the layer 2 protocol, see the section [“Layer 2 User-Network and Master-Slave Protocol”](#) earlier in this chapter.

## Minimizing the Occurrence of Glare

The chances that two sides attempt to seize the same trunk simultaneously are much less in ISDN PRI trunks than with other trunks. Thus, it is usually not important to try to minimize the occurrence of glare. The one case where minimizing the occurrence of glare is essential, however, is on DCS trunks. When a call is made on a DCS trunk group, the trunk number is put into the DCS message. If the trunk number in the message does not match the trunk carrying the call, DCS transparency will fail. Thus, a DCS call cannot be negotiated to another channel. For this reason, you can do the following to minimize glare on DCS trunk groups that use ISDN B channels, or to minimize glare on any ISDN PRI trunk group if it is a concern:

- Divide the ISDN PRI trunk group into two trunk groups.
- Assign the two trunk groups to two separate preferences in a pattern on one system.
- Reverse the order of the preferences on the other system. For example if the first preference on one system is trunk group 1, then the first preference on the other system is trunk group 2.



Another better method to minimize the occurrence of glare on ISDN PRI trunks is available only in G3V2. In G3V2 you can administer the trunk hunting direction for the ISDN PRI trunk group as ascending on one system and as descending on the other system. This will make it unlikely that the same trunk (B channel) will be chosen for the two calls.

## Digit Collection

The intention of the ISDN PRI specifications is that all digits be collected and sent in the SETUP message for a call. This is not an absolute requirement, however. Two methods exist for collecting digits on ISDN PRI calls, as follows:

- ISDN PRI calls routed by networking software collect all digits and send them in the SETUP message.
- ISDN PRI calls made by dialing a trunk access code do not collect the digits. Instead, the SETUP message is sent without the digits. The digits are then sent in-band as with non-ISDN calls.

G2.2 does not support the use of trunk access code dialing on ISDN PRI trunks. The primary problem with TACs on G2.2 systems is that all digits must be dialed before expiration of the T310 layer 3 timer (10 seconds) otherwise the call will be torn down. Thus, this limits the number of switches you can cut through within the allotted time. G2.2 systems block ISDN PRI calls that try to use a trunk access code to dial the call.

G3V2 systems support trunk access code dialing on ISDN PRI trunks that are not call by call trunks or nodal services trunks. When a G3V2 system receives a SETUP message with no digits, it returns a PROGRESS message, which suppresses the layer 3 timers. Thus, for calls dialed with trunk access codes to be guaranteed to work, all switches in the call path must be G3V2s (or G1s or G3V1s).

For calls routed with AAR or ARS, G3V2 systems implement digit collection by automatically collecting all digits before trunk seizure for all calls in a pattern starting with the first ISDN preference encountered. For example, if the third preference in a pattern is the first occurrence of an ISDN trunk group, all digits will not be collected before trunk seizure for calls on the first two preferences. All digits will be collected before trunk seizure starting with calls on the third preference and continue for all subsequent preferences regardless of whether they are ISDN trunk groups. Thus, if you want to collect all digits before trunk seizure on some non-ISDN calls, you can administer the first preference of a pattern as an ISDN trunk group containing no members. All calls on subsequent preferences will have all digits collected before trunk seizure. This administration is done in the routing pattern form. There are both advantages and disadvantages to administering the patterns this way, however, as follows:

- Advantages
  - No resources are tied up for calls not completely dialed (abandoned calls).
  - Call holding times are shortened.
- Disadvantages
  - Call setup times (the time from the last dialed digit to alerting on the far end) will lengthen for non-ISDN PRI calls, especially over dial-pulse trunks.
  - Trunk queuing will not be possible because the first preference is the only trunk group used for queuing and it has no members.

## Digit Receiving

Although DEFINITY systems collect all digits and send them in a single SETUP message, not all systems are constrained to this method. Some vendors' equipment use overlap sending procedures in which the digits are sent as they are received starting with the first digits in the called party number IE in the SETUP message and the rest of the digits in the called party number IE in subsequent INFORMATION messages. Although the DEFINITY systems do not support overlap sending, the G3V2 systems do support receiving digits from systems using overlap sending. This new capability is called overlap receiving and is available only on G3V2 systems. You administer overlap receiving on page 1 of the trunk group form.

At the present time in the U.S., public network ISDN does not employ overlap sending. Thus, in the U.S. you should not use this option. If you set overlap receiving and the digits are all delivered in the SETUP message, the call completion might be delayed while the system waits for added digits in the INFORMATION message.

## Call Control Messages

ISDN PRI call control messages are those messages involved in establishing, maintaining, and terminating circuit switched connections. These messages are composed of a series of octets (bytes) of information. One or more of these octets compose an information element (IE). In any given call control message, some of these IEs are used for call control signaling while others are used for user-to-user information signaling. For example, within the SETUP message, which is a call control message, is the channel identification IE, which is used for call control signaling, and the low layer compatibility IE, which is used for user-to-user information signaling.

Some IEs not defined as user-to-user information IEs can also be used to convey user-to-user data. The calling party number, for example, which is defined as a call control IE, is often used by the end user for applications such as terminal

displays. The IEs used for user-to-user information signaling are described later in the section [“User-to-User Information Signaling”](#).

The first three information elements of all ISDN PRI messages are the same — the protocol discriminator IE followed by the call reference value IE, followed by the message type IE. The remaining IEs in any message vary, depending on the message. All messages, IEs, and their purposes are defined in the ISDN PRI specifications.

Some information elements are required by the public network (such as the 4ESS toll switch, for example) while other IEs have meaning only to the end users. For example, the 4ESS must know the information transfer capability (restricted or unrestricted) so that it can route the call over the proper facilities. The 4ESS does not have to know the contents of the display information element, however, since it is used only to display information on the end user's terminal. In order to distinguish between information needed or not needed by the public network, the concept of codesets exists.

Information elements coded as being part of codeset 0 is information needed by the public/international network and is defined by the CCITT standard. Information elements in codesets 1-4 are reserved for future standards. Codeset 5 is used for the public network in the U.S. Codeset 6 is used by private networks. Codeset 7 is information needed by the end user. In practice, the division between codesets 6 and 7 is not always clear because codeset 6 information often looks like end user information.

At present, the DEFINITY systems automatically put all IEs except for three into their proper codesets. The three exceptions are the display, lookahead interflow, and traveling class mark IEs. By definition, IEs sent in codesets 6 or 7 are used for user-to-user information signaling and are thus discussed later in that section of this document. All DEFINITY systems allow some degree of codeset mapping, which is the capability to specify which codeset an IE will be sent in. G3V2 systems limit this mapping to user-to-user information elements. G2.2 systems, however, allow any IEs to be mapped to any codeset. In theory, this could be done for both call control and user-to-user information signaling. In practice, however, it is used to map user-to-user information elements. Thus, codeset mapping is discussed later in the section [“User-to-User Information Signaling”](#).

#### NOTE:

Public network switches in many countries do not pass codeset 6 and codeset 7 IEs.

The following sections discuss the call control IEs having relevance to personnel implementing or supporting ISDN PRI capabilities on the DEFINITY systems.

## Cause IE

Cause IEs are information elements used primarily to convey the reasons for call failures. For example, if the receiving switch rejects a voice call because it is incoming on a trunk administered for mode 1 data only, the receiving switch

could return the cause value for `bearer capability not implemented` in the DISCONNECT message. Cause values are valid in only some messages. The list of cause values and their meanings can be found in the Q.931 specifications. Note that the titles of the cause values suggest the situations in which they should be used, but the ultimate decision as to which cause value to use for a certain situation lies with the designers of each system. In other words, the specifications do not give rigorous rules for which cause values must be used for all possible situations.

Cause information elements are important to anyone using a message tracing tool to troubleshoot ISDN PRI problems. They are also important to the design of features. For example, depending on the cause value received, the rejected call might be sent to intercept or to an attendant.

## Bearer Capability IE

The bearer capability IE is sent by the near end switch to indicate that a call with certain characteristics is being made. For example, if the endpoint on the switch makes a digital data call, the bearer capability IE conveys information used by the switch at the other end of the link to let it know it needs to support a digital data call. If the destination is a voice terminal, for example, receiving the bearer capability IE will tell the receiving switch that it will not be able to support the call and to take appropriate action, such as block the call.

The bearer capability IE is used to indicate the following characteristics of a call:

- Whether the call is a circuit-switched call or a packet mode call
- Whether the call is speech/voice-grade data (3.1 KHz), or digital data
- The information transfer capability (restricted or unrestricted)
- Other information either transparent to users or not presently used by DEFINITY systems

The bearer capability IE is used by DEFINITY systems in combination with the low layer compatibility IE for the following purposes:

- Blocking incompatible calls
- Routing calls to desired trunk groups
- Determining compatibility of endpoints
- Determining when modem pool resources should be inserted

These decisions are made by comparing the information from the BC and LLC IEs with the administered call handling capabilities of endpoints, trunk groups, and routing preferences. These administered capabilities are called bearer capability classes (BCCs) and information transfer capabilities (ITCs). A BCC has elements of both the BC IE and the LLC IE. For example, the Mode 2 BCC includes the digital data characteristic of the BC IE and the user rate characteristic of the LLC IE.

G3V2 systems define the following bearer capability classes:

- Voice/voice-grade data
- Mode 0 digital data
- Mode 1 digital data
- Mode 2 digital data
- Mode 3 digital data
- Wideband (G3V2 only)

G2.2 systems define the following bearer capability classes:

- Voice
- Voice Grade Data
- Mode 0
- Mode 1
- Mode 2
- Mode 3
- Unknown Digital
- Unknown Analog
- Mode 3/2 Adaptive
- X.25

Both systems have a separate field for the information transfer capability, either restricted or unrestricted digital data. For definitions of modes 0, 1, 2, and 3, see the *Digital Multiplexed Interface (DMI) Technical Specification*, Issue 3.1, August 1986, select code 500-029. Ask for the most recent version. Less rigorous definitions can be found in [Table 4-8 on page 4-22](#).

G2.2 systems populate the bearer capability IE in the following way:

- For calls from non-ISDN endpoints to ISDN PRI trunks, the bearer capability IE is populated from the bearer capability class of service indicated in fields 15 and 16 of procedure 014, word 1 and assigned to the endpoint in procedure 000, word 3, field 5.
- For calls from ISDN endpoints to ISDN PRI trunks, the bearer capability IE is populated by the endpoint at the time the call originates. Option settings on the ISDN set determine the various BC IE codepoints, such as transfer rate and information type.

G3V2 systems populate the BC IE in the following way:

- For calls from non-ISDN endpoints to ISDN PRI trunks, the bearer capability IE, except for the information type codepoint, is populated automatically based on the type of endpoint. For example, if the endpoint is an MPDM set for mode 0 operation, the BC IE is populated with mode 0 characteristics. Two exceptions to this rule exist as follows:
  - A call from a mode 2 endpoint is routed to a pattern containing voice preferences but no mode 2 preferences. In this case a modem pool is inserted and the outgoing ISDN PRI message is populated by the BCC and ITC administration of the preference, not the originating endpoint.
  - A call from a voice endpoint is routed to a pattern containing preferences administered only for data (BCCs 1, 2, 3, or 4). In this case, the outgoing ISDN PRI message is populated by the BCC and ITC administration of the preference, not of the originating endpoint.
- In G3V2, the information type codepoint in the BC IE is coded from the administered ITC field on the data module form.
- As with G2.2, for calls from ISDN endpoints to ISDN PRI trunks, the bearer capability IE is populated by the endpoint at the time the call originates. Option settings on the ISDN set determine the various BC IE codepoints, such as transfer rate and information type.

**⇒ NOTE:**

International data calls require the information type in the BC IE to be coded as unrestricted. In G2.2 and G3V2 you can control this in administration.

Since the ways the DEFINITY systems apply the bearer capability class involve using both the bearer capability IE and the low layer compatibility IE, refer to the section [“Low Layer Compatibility IE”](#) in the section [“User-to-User Information Signaling”](#) for the details of how these information elements and the BCCs are used.

## Calling Party Number IE

The DEFINITY systems send the calling party number in codeset 0 in the SETUP message. Its primary use is to indicate the calling party's number on the connected party's station display. The number digits field in the calling party number is used to send the address of the calling party. In G2.2, the number digits field is populated with the 10 digit number formed by adding the last three or four digits of the calling party's extension to the value entered in the NPA-NXX fields in procedure 354, word 3. In G3V2, the number digits field is populated from the CPN prefix table.

At the receiving end, the contents of the received CPN IE can be either the calling party's number or the calling party's billing number. If the call is not switched through the AT&T network, the contents of the CPN IE will always be the calling party's number as populated from the calling system. If the call is

switched by AT&T, however, the called party has four choices as to how to receive calling party number or billing number. The AT&T network calls these options features.

### Options from the AT&T Network

When provisioning the AT&T service, you must tell the service providers which of these features you want. Following are the features you can choose from:

- CPN preferred. This feature tells the 4ESS to send the DEFINITY system the calling party number in the CPN IE, if it is available. If it is not available, the 4ESS sends the billing number in the CPN IE.
- BN preferred. This feature tells the 4ESS to send the DEFINITY system the billing number in the CPN IE, if it is available. If it is not available, the 4ESS sends the calling party number in the CPN IE.
- CPN only. This feature tells the 4ESS to send the DEFINITY system the calling party number in the CPN IE, if it is available. If it is not available, the 4ESS does not send the CPN IE.
- BN only. This feature tells the 4ESS to send the DEFINITY system the billing number in the CPN IE, if it is available. If it is not available, the 4ESS does not send the CPN IE.

In addition to these features, on G3V2 systems you can order the request option from the network. With this option the network sends CPN/BN only if requested by the G3V2 for a given call. This is implemented in the incoming call handling table for the trunk group. For example, if you subscribe to the CPN only feature, you can tell the 4ESS, through the settings in the incoming call handling table, to send the CPN only on calls of a certain service type (for call-by-call trunk groups) or only on DNIS calls. To have this capability, you must administer the *Per Call CPN/BN* fields in the incoming call handling table and also provision this option from the 4ESS. For details on how to implement this, see the section [“Network Specific Facilities IE in U.S.”](#).

#### NOTE:

If you provision the service to always deliver CPN/BN but you also request it on a per-call basis, the request will be rejected.

For the calling (and connected) party numbers to be supplied across a public network, the DEFINITY system and the far end endpoint must be on ISDN access to the public network. For example, in the U.S. if you receive an SDN call from a far-end switch that is connected to a 4ESS with T1.5 access, you cannot receive the calling party's number in the CPN IE. Thus, you will receive the BN in the CPN IE if you subscribe to the BN only, BN preferred or CPN preferred features. At present, SDN service and ACCUNET Switched Digital Services provide ISDN end-to-end capability in the U.S.

## Numbering Plan and Type of Number

In addition to number digits field, which carries the address of the caller, the calling party number IE also carries information on the numbering plan and type of number. These two fields are populated as follows:

Numbering Plan Identification	ISDN/telephony numbering plan (recommendation E.164/E.163)
Type of Number	National Number

The only exception to this encoding is for country protocol option 3 (Japan) in G3V2. In this case, both the numbering plan identification and the type of number fields are coded as unknown. All DEFINITY systems accept calling party number IEs regardless of how these two fields are encoded.

## Requirements for Sending CPN IE

In G2.2 systems, to send the calling party number, the NPA-NXX designator field in procedure 354, word 3 must be administered. This designator must also be entered in procedure 000 for the calling party's extension. The number sent is then always of the form NPA-NXX-extension, a 10-digit direct distance dial (DDD) number. Also, procedure 100, word 3, field 8 must be set to **0** or **2** to send the optional information elements. When set to **2**, the optional IEs are sent, but if the trunk group is a DCS trunk group on an ISDN facility and an ISDN call from another trunk group is routed to it, the DCS name message is suppressed.

In G3V2 systems, to send the calling party number IE, the CPN prefix table form must be administered. This table allows you to specify the number to be put in the CPN IE for any given extension. The `Send CPN` field in the trunk group screen must also be administered as **y**.

**G3V2 CPN Prefix Table.** Following is an example of how to administer the G3V2 CPN Prefix Table:

CPN PREFIX TABLE			
Ext Len	Ext Code	CPN Prefix	Total CPN Length
5	65	61948	10
5	66	619494	9
5	67	61949	
5	68	61949	

Screen 5-1. G3V2 CPN Prefix Table



[Table 5-3](#) describes the administration settings for the ISDN PRI-specific fields in this administration form:

**Table 5-3. Field Definitions CPN Prefix Table**

Field	Remarks
Ext Len	This field and the next constitute a key that determines which row of the table to apply to an extension. Enter the number of extension digits in the dial plan. For example, if you are on a five digit dial plan, enter "5". You can also use this table if you have a mixed numbering plan. The sum of this number and the number of digits in the <code>CPN Prefix</code> field must be a number greater than or equal to the number in the <code>Total CPN Length</code> field.
Ext Code	This field allows groups of extensions to be administered. If 12 is entered here, for example, and 5 was administered in the first field, then all extensions of the form 12XXX will match this row. If 12 is administered here and 123 is also administered, then all numbers of the form 12XXX except for 123XX will match this row. For example, if you wanted all extensions of the form 12XXX except for 123XX to be sent with the CPN prefix 30346 and the 123XX extensions to be sent with the CPN prefix 30353, then you would administer both 12 and 123 in this field in two different rows.
CPN Prefix	Enter the digits you prepend to the least significant digits of the extension code digits to form a CPN of the length specified in the <code>Total CPN Length</code> field. For example, in the sample screen shown above, if any extension of the form 65XXX places or answers a call, the number sent to the other end will be 619-486-5XXX (10 digits). In the second row the total length is 9 digits. Since the sum of the <code>Ext Len</code> field and the <code>CPN Prefix</code> field is greater than the total CPN length, the CPN prefix is prepended to the least significant digits of the extensions to form a 9 digit CPN. For example, the extension 66123, when converted to the CPN, would become 619494123.
Total CPN Length	This is the total length of the CPN. It can be any number from 0-15.

In G3V2, any number of digits (from 0 to 15) can be sent in the CPN IE because the CPN prefix table allows numbers of variable length to be formed. In practice, you should always administer the CPN in the form of the public network numbering plan for your country. For example, if the public network numbering plan is 10 digits, as in the U.S., and you administer the CPN to be 7 digits throughout your ISDN network, you might receive a 7-digit CPN over a public network trunk, which would be meaningless.

## Calling Party Number Display Requirements

In G2.2 systems, the calling party number, if sent from the far end, will always be displayed. If both the calling party number and the display IE are sent from the far end, both will be displayed.

In G3V2 systems, the calling party number, if sent from the far end, will always be displayed. If both the calling party number and the display IE are sent from the far end, both will be displayed. If only the calling party number is received, the display shows `Call From` and the number.

In G3V2 systems, the format of the display on the called party's terminal depends on the administration setting in the `North American Area Code` field in the dial plan form. If this field indicates an area code and the type of number field in the IE is not international, the number will be displayed in the NANP format with hyphens (for example, 303-538-1526). Otherwise, the number will be displayed without hyphens or spaces. Also, if the type of number field in the IE is international, the display will indicate an international number by displaying `INTL` in the `MISC ID` field.

These rules assume the call does not travel over DCS trunk groups. If the call is made on an ISDN trunk group used for DCS, the ISDN PRI display might be overridden by the DCS display. Whenever the DCS display takes precedence, the ISDN CPN IE is not displayed. See the section ["Display IE"](#) for interactions between DCS and ISDN displays.

## Calling Party Number on Tandem Calls

If a call is tandemed through any G3V2 system, CPN will be passed if the call originated as an ISDN PRI call and continued over ISDN PRI trunks. If, however, a call is tandemed from a non-ISDN trunk to an ISDN trunk, the called party will display the trunk group name of the incoming trunk, if administered.

## Called Party Number IE

The DEFINITY systems send the called party number in codeset 0 in the `SETUP` message. This IE is always sent without any prerequisite administration.

The called party number IE is not used in ISDN PRI displays. Instead, the connected number IE is displayed when the connection is made. The dialed digits appear on the caller's display as they are being dialed. The called party number IE is, however, passed to telemarketing applications, such as ASAI gateway.

On incoming calls, G2.2 systems examine the `type of number` field in the called party number IE to determine how to route the call. G3V2 systems, however, ignore these fields and route incoming calls based only on the analysis of the digits received. For example, these systems must receive the prefix 011 to route international calls correctly.

When sending the called party number IE, G2.2 systems populate the `Number Plan ID` and `Type of Number` fields from administration. You administer these fields in procedure 322, word 1, fields 3 and 4. G3V2 systems, however, populate these fields automatically as follows:

Call Type	Type of Number	Number Plan
TAC	national	ISDN/telephony number plan
int	intl	ISDN/telephony number plan
fnpa	national	ISDN/telephony number plan
hnpa	national	ISDN/telephony number plan
iop	intl	ISDN/telephony number plan
op	national	ISDN/telephony number plan
svc	national	ISDN/telephony number plan
natl	national	ISDN/telephony number plan
unk	unknown	ISDN/telephony number plan
aar	national	ISDN/telephony number plan
iaar	intl	ISDN/telephony number plan
uuar	unknown	ISDN/telephony number plan

#### Screen 5-2. G3V2 Called Party Number IE

##### ⇒ NOTE:

Except for the trunk access code (TAC), the call types above are the call types assigned to a dialed digit string in the AAR and ARS digit analysis tables.

##### ⇒ NOTE:

For Japan (country option 3) the number plan is always encoded as unknown.

## Channel ID IE

The channel identification information element, which is sent in the SETUP message and in several other ISDN messages, is used to associate a call with its corresponding B channel and corresponding D channel messages. In a FAS interface, the interface ID codepoint in the channel ID is implied and thus is not sent. In an NFAS arrangement, however, the interface ID must be present. G2.2 systems populate the interface ID in procedure 262, word 1, field 13. In an NFAS arrangement, G3V2 systems populate the interface ID from the signaling group form.

DEFINITY systems also implement the preferred/exclusive codepoint in the channel ID IE. The channel ID information element has a codepoint for information indicating whether or not a channel is negotiable. These two codepoints are used to negotiate a call to another B channel when one is busy or

unavailable. In all DEFINITY systems, only calls on DCS trunk groups are coded as exclusive. All others are coded as preferred.

**⇒ NOTE:**

For details of how channel negotiation works in glare situations, see the section [“User-Network and Peer Protocols”](#) earlier in this chapter.

The channel number codepoint in the channel ID IE identifies the timeslot the B channel for the call occupies on the interface. The circuit assignments in trunk group administration map the circuit number to the timeslot. Thus, on a FAS DS1 interface, circuits 1-23 correspond to timeslots 1-23. On an NFAS DS1 interface, circuits 1-24 map to timeslots 1-24. On a FAS CEPT1 interface, circuits 1-15 map to timeslots 1-15 and circuits 17-31 map to timeslots 17-31. On an NFAS CEPT1 interface, circuits 1-31 map to timeslots 1-31. For all country protocol options except for option 2 (Australia) the value of the channel number in the channel ID IE is the timeslot number. In country protocol option 2 on a CEPT1 FAS interface, however, channel numbers 1-15 map to timeslots 1-15 but channel numbers 16-30 map to timeslots 17-31. This mapping is automatically compensated for by the country protocol option 2 software. If you are using an ISDN tracing tool to diagnose a problem in country option 2, however, you might need to consider this mapping.

For further information on this subject, see the section [“Facility-Associated and Non-Facility Associated Signaling”](#) earlier in this chapter.

## Network Specific Facilities IE in U.S.

The network specific facilities (NSF) IE, which at present is only used by public network applications in the U.S., has the following purposes:

- It tells the public network switch, such as the 4ESS or the 5ESS, which service (such as Megacom service or Accunet Switched Digital Services) to apply to the call. The `Facility Coding Value` field in the NSF IE carries this information.
- If the service is a parameterized service, it tells the public network switch what parameters to apply to the call. Presently, WATS (outwats in the administration forms and procedures) is the only parameterized service. Thus, WATS has a facility coding value, like the other services, but also has parameters associated with the service. These parameters are the bands applied to the service. WATS calls to two different locations might be calls to two different WATS bands, which would cost different amounts.
- It tells the public network switch, such as the 4ESS or DMS100, which network feature to apply to the call. The AT&T network distinguishes between services and features. The AT&T network features currently applying to DEFINITY systems are as follows:
  - CPN preferred. This feature tells the 4ESS to send the DEFINITY system the calling party number in the CPN IE, if it is available. If it is not available, the 4ESS sends the billing number in the CPN IE.

- BN preferred. This feature tells the 4ESS to send the DEFINITY system the billing number in the CPN IE, if it is available. If it is not available, the 4ESS sends the calling party number in the CPN IE.
- CPN only. This feature tells the 4ESS to send the DEFINITY system the calling party number in the CPN IE, if it is available. If it is not available, the 4ESS does not send the CPN IE.
- BN only. This feature tells the 4ESS to send the DEFINITY system the billing number in the CPN IE, if it is available. If it is not available, the 4ESS does not send the CPN IE.
- Operator. This feature applies to calls on trunk groups connected to a local exchange ISDN switch. If the operator code is in the NSF on an outgoing call to the LEC, the caller will receive operator service on the call.
- Presubscribed common carrier operator. This feature applies to calls on trunk groups connected to an interexchange carrier's ISDN switch. If the presubscribed common carrier operator code is in the NSF on an outgoing call to the toll switch, the caller will receive operator service on the call.
- Call-associated temporary signaling connection. If the code for CA-TSC is in the NSF on an outgoing call to the 4ESS, a CA-TSC will be requested for that D channel.
  - It tells the local exchange switch which interexchange carrier to route the call to (AT&T etc.). This information is carried in the `Network Identification` field in the NSF.
  - On incoming calls to G3V2 systems on call-by-call service selection trunks, it tells the system what type of service the call is so that the incoming call handling table can treat it correctly.

G2.2 systems populate the NSF in procedure 318. The G3V2 systems populate the NSF in the routing pattern form. For example, if a preference is administered for **accunet**, calls routed to that preference will have the value 00110 put into the `Facility Coding Value` field in the NSF IE.

## G2.2 Implementation

In the G2.2, you must define the NSFs in procedure 279, word 1. This administration supplies the facility coding value portion of the NSF IE. To administer the network identification, you must, for each ISDN sending index, build the network identification, called the IXC in DEFINITY terminology, in procedure 321, word 1, fields 7 through 11. If field 7 is a **2** or **3**, then the IXC assigned in fields 8 through 11 will be used to populate the network identifier in the NSF. The complete NSF is then assigned to a preference in procedure 318, word 1, field 9, which is the ISDN sending index corresponding to the desired NSF for that preference.

## G3V2 Implementation

G3V2 systems use the following forms and other system parameters to populate the NSF IE:

- Routing pattern form
- Incoming call handling table in the trunk group form
- Usage allocation plan in the trunk group form
- Network facilities form

**NSF Implementation in the Routing Pattern Form.** The following list describes how the NSF relates to settings in the routing pattern form:

- For each ISDN PRI preference in a routing pattern, you can enter the IXC for the interexchange carrier that is carrying the call. This populates the network identification codepoint of the NSF IE. If the trunk group connects directly to an IXC's switch, the IXC is not needed. If the trunk group is connected to a LEC switch, however, and the call will eventually be switched to an IXC's switch, the IXC information will tell the intermediate switch to route the call to the appropriate carrier.
- For each ISDN PRI preference in a routing pattern, you must enter the mnemonic for the service that will use that trunk group if it is a call by call trunk group. This populates the facility coding value codepoint in the NSF IE for outgoing calls over that trunk group. If you do not enter the service, the facility coding value in the NSF will not be populated. For trunk groups dedicated to a service, this is usually no problem because the NSF is automatically populated. For call by call trunk groups, however, the NSF must be populated correctly because the trunk group can carry calls of differing services. The list of valid services for this field can be found by displaying the network facilities form.
- If the service/feature mnemonic is outwats-bnd, you must also administer the band number (0-255) for the call.

**NSF Implementation in the Incoming Call Handling Table.** For calls incoming on ISDN PRI trunk groups, the system uses the NSF IE to identify the service so that the call can be treated in the incoming call handling table in the trunk group form. The mnemonic identifying the NSF is administered for each type of service that can be incoming on the trunk group. When a call comes in on that trunk group and its NSF matches the administered value, that call is treated in the way defined on that row of the table. For example, an incoming Megacom 800 call to a given range of extensions could be routed to a telemarketing application. This table obviously has its greatest application in call-by-call trunk groups. If the service type of the trunk group is not cbc and special treatment of calls on that trunk group is not required, the table does not have to be administered. If you want special treatment for calls on dedicated trunk groups, however, you must enter the service/feature.

**⇒ NOTE:**

If the service type of the trunk group is tie or tandem, calls with any NSF on the trunk group will be allowed to complete, regardless of whether the incoming call handling table is administered or not. For example, if the service type is tandem and the incoming call handling table is blank, any SDN, Megacom, etc., calls will complete. Thus, the incoming digits must be the expected digits for routing purposes. For these calls to receive special treatment still requires administering the incoming call handling table, however. Also, even though calls on trunk groups of tie and tandem are tandemed, the NSFs are not tandemed — the NSF is always determined by the routing pattern administration.

**⇒ NOTE:**

Megacom 800 and International 800 services have different NSFs, and thus cannot be put on the same dedicated trunk groups. These two services must be put on call-by-call trunk groups. Other U.S./global services combinations use the same NSFs, and thus can be put on the same trunk groups. For example, SDN and global SDN services have the same NSF, as do Accunet Switched Digital Services and Switched Digital International Services.

For details on how to implement the incoming call handling table, see the section [“Incoming Call Handling Table in G3V2”](#) later in this chapter.

**NSF Implementation in the Usage Allocation Plan in the Trunk Group Form.** The system also implements the NSF IE in the usage allocation plan in the trunk group form. This applies only to ISDN PRI trunk groups with a service type of cbc. The service/feature mnemonic in each row of the plan is compared with the facility coding value in the NSF IE of a call on that trunk group to determine which row of the plan applies to the call. For details of how to implement the usage allocation plan, see the section [“Call by Call Service Selection in G3V2 Systems”](#) later in this chapter.

**NSF Implementation in the Network Facilities Form.** The network facilities form contains the mnemonics for the facility coding values of each NSF IE used by the system. If an NSF is not represented in this form, it will not be recognized by the system. This form is also used for adding new NSFs. This can be done only by AT&T personnel with the correct administration password level. If a new service is entered in the form, all other relevant forms are automatically updated to include the new mnemonics.

**NSF Implementation in Countries other than the U. S.**

At present, the U.S. is the only country in which the NSF IE is used. The administration forms for implementing NSF IEs are available but have no use outside the U.S.

## User-to-User Information Signaling

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In addition to providing signaling to establish, maintain, and terminate calls, the layer 3 protocol also includes signaling allowing endpoints to exchange information unrelated to call control. For example, while call control signaling is taking place, information can also be sent for display on the calling or called party's station. This kind of signaling is called user-to-user information signaling. The exact definition of what constitutes a user is often fuzzy, however. To some, a user means a terminal, station, or an applications processor connected to a switch. The AT&T network's ISDN PRI specification, however, seems to include a PBX as a user. Thus, information used to route a call through a private network, such as the traveling class mark, is defined as user-to-user information. User-to-user information signaling can be divided into two fundamental types, as follows:

- Call control message associated user-to-user information
- Temporary signaling connections (TSC)

Call control message associated means that the user-to-user signaling information is being passed in call control messages. For example, the display information element is sent in the SETUP and CONNect messages. TSCs at present only exist in the AT&T network and in private G3 networks. They are special signaling connections that allow user-to-user information to be passed in a non-call control message, called the USER INFORMATION message. Two types of TSCs exist, call-associated TSCs (CA TSC) and non-call associated TSCs (NCA TSC).

As with call control information, user-to-user information is transported in information elements. The AT&T network's ISDN PRI specification lists the following information elements as user-to-user IEs:

- Connected number
- Redirecting number
- Calling party subaddress
- Called party subaddress
- High layer compatibility
- Low layer compatibility
- Locking shift to codeset 6 or 7
- Any IEs included in codeset 6 that do not undergo processing or interpretation by the public network switches. Codesets are discussed below.
- Any IEs included in codeset 7
- User-user



Some IEs are defined as call control IEs but can also be used for the purpose of user-to-user information signaling. The calling party number, for example, which is defined as a call control IE, is often used by the end user for applications such as terminal displays.

In order to distinguish between information needed or not needed by the public network, the concept of codesets exists. Information elements coded as being part of codeset 0 is information needed by the public/international network and is defined by the CCITT standard. Information elements in codesets 1-4 are reserved for future standards. Codeset 5 is used for the public network in the U.S. Codeset 6 is used by private networks. Codeset 7 is information needed by the end user. In practice, the division between codesets 6 and 7 is not always clear because codeset 6 information often looks like end user information.

All DEFINITY systems allow some degree of codeset mapping, which is the capability to specify which codeset an IE will be sent in. G3V2 systems limit this mapping to user-to-user information elements in the outgoing direction. G2.2 systems, however, allow any IEs to be mapped to any codeset in the incoming and outgoing directions. In theory, this could be done for both call control and user-to-user information signaling. In practice, however, it is used to map user-to-user information elements.

**NOTE:**

Public network switches in many countries do not pass codeset 6 and codeset 7 IEs.

## Codeset Mapping in G2.2 Systems

Because switches sometimes differ in the codesets in which certain ISDN information elements are sent and also in the values of the opcodes of those information elements, G2.2 systems have the capability to map the codesets and the opcodes to accommodate these different implementations across systems. For example, the System 85 R2V4 implements the TCM, lookahead interflow, and display IEs in codeset 7 whereas the G2.2 and G3V2 systems implement them in codeset 6 by default. If the G2.2 must pass these IEs to or from the R2V4, it must map them from codeset 6 to codeset 7 in the outgoing direction and from codeset 7 to 6 in the incoming direction.

Codeset mapping is implemented in procedure 280, word 1 as follows:

1. An index in the range 0 to 15 is assigned in field 1.
2. **Incoming** is selected in field 2.
3. A codeset to be mapped in the incoming direction is selected in field 3.
4. An opcode (information element) belonging to the selected codeset is selected in field 4.
5. The codeset on the G2.2 to which the incoming codeset from field 3 is to be mapped is selected in field 5.

6. The opcode on the G2.2 to which the incoming opcode from field 4 is to be mapped is selected in field 6.
7. Steps 2 through 6 can be repeated up to 256 times for the incoming case.
8. **Outgoing** is selected in field 2 and steps 3 through 7 are repeated. For every incoming mapping there should be an identical outgoing mapping.
9. All of the above steps can be repeated up to 16 times (the number of map numbers available).
10. For each ANN35 or TN767 containing a primary D-channel to which you want a codeset mapping, assign the map numbers in procedure 262, word 3. Note that different interfaces can use different mappings for the same codesets and opcodes. For example, one interface can map the TCM to codeset 7 while another interface can map the TCM to codeset 0.

[Table 5-4](#) summarizes the current codeset mapping requirements for the G2.2:

**Table 5-4. G2.2 Codeset Mapping Requirements**

IE	Codeset Map	Opcode Map	When Required
TCM	Map from codeset 6 to codeset 7 outgoing. Map from codeset 7 to codeset 6 incoming.	Map from opcode 8 to opcode 8 in both directions.	If a System 85 R2V4 is present in an end-to-end ISDN network with the G2.2, this codeset mapping is required.
Display	Map from codeset 6 to codeset 7 outgoing. Map from codeset 7 to codeset 6 incoming.	Map from opcode 40 to opcode 40 in both directions.	If a System 85 R2V4 is present in an end-to-end ISDN network with the G2.2, this codeset mapping is required.
Lookahead Interflow	Map from codeset 6 to codeset 7 outgoing. Map from codeset 7 to codeset 6 incoming.	Map from opcode 123 to opcode 123 in both directions.	If a System 85 R2V4 is present in an end-to-end ISDN network with the G2.2, this codeset mapping is required.

## Codeset Mapping in G3V2 Systems

G3V2 systems allow limited codeset mapping in the outgoing direction.

G3V2 systems allow the TCM and lookahead interflow IEs to be sent in either codeset 6 or 7. In the incoming direction, these systems accept these IEs in either codeset 6 or 7. You administer this in the trunk group form in the field `Codeset to Send TCM/Lookahead`. G3V2 systems also allow the display IE to be sent in codeset 0, 6, or 7. This is because many countries' public network switches do not pass codeset 6 or 7 information. In the incoming direction, G3V2 accepts the display IE in either codeset 0, 6, or 7. You administer this in the trunk group form in the `Send Display in Codeset 0/6/7` field.

## Call Control Message Associated User-to-User Information Signaling

User-to-user information can be passed in information elements in layer 3 call control messages. In CCITT terminology, this is simply called user to user information signaling. The AT&T specification, however, calls this type of signaling message associated user to user information (MA UUI). This distinction is necessary because the AT&T specification also defines ways to exchange user to user information in messages other than call control messages. The following sections describe the information elements used in user to user information signaling associated with call control messages in DEFINITY systems.

### Connected Number IE

The DEFINITY systems send the connected number in codeset 0 in the CONNect message. Its primary use is to indicate the connected party's number on the calling party's station display. For the connected number to be supplied across a public network, the DEFINITY system and the far end endpoint must be on ISDN access to the LEC or toll office switch. For example, if you receive a call from a far-end switch that is connected to a public network switch with bit-oriented signaling access, you cannot receive the connected number.

**Numbering Plan and Type of Number.** When sending a connected number IE, G2.2 systems populate the `Numbering Plan ID` and `Type of Number` fields in the following way:

Type of Number	National Number
Numbering Plan Identification	Telephony Numbering Plan

G3V2 systems populate these two fields as follows:

Type of Number	National Number
Numbering Plan Identification	ISDN/telephony numbering plan recommendation E.164/E.163

**Requirements for Sending Connected Number IE.** In G2.2 systems, to send the connected number, the NPA-NXX designator field in procedure 354, word 3 must be administered. This designator must also be entered in procedure 000 for the connected party's extension. The number sent is then always of the form NPA-NXX-extension, a 10-digit direct distance dial (DDD) number. Also, procedure 100, word 3, field 8 must be set to **0** or **2** to send the optional information elements. When set to **2**, the optional IEs are sent, but if the trunk group is a DCS trunk group on an ISDN facility and an ISDN call from another trunk group is routed to it, the DCS name message is suppressed.

In G3V2 systems, to send the connected number information element to the calling party on the far end, the CPN prefix table form must be administered and the `Send CPN` field in the trunk group form must be administered as **yes**. This table allows you to specify the number to be put in the connected number IE for any given extension. The `Send CPN` field in the trunk group screen must also be administered as **y**. In G3V2, this number can be any length from 0 to 15 digits. For guidelines on how to administer the CPN prefix table, see the section [“Calling Party Number IE”](#) earlier in this chapter.

**Display Requirements for Connected Number IE.** On G2.2 systems, no administration is necessary to display the connected party number. As they are being dialed, the dialed digits are displayed until the last digit is dialed. As the call is progressing, `OUTSIDE CALL` is displayed if the names database and the outgoing display are administered in procedure 012. If either of these is not administered, the dialed digits continue to be displayed. When connected, the far end may send back the connected number and the display IE in the `CONNECT` message. If both are present, both are displayed. If only one IE is present, it is displayed.

On G3V2 systems, to display the connected number if sent from the far end, no administration is necessary. To overwrite the dialed digits display with the trunk group name after the call is dialed but before connected, the `Outgoing Display` field in the trunk group form must be set to **yes** and the trunk group name must be administered.

As they are dialed, the dialed digits are displayed. Before connected, this display may be overwritten by the outgoing trunk group name, depending on administration. When connected, the far end sends back the connected number IE and the display IE in the `CONNECT` message and the display changes. If both are present, they are both displayed. If only one IE is present, it is displayed. If only the connected number is present, the display shows `Answered By` and the number.

## Display IE

All DEFINITY systems send the display IE in either codeset 0, 6, or 7, depending the system and on administration. G2.2 systems and G3V2 systems allow the display IE to be mapped to codeset 0, although for applications in the U.S. it should be sent in either codeset 6 or 7. The display IE is sent in either the `SETUP` message or the `CONNECT` message. When sent in the `SETUP` message, its

purpose is to display the calling party name for display on the connected party's terminal, though anything in the IE will be displayed. When sent in the CONNect message, its purpose is to display the connected party's name on the calling party's terminal, though anything in the IE will be displayed. The appropriate codeset in which to send the display IE depends on the public network requirements of the country or on the private switch to which the DEFINITY system is connected. In general, in the U.S. the display IEs should be sent and received in codeset 6 on the DEFINITY systems unless a System 85 R2V4 is present somewhere in the network (an SDN-with-ISDN network or an ETN for example). In this case, it should be sent in codeset 7. This is because the System 85 sends and receives the display IE (as well as the TCM) in codeset 7.

**Requirements for Sending the Display IE in the SETUP Message.** G2.2 systems will send the display IE if procedure 100, word 3, field 8 is set to **0** to send the optional information elements. Also, the name must be administered in the names database in procedure 012. The contents of the names database populates the display IE that is sent in the both the SETUP and CONNect messages. Thus, more information than the name can be displayed if the display IE contains more than the name-only. You must also map the codeset you want the display IE to be sent in by administering procedure 280, word 1.

In G3V2 systems, to send the display IE, the *Send Name* field in the trunk group form must be set to **y**. The name associated with the extension is administered in voice terminal forms. On G3V2 systems in the U.S., the display IE should be sent in codeset 6 unless a system that does not support these IEs in codeset 6, such as a System 85 R2V4, is present in the network, in which case it should be set to **7**. In other countries, the display IE can be sent in codeset 0 if necessary.

**Requirements for Displaying the Display IE.** All DEFINITY systems always display the contents of the display IE if sent from the far end. If both the display IE and calling party number are sent from the far end, both will be displayed.

**Display IE Interactions with DCS Messages.** When both the ISDN PRI message and the DCS message are available on a call (when DCS messages are transported over PRI trunks, for example) the contents of the DCS message are displayed except in the following cases:

- In G3V2 systems, when an incoming call on a DCS trunk is routed to an outgoing ISDN PRI-only trunk, the contents of the display information element in the ISDN PRI SETUP message, which contains the calling party name, are taken from the contents of the DCS name message.
- When an incoming call on an ISDN PRI trunk is routed to an outgoing DCS trunk over an ISDN PRI trunk, the DCS name message is suppressed in G3V2 systems. G2.2 systems also suppress the DCS name message in this situation but only if procedure 100, word 3, field 8 is administered as **2**. The reason for this is that the DCS name message in this case only contains the trunk group name, if administered, of the incoming ISDN PRI trunk. Since DCS messages normally take precedence, the more informative ISDN PRI display IE would not be used. Thus, the DCS name message is turned off, allowing the ISDN PRI display IE to be used.

## Lookahead Interflow IE

All DEFINITY systems populate the lookahead interflow IE with the contents of the names database for the listed VDN of the originating system.

## Low Layer Compatibility IE

The low layer compatibility IE is used to tell an endpoint, trunk group, or routing preference, the characteristics of the associated call on the B channel. These characteristics include such things as whether the call is voice, restricted digital data, the user data rate, and whether it is synchronous or asynchronous. This information is used by the receiver to determine whether it is compatible with the call and to take the appropriate actions.

In DEFINITY systems, information from the bearer capability IE and the low layer compatibility IE is compared with the information from the administered bearer capability class and information transfer capability of an endpoint, trunk group, or routing preference to do the following:

- Route calls
- Insert modem pools
- Accept or block calls at the endpoint based on compatibility

Bearer capability class (BCC) and information transfer capability (ITC) are administrable attributes describing the types of calls supported by a terminal, trunk group, or routing preference. Together the BCC and ITC populate the bearer capability IE and the low layer compatibility IE on outgoing calls. For example, mode 2 data is a bearer capability class and restricted data is an information transfer capability (these are DEFINITY terms, not ISDN PRI terms). If a call to an ISDN PRI trunk group is made from a mode 2 data module administered as restricted data on the data module form in a G3V2 at a user data rate of 9.6 kbps, for example, the ISDN PRI message formed for this call will contain a bearer capability IE and a low layer compatibility IE. The bearer capability IE for this call is populated with information such as the fact that it is restricted digital information at a 64 kbps information transfer rate (mode 2 uses 64 kbps even though the user data rate is only 9.6 kbps). The low layer compatibility IE for this call is also populated with restricted digital information at a 64 kbps transfer rate. It is also populated with other information such as the user data rate of 9.6 kbps.

The BCC and ITC also apply to non-ISDN calls. With incoming non-ISDN calls, however, it is harder to determine the characteristics of the call because there is no BC IE or LLC IE to convey that information.

**BCC and ITC Implementation in G3V2 Systems.** The primary use of the BCC and ITC in G3V2 systems is to populate the BC IE and LLC IE on calls to ISDN PRI trunk groups and to implement bearer capability routing (called generalized route selection, or GRS, in G3V2 systems).

G3V2 systems populate the BC IE and LLC IE in the following way:

- For calls from non-ISDN endpoints to ISDN PRI trunks, the BC IE and LLC IE, except for the information type codepoint, is populated automatically based on the type of endpoint. For example, if the endpoint is an MPDM set for mode 1 operation, the BC IE and LLC IE are populated with mode 1 characteristics. Two exceptions to this rule exist as follows:
  - A call from a mode 2 endpoint is routed to a pattern containing voice preferences but no mode 2 preferences. In this case a modem pool is inserted and the outgoing BC IE and LLC IE in the ISDN PRI message is populated by the BCC and ITC administration of the preference, not the originating endpoint.
  - A call from a voice endpoint is routed to a pattern containing preferences administered only for data (BCCs 1, 2, 3, or 4). In this case, the outgoing ISDN PRI message is populated by the BCC and ITC administration of the preference, not of the originating endpoint.
- In G3V2, the information type codepoint in the BC IE and LLC IE is coded from the administered ITC field on the data module form.
- As with G2.2, for calls from ISDN endpoints to ISDN PRI trunks, the BC IE and LLC IE are populated by the endpoint at the time the call originates. Option settings on the ISDN set determine the various BC IE and LLC IE codepoints, such as transfer rate and information type.

**NOTE:**

International data calls require the information type in the BC IE to be coded as unrestricted. In G2.2 and G3V2 you can control this in administration.

The following list explains some of the implementation details of bearer capability routing:

- GRS works only if **ISDN-PRI** is assigned in the system parameters - customer options administration form.
- GRS is used to make outgoing call routing decisions and modem pool decisions for ISDN calls but only routing decisions for non-ISDN calls.
- For non-ISDN calls, modem pool decisions are based on the trunk type (AVD or non-AVD).
- The BCC fields in the routing pattern form must be administered for every routing preference (ISDN and non-ISDN) if ISDN-PRI is administered in the system parameters-customer options screen.
- For outgoing ISDN calls, the first preference containing at least one match for the bearer capability of the originating endpoint will be chosen. If a match is not found, the following scheme is used:
  - A call of BCC 0 is never blocked.



- A call of BCC 2 will use a preference with BCC 2 set to **yes**. If no such preference exists, it will search for a preference with BCC 0 set to **yes**. Failing this match, the call is blocked with intercept.
- A call of BCC 1, 3, or 4 will be blocked with intercept.
- Calls from mode 2 endpoints must be routed to preferences with BCC 0 set to yes and BCC 2 set to no to receive a modem pool.

In G3V2 systems the administered ITC is also used to make routing decisions for outgoing calls. Since the ITC designates whether the data is restricted or unrestricted, this administration probably only applies to U.S. systems because other countries do not have restricted facilities.

 **NOTE:**

Accunet Switched Digital International 64 kbps calls must be administered as unrestricted, for all but mode 1 calls.

The fundamental rule for the ITC is that the administered ITC of the routing preference, which indicates whether restricted data or unrestricted data is supported on that preference, must not conflict with the ITC of the call, which indicates whether the data is restricted or unrestricted. If these two conflict, the call is blocked. The following list describes the compatibility of the ITC of a call and the administered ITC of a routing preference:

- Mode 0 data is restricted or unrestricted depending on whether the originating terminal packages it in a protocol guaranteeing 1s density. For example, mode 0 from an MPDM is always unrestricted unless the originating terminal on the MPDM performs some kind of 1s density protocol packaging, such as inverted HDLC.
- Mode 1 data is restricted.
- Mode 2 data is restricted.
- Mode 3 data is restricted or unrestricted, depending on whether the terminal or data module inverts the bits.
- Regardless of the nature of the data being transported, the ITC can be set to restricted or unrestricted either through administration or by option settings on the terminals. For example, mode 2 data is, by definition, restricted data, but you can administer a mode 2 MPDM as unrestricted, if the application requires it. This is required when making international ISDN PRI data calls, for example.
- Restricted data can be transported over restricted or unrestricted facilities.
- Unrestricted data can be transported over unrestricted facilities only.
- If a routing preference is a trunk group connected to a DS1 interface administered as ZCS line coding, it must be administered to support restricted data.



- If a routing preference is a trunk group connected to a DS1 interface administered as B8ZS or HDB3 line coding, it can be administered to support unrestricted data, restricted data, or both.

Given the above rules, the rules for ITC are as follows:

- If the ITC of the originating endpoint's data is restricted, and the administered ITC of the preference is restricted, the call is allowed.
- If the ITC of the originating endpoint's data is restricted and the administered ITC of the preference is unrestricted, the call is blocked with intercept.
- If the ITC of the originating endpoint's data is unrestricted and the administered ITC of the preference is restricted, the call is blocked with intercept.
- If the ITC of the originating endpoint's data is unrestricted and the administered ITC of the preference is unrestricted, the call is allowed.
- If the administered ITC of the preference is **both**, then the call is allowed regardless of ITC of the endpoint's data. In this case, a decision must be made as to how the ITC in the BC IE and the LLC IE is coded. This is done by using the value in the BCIE field. If this field is set to **ept**, the ITC from the endpoint is used. If set to **unr**, the ITC sent will be unrestricted.
- The ITC of the endpoint is administered in the data modules administration form for non-ISDN endpoints. For ISDN data modules the ISDN message generated by the terminal populates the ITC and the switch administration for that extension is ignored. This message is populated either automatically by the terminal or by an option setting on the terminal, depending on the particular terminal. The only case where switch administration populates the ITC for calls from ISDN terminals is when the terminal is administered as an access endpoint. Modes 0, 1, and 3 can be set to restricted or unrestricted with an option setting on the data module.

All incoming calls to an endpoint are allowed to complete, leaving it to the endpoints to decide on compatibility. Incoming voice or voice-grade data calls to any digital endpoint will automatically receive a modem pool.

#### NOTE:

The U.S. is the only country using restricted facilities. If you make a digital data call to Europe over Accunet Switched Digital International service, for example, the ITC in the BC and LLC IEs must be coded as unrestricted except in the case of mode 1 calls.

**BCC and ITC Implementation in G2.2 Systems.** G2.2 systems populate the BC IE and LLC IE in the following way:

- For calls from non-ISDN endpoints to ISDN PRI trunks, the BC IE and LLC IE are populated from the bearer capability class of service indicated in fields 15 and 16 of procedure 014, word 1 and assigned to the endpoint in procedure 000, word 3, field 5.

- For calls from ISDN endpoints to ISDN PRI trunks, the BC IE and LLC IE are populated by the endpoint at the time the call originates. Option settings on the ISDN set determine the various BC IE and LLC IE codepoints, such as transfer rate and information type.

G2.2 systems implement the G3V2 equivalent of GRS in a feature called Bearer Capability Class of Service (BCCOS). A BC COS is a user-definable set of attributes assigned through administration to the following objects:

- Extensions
- AAR/ARS routing pattern preferences
- Trunk groups

You can define up to 256 BC COSs (0 - 255), but BC COSs 0 through 8 are pre-defined. These pre-defined BC COSs should not be redefined. Rather, a new BC COS should be defined whenever you want to redefine a pre-defined BC COS.

To implement BC COS properly, you must have the following document:

*DEFINITY<sup>®</sup> Communications System Generic 2 Administration Procedures*. The table of pre-defined BC COSs in procedure 014 is crucial.

BC COS is implemented by defining BC COSs in procedure 014, word 1, and assigning them to extensions in procedure 000, word 3, routing preferences in procedure 318, word 2, and trunk groups in procedure 100, word 2. The attributes composing a BC COS are described by the settings of fields 2 - 16 in procedure 014. The settings of these fields for a given BC COS define how the extension, preference, or trunk group assigned that BC COS will treat calls made to that extension, preference, or trunk group based on the bearer capability and information type fields of the BC COS of the calling extension or trunk.

The remainder of the topics in this section explain the details of implementing BC COS.

At present, the following bearer capability classes are defined in the G2.2:

- Voice
- Voice Grade Data
- Mode 0
- Mode 1
- Mode 2
- Mode 3
- Unknown Digital
- Unknown Analog

- Mode 3/2 Adaptive
- X.25

In addition to the above bearer capability terms, the following terms are used as conventions in this discussion of BC COS:

- **Object** is used as an abbreviation for any one of the following:
  - extension
  - trunk/trunk group
  - AAR/ARS preference
- **ISDN extension** is an ISDN BRI terminal.
- **ISDN trunk/trunk group** is an outgoing or incoming trunk or trunk group carrying ISDN calls.
- **ISDN preference** is an AAR or ARS preference used to route ISDN calls.
- **Non-ISDN extension** is a DCP or analog extension.
- **Non-ISDN trunk/trunk group** is a DS-1 or analog trunk/trunk group.
- **Non ISDN preference** is a preference used to route calls to non-ISDN trunk groups.

The following three sections describe how BC COS operates depending on whether an extension or trunk in the G2.2 is calling another extension, trunk group, or preference in the system.

 **NOTE:**

Fields 2 and 14 of procedure 014, word 1, are not used at this time.

1. Extension or Trunk Calling Extension

The following list describes the BC COS operation when a trunk or extension calls an extension in the system:

- The bearer capability of the calling extension or trunk is presented to the called extension. This bearer capability is derived in different ways depending on the type of call as follows:
  - For a call from a non-ISDN extension or trunk to an extension, the bearer capability, taken from BC COS field 16 of the calling extension or trunk, is presented to the called extension.
  - For a call from an ISDN extension or trunk to an extension, the bearer capability, derived from the bearer capability information element and low-layer compatibility information element (if present) of the ISDN message, is presented to the called extension.

- For a digital data call, lacking the low-layer compatibility information element, from an ISDN extension or trunk to an extension, the bearer capability presented to the called extension is mode 2.
- For a call from a non-ISDN extension or trunk, having bearer capability of **unknown digital**, to an extension, the bearer capability presented to the called extension is the called extension's bearer capability taken from its BC COS field 16.
- The value in the BC COS field of the called extension (one of the fields 4 - 13) matching the presented bearer capability of the calling extension or trunk determines how the call is treated, as follows:
  - If the field is **0** the call is switched to the called extension.
  - If the field is **1** a modem pool member is inserted and the call is switched to the called extension.

**NOTE:**

Modem pool decisions are ignored for extension-to-extension, trunk-to-trunk, and trunk-to-preference calls.

- If the field is **2** the call is blocked with intercept treatment.
- The information type (restricted or unrestricted) of the calling extension or trunk is presented to the called extension. This information type is derived in different ways depending on the call type as follows:
  - For a call from a non-ISDN extension or trunk to an extension, the information type of the calling extension or trunk, taken from BC COS field 15 of the calling extension or trunk, is presented to the called extension.
  - For a call from an ISDN extension or trunk to an extension, the information type, derived from the bearer capability information element of the ISDN message, is presented to the called extension.
- The called extension's information type, taken from field 3 of the called extension's BC COS, is compared with the information type of the calling extension or trunk. Depending on these values, the following actions are taken:
  - If the information type of the calling extension or trunk is restricted and field 3 of the called extension is **1** (restricted), the call is allowed.
  - If the information type of the calling extension or trunk is unrestricted and field 3 of the called extension is **0** (restricted), the call is blocked with intercept.

- If the two information types match, the call is allowed. Note that even if the call is allowed, you must still make sure the transmission facilities the call will use are indeed what is administered. For example, if you have **unrestricted** administered but the digital data call is made over restricted transmission facilities in the network, the data will be corrupted.

## 2. Extension or Trunk Calling Trunk Group

The following list describes the BC COS operation when a trunk or extension calls a trunk group in the system:

- The bearer capability of the calling extension or trunk is presented to the called trunk group. This bearer capability is derived in different ways depending on the type of call as follows:
  - For a call from a non-ISDN extension or trunk to a trunk group, the bearer capability, taken from BC COS field 16 of the calling extension or trunk, is presented to the called trunk group.
  - For a digital call from an ISDN extension or trunk to a trunk group, the bearer capability, derived from the bearer capability information element and low-layer compatibility information element (if present) of the ISDN message, is presented to the called trunk group.
  - For a digital data call, lacking the low-layer compatibility information element, from an ISDN extension or trunk to a trunk group, the bearer capability presented to the called trunk group is mode 2.
  - For a call from a non-ISDN extension or trunk, having bearer capability of **unknown digital**, to a trunk group, the bearer capability presented to the called trunk group is the called trunk group's bearer capability taken from its BC COS field 16.
- The value in the BC COS field of the called trunk group (one of the fields 4 - 13) matching the presented bearer capability of the calling extension or trunk determines how the call is treated, as follows:
  - If the field is **0** the call is switched to the called trunk group.
  - If the field is **1** a modem pool member is inserted and the call is switched to the called trunk group.



### NOTE:

Modem pool decisions are ignored for extension-to-extension, trunk-to-trunk, and trunk-to-preference calls.

- If the field is **2** the call is blocked with intercept treatment.

- The information type (restricted or unrestricted) of the calling extension or trunk is presented to the called trunk group. This information type is derived in different ways depending on the call type as follows:
    - For a call from a non-ISDN extension or trunk to a trunk group, the information type of the calling extension or trunk, taken from BC COS field 15 of the calling extension or trunk, is presented to the called trunk group.
    - For a call from an ISDN extension or trunk to a trunk group, the information type, derived from the bearer capability information element of the ISDN message, is presented to the called trunk group.
  - The called trunk group's information type, taken from field 3 of the called trunk group's BC COS, is compared with the information type of the calling extension or trunk. Depending on these values, the following actions are taken:
    - If the information type of the calling extension or trunk is restricted and field 3 of the called trunk group is **1** (unrestricted), the call is allowed.
    - If the information type of the calling extension or trunk is unrestricted and field 3 of the called trunk group is **0** (restricted), the call is blocked with intercept.
    - If the two information types match, the call is allowed. Note that even if the call is allowed, you must still make sure the transmission facilities the call will use are indeed what is administered. For example, if you have **unrestricted** administered but the digital data call is made over restricted transmission facilities in the network, the data will be corrupted.
3. Extension or Trunk Calling Trunk Group Using AAR/ARS Routing Pattern Preference

The following list describes the BC COS operation when a trunk or extension calls an AAR/ARS routing pattern preference in the system:

- The bearer capability of the calling extension or trunk is presented to the called preference. This bearer capability is derived in different ways depending on the type of call as follows:
  - For a call from a non-ISDN extension or trunk to a preference, the bearer capability, taken from BC COS field 16 of the calling extension or trunk, is presented to the called preference.
  - For a call from an ISDN extension or trunk to a preference, the bearer capability, derived from the bearer capability information element and low-layer compatibility information element (if present) of the ISDN message, is presented to the called preference.

- For a digital data call, lacking the low-layer compatibility information element, from an ISDN extension or trunk to a preference, the bearer capability presented to the called preference is mode 2.
- For a call from a non-ISDN extension or trunk, having bearer capability of **unknown digital**, to a preference, the bearer capability presented to the called preference is the called preference's bearer capability taken from its BC COS field 16.

 **NOTE:**

If a preference is not assigned a BC COS it defaults to the BC COS assigned to the trunk group associated with the preference.

- The value in the BC COS field of the called preference (one of the fields 4 - 13) matching the presented bearer capability of the calling extension or trunk determines how the call is treated, as follows:
  - If the field is **0** the call is switched to the called preference.
  - If the field is **1** a modem pool member is inserted and the call is switched to the called preference.

 **NOTE:**

Modem pool decisions are ignored for extension-to-extension, trunk-to-trunk, and trunk-to-preference calls.

- If the field is **2** the call is blocked with intercept treatment.
- The information type (restricted or unrestricted) of the calling extension or trunk is presented to the called preference. This information type is derived in different ways depending on the call type as follows:
  - For a call from a non-ISDN extension or trunk to a preference, the information type of the calling extension or trunk, taken from BC COS field 15 of the calling extension or trunk, is presented to the called preference.
  - For a call from an ISDN extension or trunk to a preference, the information type, derived from the bearer capability information element of the ISDN message, is presented to the called preference.
  - For a mode 0, mode 3, or mode 3/2 adaptive call from a non-ISDN extension or trunk to an ISDN preference, the information type from field 15 of the BC COS of the calling extension or trunk is used to build the ISDN message.

 NOTE:

For any call to an ISDN preference requiring a modem pool member, the BC COS of the trunk group associated with the analog half of the modem pool is used to build the outgoing ISDN message.

- The called preference's information type, taken from field 3 of the called preference's BC COS, is compared with the information type of the calling extension or trunk. Depending on these values, the following actions are taken:
  - If the information type of the calling extension or trunk is restricted and field 3 of the called preference is **1** (unrestricted), the call is allowed.
  - If the information type of the calling extension or trunk is restricted and field 3 of the called trunk group is **0** (unrestricted), the call is blocked with intercept.
  - If the two information types match, the call is allowed. Note that even if the call is allowed, you must still make sure the transmission facilities the call will use are indeed what is administered. For example, if you have **unrestricted** administered but the digital data call is made over restricted transmission facilities in the network, the data will be corrupted.

 NOTE:

All international digital data calls should be administered as information type unrestricted.

The following list describes a suggested method for defining BC COSs and assigning them to extensions, trunk groups, and routing preferences:

 NOTE:

Fields 2 and 14 of procedure 014, word 1, are not used at this time.

1. For each object (extension, trunk group, and preference) in the system, list each bearer capability you want that object to accept and which ones you want blocked on incoming calls to that object.
2. Assign trunk group BC COSs before preferences. This is because if a preference is not assigned a BC COS, calls will still be allowed because the preference will use the associated trunk group's BC COS as a default.
3. For each bearer capability you want accepted in an incoming call to an object, list which ones should be switched directly to the object and which ones should have a modem inserted before being switched.
4. Make a map of connectivity between all the objects. For example, for a given routing preference, a list of all the extensions and trunk groups that can call that preference should be formed.



5. Using this map and the rules from BC COS Operation above, note any special considerations when incoming calls originate from the connected objects. For example, if a particular routing preference is to circuit switch calls from an ISDN trunk group that will be receiving digital data calls lacking low-layer compatibility, the preference's BC COS must be defined to circuit switch mode 2 bearer capability because that is what will be presented to the preference.
6. Based on the above analysis, assign a predefined BC COS to each object. For any given object, pick a predefined BC COS that most closely matches the incoming call requirements from the previous steps but that also matches the incoming requirements of the other objects to which it will call. For example, if the incoming requirements are satisfied but the object's information type is clear and it will be calling a restricted trunk group, some fields will need to be changed.
  - If one of the pre-defined BC COSs for an object does not match these requirements, make a copy of the one that most closely matches the requirements.
  - Define a new BC COS (not in the range 0 to 8) in procedure 014.
  - Change the fields in this new BC COS to satisfy the requirements.
  - Assign this new BC COS to the object.
  - Continue this procedure until all objects have been assigned a suitable BC COS.
7. For BC COSs assigned to trunk groups or preferences that are either modem pool or host access trunk groups, complete procedure 014, word 2.

### Traveling Class Mark (TCM) I

All DEFINITY systems populate the TCM IE, which is sent in the SETUP message in either codeset 6 or 7, with the facility restriction level (FRL) of the call. The TCM IE is not populated until the FRL of the call is determined. For example, if an authorization code is entered at the originating switch, the TCM IE is populated with the FRL resulting from the entered code. If an authorization code is prompted for by a switch other than the originating switch, the resulting FRL will populate the TCM for the outgoing call from that switch.

G3V2 systems do not populate the satellite hop counter octet or the end-to-end ISDN indicator octet. G2.2 systems populate the satellite hop counter octet with the current value of the counter. G2.2 systems populate the end-to-end ISDN identifier from the administered value in procedure 010, word 4 field 3. You can request that a call be sent only over ISDN PRI trunk groups, over ISDN PRI trunk groups if they are available otherwise over any trunk group, or over non-ISDN PRI trunk groups.

**NOTE:**

In the incoming direction, if this field is set to ISDN exclusive or ISDN preferred and the G2.2 receives a TCM IE indicating ISDN facilities exclusive or preferred, the G2.2 will not provide answer tone on a data call.

## Temporary Signaling Connections

Another capability of user-to-user information signaling, called temporary signaling connection (TSC), allows two ISDN PRI endpoints to exchange user-to-user information (such as the data in a DCS message) in messages not associated with establishing or tearing down a particular call. In normal signaling connections, user-to-user information can be passed end to end in call establishment and clearing messages (SETUP, ALERTing, CONNect, and DISConnect). This is called message-associated user-user (MA UUI) signaling. The AT&T network, however, being concerned about resources for transporting large quantities of user-to-user information, could not guarantee end-to-end delivery of MA UUI information in these messages. To handle this type of service, the network established TSCs, in which user-user information is sent in a special message (USER INFOrmation). The user requests the TSC from the network in a message. After the TSC is set up, the two ends exchange information in the USER INFOrmation messages until the TSC is torn down. TSCs are presently used to exchange user-to-user information supporting the DCS and DCS-AUDIX features in which the DCS messages are transported over the D channel.

Two types of TSCs exist, call-associated TSCs (CA-TSCs) and non-call-associated TSCs (NCA-TSCs). In CA-TSCs, user-user information can be exchanged at any time between when the call has been established to when it is torn down. In NCA-TSCs, user-user information can be exchanged without an associated call being set up on a B channel. In this case, the NCA-TSC is requested in a SETUP message in the channel ID IE. A codepoint in the channel ID IE (the D channel indicator) allows you to specify that the identified channel is a D channel, indicating this is a D channel call. User-user information can then be exchanged until one side decides to send a RELease message, at which time the NCA-TSC is cleared. For the DCS and DCS AUDIX features implemented over the D channel, NCA-TSCs are used to transport some of the DCS messages (CA-TSCs are also used for some DCS messages). Because of the way standard DCS was implemented (over X.25 virtual circuits), the NCA-TSCs must be administered. This is because D channel DCS still requires the concept of a virtual circuit (a logical channel on an X.25 link). Thus, the NCA-TSCs are administered on the signaling group form. You can establish the NCA-TSC either permanently or on an as-needed basis. In a private network, the TSC should be established permanently whereas if the TSC is going over the public network, such as SDN service, it should be established on an as-needed basis to save the cost of the service.

## Implementing TSCs in G3V2 Systems

For details on how to implement TSCs in G3V2 systems, refer to the DCS over the ISDN PRI D channel section in the *Implementation* manuals for G3rV2 and G3iV2. In general, NCA-TSCs in G3V2 systems work as follows:

- If the G3V2 is originating an NCA-TSC, the TSC is sent out the D channel of the signaling group form in which it is administered. No routing is performed based on the called party digits.
- An incoming NCA-TSC is treated by the incoming call handling table of the trunk group indicated in the `Trunk Group for NCA-TSC` field in the signaling group form.
- An incoming NCA-TSC that is to be tandemed to an outgoing NCA-TSC works as follows:
  - The incoming NCA-TSC is treated by the incoming call handling table as described above.
  - The resulting digits from the called party number are analyzed.
  - Route selection is performed just as if this were a B channel call and an outgoing trunk group is chosen (even though the NCA-TSC is not sent on a trunk group).
  - The D channel for the outgoing NCA-TSC is taken from the administration in the `NCA-TSC Signaling Group` field in the trunk group form for the chosen trunk group.

Temporary signaling connections are not supported in G3V2 unless the country protocol is **1** (U.S.) in the DS1 circuit pack form. In this case, TSCs can be used in connections to the public network in the U.S. or in private networks anywhere.

### Call by Call Service Selection in G2.2 Systems

The method commonly used for call-by-call trunk group administration in G2.2 is to use trunk type 41 for all call-by-call trunk groups. If you make sure your dial plan is consistent with this trunk type, this trunk type will work and it will also make it easy to migrate from non-ISDN trunks to ISDN trunks.

### Call by Call Service Selection in G3V2 Systems

To implement CBC on a trunk group, you must administer the `Group Type` field on the trunk group form as **isdn-pri** and the `Service Type` field as **cbc**. If **cbc** is assigned in the trunk group form, the `Usage Alloc` field is displayed. Setting this field to **y** causes two new screens to appear on pages three and four of the trunk group form. These forms are used to administer the usage allocation plan (UAP). The purpose of the UAP is to allow you to have control over the allocation of trunks to network services without incurring the costs charged by the network services for trunk/service re-arrangements. The UAP allows you to gain the functionality of static trunk groups and call-by-call trunk groups on call-by-call trunk groups.



#### NOTE:

The usage allocation plan applies only to calls having NSF values. It will not work for DID calls, for example.

The following list describes how the UAP works:

- If the UAP screens are left blank, a call routed to a CBC trunk group will use that trunk group if it is available, with no preference given to the particular service type of the call. In this case, the total number of members in the CBC trunk group constitutes the CBC pool.
- The CBC trunk group usage allocation form (page 3 of the trunk group form) is used to set the minimum and maximum number of channels (trunks or members) to be used for each service type for up to three different plans. For example, for Megacom calls made during the times plan 1 is in effect, you can set the `Min# Chan` and `Max# Chan` fields for all the service types in that plan such that a given usage for the Megacom calls can be specified.
  - The `Min# Chan` field specifies the minimum number of trunks that will always be available for a given service. The value in the `Min# Chan` field is equivalent to having that number of dedicated trunks for that service. For example, if the MEGACOM row has a **3** entered in the `Min# Chan` field, it is equivalent to having three static trunks dedicated to MEGACOM service.
  - The `Max# Chan` field specifies the maximum number of trunks that can be used by a specific service at any given time.
  - The pool of trunks available for call-by-call service selection, the CBC pool, is equivalent to the total number of trunks in the group minus the sum of all the `Min# Chans` in the group. For example, if Megacom has three trunks reserved in the `Min# Chan` field and three trunks are busy with Megacom calls, the next Megacom call will overflow to an available trunk in the CBC pool.
  - For any given service (any given row in the table) the `Max# Chan` minus the `Min# Chan` must be less than or equal to the total number of trunks in the group minus the sum of all the `Min# Chan` in the group.

To tune the usage allocation plan such that you achieve the desired trunk usage for each service, you can follow these steps:

1. Observe the hourly CBC traffic measurements for each service during the times the plan is in effect.
  2. If the performance is not what is desired (too many Megacom calls are being blocked, for example), adjust the `Min# Chan` and `Max # Chan` fields until the desired performance is achieved.
- Page four of the trunk group form is the CBC trunk group usage allocation plan assignment schedule. This form is used to schedule the (up to) three possible plans defined on page three of the form. Two possibilities, fixed and scheduled plans, exist as follows:
    - A fixed plan means that the plan administered on page three of the trunk group form corresponding to the number in the `Allocation Plan Number` field on this form is always in effect, i.e., does not

change depending on time of day or day of week. For example, if **y** is assigned in the `Fixed` field and if **1** is assigned in the `Allocation Plan Number` field, then usage allocation plan 1, administered in the first column on page three, will be in effect until the schedule is re-administered.

- A scheduled plan means that the plans defined on page three are in effect at the times assigned on page four. The `Scheduled` field on page four must be set to **y** for a scheduled plan. In this case, the plan assigned in a `Plan #` field stays in effect from the time-of-day and day-of-week indicated in the `Act Time` (activation time) field until the next occurrence of a different plan is encountered. The `Allocation Plan #` field is ignored if `Scheduled` is marked as **y**.
- You can change between fixed and scheduled plans without re-administering the screens because the translations are saved and the scheduling is ignored if a fixed plan is in effect.

## Incoming Call Handling Table in G3V2

The incoming call handling table administered on page two of the ISDN PRI trunk group form is used to treat incoming calls, on a per-call basis, in special ways. For example, you can insert digits, delete incoming digits, and infer access codes. Although not restricted to CBC trunk groups, the incoming call handling table has important applications with CBC when the G3V2 is connected to a public network switch using several different services. The table consists of up to 12 rows of seven columns per row. The first three columns constitute a key that together select which row or unique treatment should apply for an incoming call on the group. The remaining four columns specify the treatment to be provided for a call that matches the key.

The first column or field in the key is the `Service/Feature` field. If an incoming call is for a service listed in a row in the incoming call handling table, then that row may specify the treatment for the call, depending on the other two columns of the key. The `Called Len` field is used to continue the row determination. If the number of digits received with the incoming call match the number of digits in the `Called Len` field for calls to the matched service, then this row may apply. If no other row also contains a matching service and called length, then this row does apply. If another row does exist with the same service and number length, then the `Called Number` field will be used to continue the row determination. If the leading digits received with the incoming call match the digits specified in the `Called Number` field, then this row applies to the call. Therefore, with this table, a unique treatment can be given to any incoming call, even if these calls are to the same service or have the same number of digits. The remaining four fields specify the unique treatment for the call once the row has been determined. Together, the `Del` and `Insert` fields can be used to manipulate the incoming number that will be used to route the call. The `Per Call CPN/BN` field can be used to request CPN/BN only for specific calls incoming on the group from a

4ESS switch. The `Night Serv` field is used to have calls of different types routed to different night destinations when night service is in effect.

This table is especially suited to Megacom 800 service with the DNIS feature, allowing you to treat different 800 calls in special ways based on the dialed number. Another application is to add digits to an incoming SDN call such that the AAR access code is prepended to the incoming digits for routing through an ETN network.

 **NOTE:**

If the service type of the trunk group is tie or tandem, calls with any NSF on the trunk group will be allowed to complete, whether the incoming call handling table is administered or not. For example, if the service type is tandem and the incoming call handling table is blank, any SDN, Megacom, etc., calls will complete. Thus, the incoming digits must be the expected digits for routing purposes. For these calls to receive special treatment still requires administering the incoming call handling table, however.

Also, even though calls on trunk groups of tie and tandem are tandemed, the NSFs are not tandemed — the NSF is always determined by the routing pattern administration.

## System Administration

# 6

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The two previous chapters describe how the DEFINITY systems implement DS1 and CEPT1 capabilities for narrowband switching that are defined in external standards, such as ISDN PRI specifications. To implement these standard capabilities on DEFINITY systems, however, requires additional system administration. For example, trunks must be added to trunk groups and routes must be chosen for calls over digital trunks. This chapter describes the system administration required to implement DS1 and CEPT1 narrowband switching capabilities on DEFINITY systems.

For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, 555-230-230.

## G3V2 Administration

The following list shows the forms that must be administered for most digital trunk applications in G3iV2 systems. The general application (either bit oriented signaling or ISDN PRI signaling) appears in parentheses to the right of each entry. For example, the system parameters-customer options form is required only for ISDN PRI trunks.

1. System Parameters—Customer Options (ISDN PRI)
2. System Parameters—Features (ISDN PRI)
3. System Parameters—Maintenance (ISDN PRI)
4. Data Module (bit-oriented, ISDN PRI)
5. Dial Plan Record (bit-oriented, ISDN PRI)
6. DS-1 Circuit Pack (bit-oriented, ISDN PRI)
7. Signaling Group (ISDN PRI)

8. Synchronization Plan (bit-oriented, ISDN PRI)
9. Communication Interface Links (ISDN PRI)
10. Communication Processor Channel Assignment (ISDN PRI)
11. Communication Interface Links. Enable the interface links. (ISDN PRI)
12. Trunk Group (bit-oriented, ISDN PRI)
13. Network Facilities (ISDN PRI)
14. Routing Pattern (bit-oriented, ISDN PRI)
15. CPN Prefix Table (ISDN PRI)
16. Hunt Group (ISDN PRI)
17. Terminating Extension Group (ISDN PRI)

The following list shows the forms that must be administered for most digital trunk applications in G3rV2:

1. System Parameters—Customer Options (ISDN PRI)
2. System Parameters—Features (ISDN PRI)
3. System Parameters—Maintenance (ISDN PRI)
4. Data Module (bit-oriented)
5. Dial Plan Record (bit-oriented, ISDN PRI)
6. DS-1 Circuit Pack (bit-oriented, ISDN PRI)
7. Signaling Group (ISDN PRI)
8. Synchronization Plan (bit-oriented, ISDN PRI)
9. Trunk Group (bit-oriented, ISDN PRI)
10. Network Facilities (ISDN PRI)
11. Routing Pattern (bit-oriented, ISDN PRI)
12. CPN Prefix Table (ISDN PRI)
13. Hunt Group (ISDN PRI)
14. Terminating Extension Group (ISDN PRI)

### **System Parameters—Customer Options Form**

The administration for this form is performed remotely by the Technical Support Center (TSC). It activates the optional features of the G3V2 systems.

The following list describes the DS1/CEPT1/ISDN PRI-related administration settings for the fields of this form:



ARS	ARS is required for ISDN PRI connections to public network switches.
ARS Partitioning	This field is factory-set to <b>y</b> if ARS is ordered.
ISDN-PRI	<b>y</b> here turns on ISDN PRI.
Wideband Switching	A <b>y</b> here enables wideband switching. For technical information on wideband switching in DEFINITY systems, refer to <i>AT&amp;T DEFINITY Wideband Technical Reference</i> , issue 1, 555-230-230.

### Feature-Related System Parameters Form Settings

The only ISDN PRI-related field in this form is the `DID/Tie/ISDN Intercept Treatment` field. You can optionally enter the extension of the recorded announcement you want to use for intercept treatment for invalid ISDN PRI calls. This field defaults to **0** to go to the attendant.

### Maintenance-Related System Parameters Form Settings

This form is primarily for use by maintenance personnel. The only ISDN PRI-specific field in this form is the `ISDN Test Call Extension` field. You should enter the number that the far end should call when it performs an ISDN test. At present, it is not possible for public network switches to call this number. In these cases the only way to perform this test is to have a far-end endpoint call this extension. This is possible if you are using ACCUNET Switched Digital Services or SDN to access the far end, for example.

### Data Module Form Settings

Any data endpoints using DCP data modules (MPDMs) for calls routed to ISDN PRI trunk groups must have the `ITC` field administered. This field can be either **restricted** or **unrestricted**. The setting here is compared with the ITC on the trunk group preference to determine if the call can use that trunk group.

**NOTE:**

This form only applies to G3iV2 systems.

In addition to any external data modules used to make calls, you must also administer a special type of data module called the processor interface data module. The G3iV2 interface to ISDN PRI requires a synchronous/asynchronous processor interface circuit pack (TN765). Each TN765 has four ports (links) for supporting BX.25 and/or ISDN applications. Up to two TN765 (8 links) are possible in a multiple carrier cabinet or one (4 links) in a single carrier cabinet. The TN765 has data modules (PDMs) integrated into its ports. These processor

interface data modules must have extensions assigned to them just as if they were external MPDMs.

This form is used to administer these extensions.

The following list describes the administration settings for this form:

Data Extension	You must assign a data module extension to the physical channel to be used for the ISDN PRI link. Any valid extension can be used here. Use the system command <b>add data-module extension</b> .
Type	Enter <b>procr-inf</b> .
Physical Channel	Enter the physical channel number in the range 01 - 08, corresponding to the ports on the PI boards to which you assigned the data extension.
Name	This field is optional. You should enter something indicating what is on the far end of this link.

## DS1 Circuit Pack Form Settings

The following list describes the administration settings for this form.

Location	Display-only. This is the slot location of the DS1/CEPT1 circuit pack.
Name	Enter a name or description, up to 15 characters, to describe the DS1/CEPT1 board. A common convention is to use the far-end destination (SDN-1, for example).
Bit Rate	G3V2 only  <i>Values:</i> 1.544 (default) 2.048  <i>Reference:</i> Section <a href="#">"Bit Rate"</a> in <a href="#">Chapter 4, "Physical Layer"</a> .  If the board code is a TN722, TN722B or a TN767 this field is display-only with a value of 1.544. If the board code is a TN464B this field is display-only with a value of 2.048. If the board code is a TN464C or later release, this field is administrable for the value of 1.544 or 2.048 with a default of 1.544. If 2.048 is chosen, the Framing Mode, Line Compensation and DMI-BOS fields will disappear. In 2.048 the Framing Mode will be multi-framing and will not be administrable. The Line Compensation and DMI-BOS fields are not applicable.

## Line Coding

*Values:*

b8zs  
hdb3 (G3V2 only)  
none (G3V2 only)  
zcs (default)

*Reference:*

Section *Line Coding* in Chapter 4, *Physical Layer*.

For systems in the U.S., unless you have requested unrestricted facilities end-to-end, you should assign **zcs** here. If you are guaranteed unrestricted facilities end-to-end, then you should assign **b8zs** or **hdb3** here. ZCS causes an inverted D channel. B8ZS and HDB3 result in a non-inverted D channel. The value **none** can also be used to signify AMI-only line coding, which does not perform 1s density conformance.

Line  
Compensatio  
n*Values:*

A number from 1 to 5

*Reference:*

Section [“Line Compensation”](#) in [Chapter 4, “Physical Layer”](#).

Select one of the following compensation values corresponding to the length of the cable from the DS1/CEPT1 board to the CSU (or other DSX-1 cross connect).

Compensation	Length (feet)
1	000 - 133
2	133 - 266
3	266 - 399
4	399 - 533
5	533 - 655

This field does not appear if the bit rate is 2.048.

Framing  
Mode*Values:*

d4  
esf (default)

*Reference:*

Section [“Framing Format”](#) in [Chapter 4, “Physical Layer”](#).

Framing format must be the same on each end of the link. In the U.S., ESF is recommended with all ISDN PRI applications. You must specify ESF framing on the service order form. You must also option ESF on the CSU. The other possible option is D4 framing. If D4 framing is used, the CSU must also use D4-framing for that ISDN PRI interface. If the bit rate is 2.048 mbps, this field does not appear.

Signaling  
Mode*Values:*

CAS (G3V2 only)  
common-chan (default)  
isdn-ext (G3V2 only)  
isdn-pri  
robbed-bit

*Reference:*

Section [“Channel Structure and Signaling”](#) in [Chapter 4, “Physical Layer”](#).

Section [“Facility-Associated and Non-Facility Associated Signaling”](#) in [Chapter 5, “Layers 2 and 3”](#).

This parameter selects the signaling mode. It must match the signaling mode in use at the other end of the link. If there is a free choice at both ends, common-chan mode has the advantage that it is unrestricted, i.e., may be used for voice or 64-kb data, including AVD and DMI services, whereas robbed-bit mode is restricted to voice or 56 kbps data. On the other hand, robbed-bit mode does provide an extra trunk.

The choice of **CAS** selects a signaling mode consistent with Tie or CO trunk protocol (depending on Interconnect value) supported on the 2.048 mbps interface. This requires the circuit pack to be a TN464B or a TN464C or later release DS1/CEPT1 interface. This choice will cause the `Country Protocol`, `Interconnect` and `CRC` fields to appear.

The choice of the **common-chan** parameter selects a signaling mode used for 24 channel tie trunks.

The choice of **isdn-ext** requires the circuit pack be a TN767, TN464B or TN464C or later release DS1/CEPT1 interface. This choice will enable the board to use ISDN signaling with the D channel associated with a different DS1/CEPT1 interface.

The choice of the **isdn-pri** parameter along with `Bit Rate` set to **1.544** selects the 24 Channel ISDN interface. This requires that the circuit pack be a TN767 or TN464C or later release DS1/CEPT1 interface on G3iV2 or a TN464C or later on a G3rV2. This choice will enable ISDN-PRI signaling to be carried over the 24th channel of the DS1/CEPT1 interface, and will cause the `Country Protocol` and `Connect` fields to appear.

The choice of the **isdn-pri** parameter along with `Bit Rate` set to **2.048** selects the 32 Channel ISDN interface. This requires that the circuit pack be a TN464C or later release DS1/CEPT1 interface. This choice will enable ISDN-PRI signaling to be carried over the 16th channel of the interface, and will cause the `Country Protocol` and `Connect` fields to appear.

The choice of the **robbed-bit** parameter selects a signaling mode that is used for tie, CO or DID trunks, or for 56 kbps data trunks, such as for Accunet Switched 56 service.

Country  
Protocol

G3V2 only

*Values:*

A number from 1 to 17. Default is 1.

*Reference:*Section [“Country-Specific Layer 3 in G3V2”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field will only be displayed if the Signaling Mode is **isdn-pri**, **isdn-ext**, or **CAS**. This field is used for ISDN calls and for non-ISDN calls. For ISDN-PRI the field is used to specify the layer 3 PRI implementations applicable for the selected country. For non-ISDN it is used to indicate to the firmware what signaling protocol to use for CAS/CO calls. Following is the mapping of country protocol option to country:

Option	Country
1	United States
2	Australia
3	Japan
4	Italy
5	Netherlands
6	Singapore
7	Mexico
8	Belgium
9	Saudi Arabia
10	United Kingdom
11	Spain
12	France
13	Germany
14	Czechoslovakia
15	CIS (Russia)
16	Argentina
17	Greece

All entries are valid, though only some make sense. For example, if the user configures this DS1/CEPT1 for CAS/CO operation, only specific countries are logical choices for the country protocol. This is due to the limitation of which countries' specific DS1/CEPT1 boards are capable of operating in as CAS/CO configurations. Thus, you can enter any country protocol. If the country protocol value chosen is not one which is recognized for CAS/CO operation, the DS1/CEPT1 software will downlink the best choice for country protocol for CAS/CO operation. Each country will be mapped to a specific country for CAS/CO operation which best fits its operation. This mapping is chosen because it most closely follows CCITT specifications.

**Connect***Values:*

host  
network (default)  
pbx

*Reference:*

Section [“User-Network and Peer Protocols”](#) in [Chapter 5, “Layers 2 and 3”](#).

The `Connect` field will only appear if `isdn-pri` signaling is chosen. This field indicates what is on the far end of the PRI in order to control the layers 2 and 3 protocol properly (see the following description of the `Interface` field). The default value for this field is `network`. Network means that the trunks on this board are connected to a public network switch. Because the public network ISDN PRI protocol differs from country to country, a value of `network` here causes the country protocol field to appear in G3V2 systems, allowing you to choose the correct protocol. Similarly, if you administer `host`, it means that the system is connected to a computer of some kind. Again, the country protocol field appears in G3V2 systems. In G3V2 systems in the U.S. (country option 1) a value of `network` means the system is the user side in a user-network protocol and a value of `host` means the system is the network side in a user-network protocol. If the `Connect` value is `pbx`, it means the interface is connected to another PBX, which does not necessarily have any relationship to the country in which the system resides. Thus, instead of the country protocol field appearing, the field `Interface` appears. In G3V2 systems, this field allows you to choose a user-network protocol or a peer protocol for PBX-to-PBX connections. If a peer protocol is administered, the country protocol is not needed because a specific peer protocol (ECMA) has been implemented. If a user-network protocol is chosen, however, the country protocol is relevant and this field will appear in G3V2 systems.

## Interface

*Values:*

network  
peer-master (G3V2 only)  
peer-slave (G3V2 only)  
user (default)

*Reference:*

Section [“User-Network and Peer Protocols”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field will only appear if **pbx** is chosen as the `Connect` value. If you administer **user**, the system is user at both layers 2 and 3 in a user-network protocol for ISDN PRI calls on trunks on this interface. If you administer **network**, the system is network at layers 2 and 3 in a user-network protocol. If you administer **peer-master**, the system is a master at layer 2 in the ECMA peer protocol. If you administer **peer-slave**, the system is a slave a layer 2 in the ECMA peer protocol. When you administer user or network, the country protocol field appears in G3V2 systems. When you administer either peer-master or peer-slave, two fields, `peer protocol` and `side`, appear. The only choice, and thus the default, for the peer protocol is the value **ECMA**. Administering the system as side A means that the system is the A side at layer 3 in the ECMA peer protocol. Similarly, administering the system as side B means that it is side B at layer 3 in the ECMA peer protocol. For the purposes of handling glare, side A is roughly equivalent to the network side at layer 3 and side B roughly equivalent to the user side. Note that with the peer protocol the layer 2 administration is not linked to the layer 3 administration.

 **NOTE:**

When a G3V2 DS1/CEPT1 interface administered with a user-network protocol is connected to a G2.2 interface, the G3V2 interface must be administered as network and the G2.2 interface as user. This is because the user-network administration on the G2.2 is only implemented for layer 2. The layer 3 user/network relationship in G2.2 is user by default, which means the layer 3 user/network identification must be network in the G3V2, which in turn means the layer 2 user/network is also network, which in turn means the layer 2 user/network on the G2.2 must be user. If a G3V2 administered for the ECMA peer protocol is connected to a G2.2, you must make sure that if the G2.2 is administered as user at layer 2 then the G3V2 is administered as peer-master and conversely, as peer slave if the G2.2 is network. The following table shows the recommended ways to administer the user-network and peer protocols when a G2.2 is connected to a G3V2:



G2.2			G3V2		
Administered as	Layer 2	Layer 3	Administered as	Layer 2	Layer 3
user	user	user	network	network	network
user	user	user	peer-master/side A (G3V2 only)	master	side A
network	network	network	peer-slave/side B (G3V2 only)	slave	side B



**NOTE:**

When connecting two DEFINITY systems via ISDN PRI, you should use the user-network protocol and country option 1 if you want the extra features supported by option 1.

**Interconnect**

G3V2 only

*Values:*

CO

pbx (default)

This field will only appear if **CAS** signaling mode is administered. This parameter selects the trunk signaling mode that the board will support.

If **pbx** is selected, the board will operate as a digital tie trunk board; if **CO** is selected, the board will operate as a digital CO/DID trunk board.

**Interface  
 Companding**

G3V2 only

*Values:*

alaw

mulaw (default)

*Reference:*

Section [“Companding”](#) in [Chapter 4, “Physical Layer”](#).

This field will only be displayed if the DS1/CEPT1 interface is a TN464C or later release. This is the only DS1/CEPT1 board that allows selectable companding. All other DS1/CEPT1 boards operate in either alaw or mulaw. The TN722, TN722B, and TN767 are mulaw companding.

## CRC

G3V2 only

*Values:*

no (default)

yes

This field will only appear if **CAS** is chosen as the signaling mode. The **CRC** field indicates whether the cyclical redundancy check is to be done on the board.

## Idle Code

G3V2 only

*Values:*

An 8-digit binary number in the range 00000000 to 11111111.

Default is 11111111.

*Reference:*Section [“Idle Code”](#) in [Chapter 4, “Physical Layer”](#).

This field enables the customer to administer the idle code channel for all country protocols. The idle code bit pattern can be administered to be any pattern of 0s or 1s which is eight characters in length, with the least significant bit in the farthest right position. The expected value of the idle code for the far end is determined by the specific equipment located at the remote end. The following list shows a few examples of the idle code for specific countries; for countries that do not define the idle code, the default value of domestic idle code 11111111 will be used.

United States	11111111
Australia	11111111
Italy	01010100
Japan	at least 3 1's must be administered

The **Idle Code** field indicates the signal that is transmitted on all DS0 channels on a DS1 that have been administered to a channel group or as an access endpoint, but are not carrying an active connection.

DMI-BOS

*Values:*

no  
yes (default)

*Reference:*

Section [“Channel Structure and Signaling”](#) in [Chapter 4](#),  
[“Physical Layer”](#).

This field only appears when the `Bit Rate` is **1.544**. DMI-BOS **y** selects a mode of operation that is compatible with the DMI-BOS standard. Its use requires a TN722B or TN767 circuit pack and **common-chan** signaling mode. It also can use a TN464C or later release DS1/CEPT1 board, configured with `Bit Rate` set to **1.544** and `Signaling Mode` set to **common-chan**. If the `Signaling Mode` is anything other than **common-chan** then the field disappears.

Slip Detection

*Values:*

no (default)  
yes

If frame slip detection is enabled, then the slip-rate status of this circuit pack will be used by maintenance software along with the status of the other DS1/CEPT1 circuit packs to determine whether an excessive frame slip rate exists. Otherwise, the slip-rate status of this circuit pack will be ignored. The preferred choice is yes unless there is no precise, independent clock at the other end of the link, as in DMI service. In spite of this preference, the default value is no, because it is safe; an incorrect no will not harm a properly working system, but an incorrect yes might trigger unwanted maintenance reports and actions. A **y** should be assigned if this interface is a synchronization source.

Remote  
Looparound  
Test

*Values:*

no (default)  
yes

This parameter controls whether the maintenance software is permitted to execute a remote loop-around test. This test should not be permitted unless the physical configuration allows it, which requires that the DS1/CEPT1 link be connected to appropriate equipment, such as a DSX-1 cross-connect or a DMI interface.

## Synchronization Plan Form Settings

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Refer to the section [“Synchronization”](#) in [Chapter 4, “Physical Layer”](#) for further information on synchronizing the system.

Using the command **change synchronization**, enter the stratum, either 3 or 4, and the board locations of the primary and secondary timing sources. If you administer stratum 3, the location of the stratum 3 source is displayed. If you administer stratum 4, you can then administer the locations of the primary and secondary sources. The administered sources must be DS1/CEPT1 boards (not including the DS1C board). If the form is left blank, the timing source defaults to the tone/clock last used as a timing source.

In G3iV2, the list of valid timing sources appears on the form. In G3rV2, you must use the command **list timing-sources** for this list.

## Signaling Group Form Settings (G3V2 Systems Only)

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The signaling group form consists of two parts. The first part is page 1 of the form. The second part is called the administered NCA TSC assignment form and consists of pages 2 through 5.

### Signaling Group Form Settings — Page 1

The following list describes the administration settings for page 1 of the signaling group form. For further information on implementing signaling groups, see the section [“Facility-Associated and Non-Facility Associated Signaling”](#) in [Chapter 5, “Layers 2 and 3”](#).

Group Number	This display-only parameter reflects the signaling group number given in the command argument.
Associated Signaling	<i>Values:</i> no (NFAS) yes (FAS—default)  This field indicates this is either an NFAS (Non-Facility Associated Signaling) signaling group or a FAS (Facility Associated Signaling) signaling group. If FAS is selected, only the field <code>Primary D channel</code> will be shown on the screen. NFAS cannot be used on interfaces with a country protocol other than 1 (U.S.).
Primary D channel	<i>Values:</i> Port location of the D channel. The default is blank.  This parameter selects the primary D channel in the signaling group.

Secondary D channel *Values:*  
Port location of the backup D channel. The default is blank.

This field will only appear if this signaling group is an NFAS signaling group. It indicates the secondary D channel in this signaling group. NFAS is supported only in country option 1.

Trunk Group for Channel Selection Enter a valid ISDN PRI trunk group here. In countries where this is supported, if a SETUP message is received for this signaling group with the channel ID IE coded as **any channel**, or if a SETUP message is received with an empty or missing channel ID IE, a B channel from this trunk group will be selected.

Max number of NCA TSC



**NOTE:**

Administering this field, the next two fields, and pages 2 through 5, depend on the application for which temporary signaling connections are being used. For G3V2 systems, the only application for TSCs is in ISDN DCS. G3V2 systems will also tandem TSCs being used by some other application. For information on how to administer these fields for ISDN DCS, see the G3V2 implementation manuals. Only country option 1 supports TSCs.

*Values:*  
A number in the range 0 - 256. The default is 0.

*Reference:*  
Section [“Temporary Signaling Connections”](#) in [Chapter 5, “Layers 2 and 3”](#).

This is the maximum number of non-call-associated temporary signaling connections possible in this signaling group. This number is the sum of all the NCA-TSCs administered on pages 2 through 5 of this form plus the number of NCA-TSCs tandemed through the system on this signaling group.

Max number of CA TSC

*Values:*  
A number in the range 0-400.

*Reference:*  
Section [“Temporary Signaling Connections”](#) in [Chapter 5, “Layers 2 and 3”](#).

This is the maximum number of simultaneous call-associated temporary signaling connections that can exist in this signaling group. A typical value is the number of members in the signaling group.

Trunk Group for NCA TSC	<p><i>Values:</i> A valid trunk group number. The default is blank.</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This field designates one ISDN PRI trunk group whose incoming call handling table will be used to handle incoming NCA-TSCs on this signaling group.</p>
Trunk Brd	<p>Board location of the DS1/CEPT1 board having trunk group members in this signaling group. The default is blank.</p> <p>This field will only appear if this signaling group is an NFAS signaling group. It indicates all the trunk boards having members belonging to this signaling group.</p>
Interface ID	<p><i>Values:</i> Interface ID between 0-31. The default is blank.</p> <p>This field will only appear if this signaling group is an NFAS signaling group. It indicates the interface ID for the corresponding trunk board. In an NFAS Signaling Group, an Interface ID must be assigned to each DS1 facility so that it can be referenced by both ends.</p>

## Signaling Group Form Settings — Pages 2-5

Pages 2-5 of the signaling group form are for administering NCA-TSCs. Not all NCA-TSCs have to be administered. The ISDN DCS feature requires one NCA-TSC to be administered per logical DCS channel, however.

The following list describes the administration settings for pages 2-5 of the signaling group form. For further information on implementing signaling groups, see the section [“Facility-Associated and Non-Facility Associated Signaling”](#) in [Chapter 5, “Layers 2 and 3”](#).

Service/Feature	<p><i>Values:</i> Interface ID between 0-31. The default is blank.</p> <p>Any valid service type defined in the network facilities form.</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This field indicates the service type of all the administered NCA-TSCs on this signaling group. This service type along with the trunk group for NCA-TSC field from page 1 determines which row of the incoming call handling table to apply to the NCA-TSC.</p>
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As Needed Inactivity Timeout (min)	<p><i>Values:</i> A number in the range 10-90.</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This setting represents the number of minutes a CA-TSC administered as-needed in the establish field can be inactive before being removed from service.</p>
TSC Index	<p>Display only</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This column shows all the administered NCA-TSCs that have been assigned. For the ISDN DCS application, each administered NCA-TSC represents a logical channel connecting two DCS systems. This logical channel is analogous to the BX.25 logical channel in traditional DCS.</p>
Local Ext	<p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This field assigns an extension to the administered TSC in the first column. This must be a unique extension.</p>
Enabled	<p><i>Values:</i> y or n.</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>A <b>y</b> enables the NCA-TSC. An <b>n</b> disables it.</p>
Establish	<p><i>Values:</i> permanent as-needed blank (default)</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>A setting of <b>permanent</b> here means that the administered NCA-TSC can be established at will by either end of the connection and once established does not time out. A setting of <b>as-needed</b> means that the NCA-TSC is established by either end automatically the first time it is needed.</p>

Dest. Digits	<p><i>Values:</i> Up to 15 digits, including digits 0-9 and +, *, and #</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>These digits are used to populate the called party number IE in the NCA TSC, though no digit manipulation or routing is performed on these digits. The NCA TSC is sent out the D channel of this signaling group without routing.</p>
Appl.	<p><i>Values:</i> dcs audix gateway blank (default)</p> <p><i>Reference:</i> Section <a href="#">“Temporary Signaling Connections”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This field specifies the application for which the NCA-TSC is being used. The dcs entry is for ISDN DCS. The audix entry is for ISDN DCS AUDIX. The gateway entry is used when the administered NCA-TSC is used as one end in the gateway channel connecting to a BX.25 link. If gateway is entered, the ISDN TSC gateway channel assignments form must be administered.</p>
Adjunct Name	Enter the name of the AUDIX machine as it appears on the adjunct names form if the application is audix.
Machine ID	<p><i>Values:</i> 1-63 for DCS 1-99 for AUDIX</p> <p>This number is the node number of the DCS PBX or the AUDIX connected to the administered NCA-TSC.</p>

## Communication Interface Links Form Settings



### NOTE:

This form applies only to G3iV2.

The following list describes the administration settings for the ISDN PRI-specific fields in this administration form:



Enable	You will not be allowed to enable any links until all other fields in this form and all fields in the processor channel assignment form have been administered. After administering these other fields, come back to this form. Enter a <b>y</b> next to the link corresponding to the physical channel number assigned in the processor data module form to enable that link.
Est Conn	For ISDN PRI links, the correct entry is always <b>y</b> .
PI Ext	This is a display-only field. It should display the extension of the processor interface data module assigned in the processor interface data module form.
Prot	This field is used to set either ISDN PRI or BX.25 protocol. In this case, since ISDN PRI is being used, enter <b>isdn</b> .
Destination	In the <code>brd</code> field, enter the board address, e.g., 1C19, of the DS1/CEPT1 board corresponding to the link. The DS1/CEPT1 board must have previously been administered as using ISDN signaling in the DS1 circuit pack form. This address can only appear once in this form.
DTE/DCE	Leave this field blank. It only applies to links using BX.25 signaling.
Identification	Enter a one to fifteen character name for the link identifying the far-end destination. This field is used only for identification and can be left blank.

## Communication Processor Channel Assignment Form Settings

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### NOTE:

This form only applies to G3iV2 systems.

This form assigns processor channels to interface links. For ISDN-PRI, one processor channel per interface link is allowed. This administration is used by the system software to identify the link as an ISDN application, rather than an X.25 application. The following list describes the administration settings for the ISDN PRI-specific fields in this administration form:

Proc Chan	This field is display only and identifies the processor channel for which you are administering a link.
Appl	This is the application type that connects to this processor channel. Enter <b>isdn</b> here.
Interface Link	Enter an interface link number assigned in the interface links form. For example, if links 2 and 4 were assigned to ISDN protocol in the interface links form, then links 2 and 4 should be assigned to processor channels in this form.

Interface Channel	This field does not apply to ISDN processor channels and must be left blank.
Priority	The ISDN application always uses high (h) priority.
Remote Proc Chan	This field does not apply to ISDN processor channels and must be left blank.
Machine-Id	This field does not apply to ISDN. Leave it blank.

## Communication Interface Links Form — Enable



### NOTE:

This form only applies to G3iV2 systems.

After the processor channel assignments have been completed, you must go back to the interface links form and enter **y** in the `Enable` fields. Doing this establishes a connection between the D channel on the DS1/CEPT1 board and the administered port on the PI board. Layer 2 (LAPD) of the D channel is then terminated by the PI board.

## Trunk Group Form Settings

Refer to the *Implementation* manuals for all the various parameters in the trunk group forms. This section deals with the administration relevant to the fact that the trunk groups are composed of members from DS1/CEPT1 boards.

Trunk groups are classified by their group types, as follows:

- Access
- APLT
- CO
- CPE
- DID
- DMI-BOS
- FX
- RLT
- Tandem
- Tie
- WATS
- ISDN PRI

Trunk groups composed of members from DS1/CEPT1 boards can be of any of these group types. Except for the DMI-BOS and the ISDN PRI group types, the

fact that the trunks are digital instead of analog makes little difference in the administration. Also, all the group types except for ISDN PRI are some specific kind of application. ISDN PRI group types, on the other hand, are flexible and can function as any of these other group types. Thus, it makes sense to divide trunk group administration into administration of bit-oriented signaling trunk groups and ISDN PRI trunk groups.

## Bit-Oriented Signaling Trunk Group Administration

The DS1 and CEPT1 aspects of trunk group administration for bit-oriented signaling depend on the application for the trunk group. See [Appendix B, "Digital Trunk Administration Summary for U.S. Applications"](#), for a guide to the correct group type, trunk type, and comm type parameters for trunk groups using bit-oriented signaling given specific bearer capabilities and applications in the U.S. For explanations of all the fields in all the trunk group forms, see the implementation manuals for G3V2 systems and the administration manuals for G2.2 systems.

## ISDN PRI Trunk Group Administration

This form is used to administer trunk groups having the group type **isdn-pri**. When connected to a public network switch, such as a 4ESS, using several network services, such as MEGACOM service, MEGACOM 800 service and ACCUNET Switched Digital Services, it is advantageous to administer the trunk groups as call-by-call trunk groups. If you do this, you have the option of also administering the usage allocation plan, which further refines the capabilities of call-by-call service selection. Thus, the trunk group administration screens consist of up to 11 pages, as follows:

- Page 1—trunk group parameters
- Page 2—trunk group features, including the incoming call handling table
- Page 3—trunk group usage allocation plan
- Page 4—cbc trunk group usage allocation plan assignment schedule
- Pages 5 on—group member assignments
- Wideband Support Options

Pages 3 and 4 are only displayed if cbc is the service type and if the `Usage Alloc` field is `y`.

See [Appendix B, "Digital Trunk Administration Summary for U.S. Applications"](#), for a guide to the correct group type, trunk type, and service type parameters for trunk groups using ISDN PRI signaling given specific bearer capabilities and applications. For explanations of all the fields in all the trunk group forms, see the *Implementation* manuals for G3iV2 and G3rV2.

## Page 1 — Trunk Group Form

The following list explains the administration for the fields having implications for ISDN PRI trunk groups:

Group Number	This field displays the ISDN PRI trunk group number.
Group Type	Enter <b>isdn-pri</b> here.
TAC	<i>Values:</i> A number from one to four digits in length  Enter the access code for this trunk group. This is needed for SMDR reports and in general for identification of the trunk group, whether or not the trunk can be accessed by TAC.
Direction	<i>Values:</i> incoming outgoing two-way (default)  For applications with the AT&T public network, use two-way trunks for ACCUNET Switched Digital Services, SDN, and call-by-call trunk groups. Use one-way incoming for MEGACOM 800 service and incoming WATS service trunk groups and one-way outgoing for MEGACOM service and outgoing WATS service trunk groups.
Dial Access	<i>Values:</i> no yes  Although G3V2 systems support using TACs to access an ISDN trunk group, this practice is not recommended. Also, they should not be used when connected to a G2.2 because the G2.2 does not support dial access to ISDN trunk groups.

Service Type *Values:*  
**access, accunet, cbc, dmi-mos, i800, inwats, lds, mega800, megacom, multiquest, operator, outwats-bnd, public network, sddn, sdn, sub-operator, other, tandem, tie, wats-max-bnd** and any other services defined in the network facilities form.

*Reference:*

Section [“Network Specific Facilities IE in U.S.”](#) in [Chapter 5, “Layers 2 and 3”](#).

If you have more than one network service, you might want the efficiency gained by call-by-call service selection. If so, enter **cbc** in this field. If you want to put services on dedicated trunk groups, enter the service name here.

Note that international Megacom 800 service has a different NSF (i800) than Megacom 800 service (mega800). Thus, if you want to put these two services on the same trunk group, you must put them on a call by call trunk group. International Megacom service and Megacom service have the same NSF as do SDN and Global SDN.

Usage Alloc *Values:*  
no (default)  
yes

*Reference:*

Section [“Call by Call Service Selection in G2.2 Systems”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field only appears if the service type is **cbc**. It specifies whether the customer wishes to allocate the usage of the services provided by the trunk group. If this field is yes, then two additional pages appear, the CBC Service Type Usage Allocation Plans and the CBC Service Type Usage Allocation Plan Assignment Schedule.

Far End Test Line No *Values:*  
A valid station number up to 15 digits. The default is blank.

Calls to this number are used to test ISDN PRI B channels. This number must be the real number of far-end test board because calls to this number do not undergo any routing, such as through ten-digit-to-seven digit conversion or subnet trunking. Thus, this number must be the actual public network number of the far-end test board. This test cannot be done to the public network switch. It can only be performed to a far-end endpoint. The far end must be able to loop the call back.

Test Call ITC	<p>G3V2-only</p> <p><i>Values:</i> restricted unrestricted</p> <p><i>Reference:</i> Sections <a href="#">“Bearer Capability IE”</a> and <a href="#">“Low Layer Compatibility IE”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>Enter either restricted or unrestricted depending on the nature of the facilities over which the test call will be sent. Since the test call is not routed via networking software, the call will not be blocked if an ITC incompatible with the facility is administered.</p>
Test Call BCC	<p>G3V2-only</p> <p><i>Values:</i> A BCC value in the range 0-4 as follows: 0 = voice 1 = mode 1 2 = mode 2 3 = mode 3 4 = mode 0 (default)</p> <p><i>Reference:</i> Sections <a href="#">“Bearer Capability IE”</a> and <a href="#">“Low Layer Compatibility IE”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>The BCC value entered here will be used to populate the bearer capability IE and the low layer compatibility IE in the SETUP message for the test call. Since the test call is not routed via networking software, the call will not be blocked for any BCC value.</p>
Test Call Service	<p>G3V2-only</p> <p><i>Values:</i> Any valid service type that appears on the network facilities form.</p> <p><i>Reference:</i> Section <a href="#">“Network Specific Facilities IE in U.S.”</a> in <a href="#">Chapter 5, “Layers 2 and 3”</a>.</p> <p>This field populates the network specific facilities IE for the test call. Since the test call is not routed via networking software, the call will not be routed based on the service type.</p>

Codeset to  
 Send Display

*Values:*  
 0  
 6 (default)  
 7

*Reference:*  
 Section [“User-to-User Information Signaling”](#) in [Chapter 5, “Layers 2 and 3”](#).

When connected to the 4ESS, 5ESS, Generic 2 or Generic 1, the display information element should be sent in codeset 6. Only when a System 85 R2V4 is present in the network should it be sent in codeset 7. In some countries, this IE is sent in codeset 0.

Codeset to  
 Send TCM/  
 Lookahead

This field applies to G3V2 only.  
*Values:*  
 6 (default)  
 7

*Reference:*  
 Section [“User-to-User Information Signaling”](#) in [Chapter 5, “Layers 2 and 3”](#).

When connected to the 4ESS, 5ESS, Generic 2 or Generic 1, the display and TCM information elements should be sent in codeset 6. Only when a System 85 R2V4 is present in the network should they be sent in codeset 7.

Max  
 Message  
 Size To Send

*Values:*  
 260 (default)  
 256  
 244  
 128

The ISDN PRI specification allows messages up to 260 bytes in length. Some products, such as System 85 R2V4, can receive messages of no more than 128 bytes. You should administer this field according to the capabilities of the switch at the far end of the trunk group. In most cases, **260** is correct. The following table indicates the message size expected in several non-DEFINITY AT&T products.

Product	Message Length (octets) Received
4ESS (4E11)	256
4ESS (4E13)	256
4ESS (4E14)	256
5ESS (5E4)	244

Product	Message Length (octets) Received
5ESS (5E5)	244
5ESS (5E6)	244
System 75 (all products)	260
System 85 (R2V4)	128
System 85 (R2V5)	260
System 85 (R2V6)	260

Overlap  
 Receiving

This field only applies to G3V2.

*Values:*  
 no (default)  
 yes

*Reference:*  
 Section [“Digit Receiving”](#) in [Chapter 5, “Layers 2 and 3”](#).

Non DEFINITY switches might use overlap sending to send the digits in more than one IE. If connected to one of these switches, administer this field as **yes**.

Trunk Hunt  
 Direction

This field applies to G3V2 only.

*Values:*  
 ascend  
 descend  
 cyclical (default)

The system will search for an available trunk starting with the highest numbered member and proceeding to the lowest numbered if **descend** is administered and vice versa if **ascend** is administered. If cyclical is administered, the system searches for trunks in a circular algorithm in the order in which the trunks were added to the trunk group.

## Page 2—Trunk Group Form

This page is composed of two parts, the trunk features and the incoming call handling table. The following list describes the administration settings for the ISDN PRI-specific fields in the trunk features portion of this administration:



Wideband Support This field appears only if wideband support is administered in the system parameters-customer options form. For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230.

NCA-TSC Signaling Group *Values:*  
A valid signaling group in the range 1-8 or blank. Blank is the default.

*Reference:*  
Section [“Temporary Signaling Connections”](#) in [Chapter 5, “Layers 2 and 3”](#).  
This administration is used for an outgoing NCA-TSC that has been tandemed through the system. When an NCA-TSC is tandemed, the called party number digits from the incoming NCA-TSC are analyzed and an outgoing trunk group is chosen. The NCA-TSC will be sent on the D channel of the signaling group administered in this field of the chosen trunk group. If this field is left blank, the NCA-TSC will be sent on the D channel of a signaling group on the group member assignments form.

Send CPN *Values:*  
no (default)  
yes  
*Reference:*  
Sections [“Calling Party Number IE”](#), [“Connected Number IE”](#), and [“Network Specific Facilities IE in U.S.”](#) in [Chapter 5, “Layers 2 and 3”](#).

Assign a **y** here if you want the calling party's station number and/or connected party's number sent to the far end.

Send Name *Values:*  
no (default)  
yes

*Reference:*  
Section [“Display IE”](#) in [Chapter 5, “Layers 2 and 3”](#).

Assign a **y** here if you want the calling party name and/or connected party name to be sent to the far end.

DCS  
 Signaling

G3V2-only

Values:  
 bx.25 (default)  
 d-chan

If this trunk group is used to carry DCS calls, its signaling channel uses either BX.25 signaling (traditional DCS) or signaling carried over the ISDN PRI D channel. If this field is not administered correctly, e.g., it is administered for D channel signaling but is administered for BX.25 signaling in the DCS administration, the call will complete but without transparency of DCS features.

The following list describes the administration settings for the ISDN PRI-specific fields in the incoming call handling table portion of this administration:

The incoming call handling table, which administers incoming call handling and digit manipulation for ISDN PRI trunk groups, appears for all service types under the `isdn-pri` trunk group. For a CBC service type, incoming call handling and digit manipulation are handled on a per service basis by the table that appears on page 2 of the trunk group form when the group type is **isdn-pri**. For all other service types, the service type on the trunk group form and all the entries in the `Service/Feature` field of the table name must match. The other columns of the table work the same, as described below, whether the service/feature is `cbc` or `dedicated`.

Following is an example of this form:

Service/ Feature	Called Len	Called Number	Del	Insert	Per Call CPN/BN	Night Serv.
accunet	4	5008	4	5199		
accunet	4	5009	4	5199		
accunet	4	501	4	5199		
accunet	4	502	4	5199		
mega800	4	5119	4	2243		1000
mega800	4	512	3	224		attd

The table consists of up to 12 rows of seven fields per row. The first three fields of a row, `Service/Feature`, `Called Len`, and `Called Number`, constitute a key identifying incoming calls of a certain type. The last four fields are used to treat those types of calls in unique ways. For example, in the screen shown above, calls are treated in the following ways:

- Incoming ACCUNET Switched Digital Services calls to extensions 5008, 5009, and 5010-5029 will all be routed to extension 5199. This extension might, for example, be the extension of a hunt group containing data modules as endpoints.
- All MEGACOM 800 service calls to extension 5119 will be routed to extension 2243, or extension 1000 during night service hours.
- All MEGACOM 800 service calls to extensions 5120-5129 will be routed to 2240-2249 respectively, or to the attendant during night service hours. Extensions 5120-5129 might, for example, be the delivered DNIS numbers.

Note that the `Night Serv` field, if other than blank, overrides the `Night Service` field on page 1 of the trunk group form, but can be overridden by the `Night` field on page 5 of the form (group member assignments form).

The following list further describes the settings for this administration form. For further information on implementing this form, see the section [“Call by Call Service Selection in G3V2 Systems”](#) in [Chapter 5, “Layers 2 and 3”](#).

Service/ Feature	<p><i>Values:</i>  <b>access, accunet, cbc, dmi-mos, i800, inwats, lds, mega800, megacom, multiquest, operator, other, outwats-bnd, public network, sddn, sdn, sub-operator, other, tandem, tie, wats-max-bnd</b> and any other services defined in the network facilities. The default is blank.</p>
---------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

If the service type of the trunk group is not **cbc**, every entry in this column must be the same as the service type on page 1 of the trunk group form.

If the service type on page 1 of the trunk group form is **cbc**, the following service types are not valid in the incoming call handling table: **access, dmi-mos, public-ntwrk, sddn, tandem, tie**. Use the value **other** for treatment of all calls using services not specified in the table.

Called Len	<p><i>Values:</i>                  A number between 1 and 16 or blank. The default is blank.</p> <p>Enter the number of incoming digits expected. In the sample screen, the 4ESS is delivering three and four-digit station numbers. This field specifies the number of digits contained in the Called Party Number Information Element (IE). The number of digits contained in the Called Party Number IE must exactly match the number of digits specified in this field.</p>
------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Called Number	<p><i>Values:</i> A number from 1 to 16 digits in length. Default is blank.</p> <p>This field allows you to specify the leading digits on incoming calls that you want to match. The digits specified in this field must exactly match the leading digits contained in the Called Party Number IE of an incoming call for this row of the Incoming Call Handling Treatment table to be chosen for the call. If this field has been administered, the corresponding <code>Called Len</code> field must also be administered. Again, a blank matches any leading digits.</p>
Del	<p><i>Values:</i> A number between 1 and 16. all blank (default)</p> <p>Enter the number of leading digits you want deleted from the called party number. This field combined with the next field allows you to specially treat calls that match.</p> <p>You can elect to route all calls of a particular type to a single destination by administering the <code>Del</code> field to delete incoming digits and then administering the <code>Insert</code> field to insert the desired extension.</p>
Insert	<p><i>Values:</i> A string of up to 16 characters (0-9, *, or #) or blank. Blank is the default.</p> <p>Enter the digits to be inserted in this field. The inserted digits are prepended to the digits remaining after digit deletion, if any. The call is routed based on the new number.</p>

Per Call  
CPN/BN

*Values:*  
bn-only  
bn-pref  
none  
cpn-only  
cpn-pref  
blank (default)

This field should not be filled in unless you have provisioned the request option from the 4ESS. This option says that CPN/BN will be delivered only if the G3V2 requests it.

For MEGACOM 800 service and incoming WATS calls, only BN is available. If you want BN, enter **bn-pref**.

For ACCUNET Switched Digital Services and SDN calls incoming from an endpoint with ISDN PRI access, both CPN and BN are available.

If you want CPN only, enter **cpn-only**.

If you want CPN but will accept BN, enter **cpn-pref**.

If you want BN only, enter **bn-only**.

If you want BN but will accept CPN, enter **bn-pref**.

For ACCUNET Switched Digital Services and SDN calls incoming from an endpoint with other than ISDN PRI access, only BN is available. If you want BN, enter **bn-pref**. If you enter **none** or leave this field blank, the G3V2 will not request the CPN/BN.

If you request CPN or BN system waits up to 4 seconds for the far end to respond to the request before it continues to process the call.

Night Serv

*Values:*  
a valid extension number  
attd  
blank (default)

You can enter an extension to which you want calls routed after hours. This field allows you to specify different night service destinations for different rows (types of calls) in the table. You can also enter **attd** for the attendant. A non-blank entry overrides the night destination field administered for the group on the first page of the form. This service/feature night service can be overridden by the *Night Service* field in the group member assignments page of the trunk group form.

## Page 3 — Trunk Group Form — Usage Allocation Plan

Page 3 of the trunk group form is the usage allocation plan for call by call trunk groups. Following is an example of this showing the ISDN PRI-specific fields when the G3V2 is connected to a 4ESS via ISDN PRI:

CBC Trunk Group Usage Allocation

Usage Allocation Plan 1			Usage Allocation Plan 2			Usage Allocation Plan 3		
Service/Feature	Min# Chan	Max# Chan	Service/Feature	Min# Chan	Max# Chan	Service/Feature	Min# Chan	Max# Chan
accunet	4	8	accunet	24	42			
megacom	12	30	megacom	2	8			
mega800	12	30	mega800	2	8			

For more details on interpreting the usage allocation plan, see the section [“Call by Call Service Selection in G3V2 Systems”](#) in [Chapter 5, “Layers 2 and 3”](#).

This sample screen shows two different usage allocation plans for calls on a call-by-call trunk group using three network services. Plan 1 gives priority to MEGACOM and MEGACOM 800 services. Plan 2 gives priority to ACCUNET Switched Digital Services.

This example assumes two ISDN PRI interfaces compose this trunk group, with 46 trunk group members (23 per interface and one D channel per interface).

The following list describes the administration settings for the ISDN PRI-specific fields in this administration form:

**Service/Feature** *Values:*  
**accunet, i800, inwats, lds, mega800, megacom, operator, other, outwats-bnd, sdn, sub-operator, wats-max-bnd,** and any other services defined in the network facilities form. The default is blank.

Enter each service you want to use with the usage allocation plan, one per row, for each plan. Use the value **other** for usage allocation of all calls using services not specified in the table. In the sample screen, only two plans are administered.

**Min# Chan** *Values:*  
 For G3rV2, a number between 0 and 255  
 For G3iV2, a number between 0 and 99  
 blank (default)

For each service entry, enter the minimum number of channels allocated for that service. The sum of all the minimums in a given plan cannot add up to more than the total number of channels (members) in the trunk group. In this example, 46 is the maximum.

Max# Chan Values:  
 For G3rV2, a number from 1 to 255.  
 For G3iV2, a number from 1 to 99.

Enter the maximum number of channels allocated for that service. The sum of the maximums for a given plan can add up to more than the number of channels (members) in the trunk group but the maximum value for any entry is limited to the maximum number of trunk group members. Also, for any row in the table (service) the maximum minus the minimum must be less than or equal to the total number of members in the group minus the sum of the minimums. In this example, for the MEGACOM and MEGACOM 800 rows in Plan 1, 30 minus 12 equals 46 minus 28 (the sum of all the minimums).

Notice that plan 2, which probably would be scheduled for after hours to do bulk data transfers with ACCUNET SDS service, gives much higher priority to the ACCUNET calls than did plan 1.

### Page 4 Trunk Group Screen—Usage Allocation Plan Assignment Schedule

Following is an example of this screen showing the ISDN PRI-specific fields when the G3V2 is connected to the 4ESS via ISDN PRI:

CBC Trunk Group Usage Allocation Plan Assignment Schedule

Usage Method:

Fixed? n Allocation Plan Number: 1  
 Scheduled? y

Usage Allocation Plan Activation Schedule:

	Act Time	Plan #	Act Time	Plan #	Act Time	Plan #	Act Time	Plan #	Act Time	Plan #	Act Time	Plan #
Sun	00:00	2	:		:		:		:		:	
Mon	07:00	1	19:00	2	:		:		:		:	
Tue	07:00	1	19:00	2	:		:		:		:	
Wed	07:00	1	19:00	2	:		:		:		:	
Thu	07:00	1	19:00	2	:		:		:		:	
Fri	07:00	1	19:00	2	:		:		:		:	
Sat	00:00	2	:		:		:		:		:	

In the example above, a scheduled plan is being used. Plan 1, as administered on the previous page of the trunk group form, is in effect from 7:00 A.M. to 7:00 P.M. Monday through Friday. Plan 2 is in effect at all other times.

The following list describes the administration settings for the ISDN PRI-specific fields in this administration form:

Fixed,  
Scheduled

*Values:*  
yes  
no (default)

Enter **y** in the `Fixed` field and **n** in the `Scheduled` field if you want a single plan to be in effect at all times. If you want different plans to be in effect depending on the time-of-day and/or day-of-week, enter **n** in the `Fixed` field and **y** in the `scheduled` field.

Allocation  
Plan Number

*Values:*  
A number from 1 to 3  
blank (default)

If a fixed plan is being used, enter the plan number you want in effect. This entry is ignored if scheduled plans are used.

Act Time,  
Plan #

1. Choose a day of the week where you wish to start scheduling plans.
2. Choose a plan you want to start on that day.
3. In that row, enter the time of day (00:00 - 23:59) you want the plan to start on that day.
4. Enter the plan number you want in effect starting at that time.
5. Decide when you want that plan to stop and another to start.
6. If you want it to stop on the same day, go to the next `Act Time` in that row and enter the time you want that plan to stop and another to start. You can have up to six starts and stops on a single day.
7. Skip to the next day of the week and do the same thing. You must have at least one entry for each day of the week.
8. If you want a plan to continue through another day, simply enter 00:00 and the same plan number on the day you want the plan to continue. In the example above, the plan starting at 7 P.M. on Friday (plan 2) is carried through Saturday and Sunday by entering 00:00 and 2.
9. Continue this routine until you have all times of the week filled with the desired plans.



## Wideband Support Options Page (G3V2-only)

This page appears if wideband support field is set to yes. This page is either page 3 or 5 depending on whether the usage allocation plan is administered. For technical information on wideband switching in DEFINITY systems, refer to *AT&T DEFINITY Wideband Technical Reference*, issue 1, 555-230-230. Following are the settings for this page of the form:

- |            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| H0         | The H0 field refers to the ISDN information transfer rate for 384 kbps data, which is composed of 6 B-channels. When a trunk group is administered to support H0, the trunk/hunt algorithm to satisfy a call requiring 384 kbps of bandwidth uses a fixed allocation scheme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| H11        | The H11 field refers to the ISDN information transfer rate for 1536 kbps data, which is composed of 24 B-channels. When a trunk group is administered to support H11, the trunk/hunt algorithm to satisfy a call requiring 1536 kbps of bandwidth uses a fixed allocation scheme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| H12        | The H12 field refers to the ISDN information transfer rate for 1920 kbps data, which is comprised of 30 B-channels. When a trunk group is administered to support H12, the trunk/hunt algorithm to satisfy a call requiring 1920 kbps of bandwidth uses a fixed allocation scheme.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| N X DS0    | Setting this field to <b>yes</b> indicates the user wants the <b>N x DS0</b> multirate service. If this is the case, the <code>Contiguous</code> field will appear to determine whether a floating or a flexible trunk allocation scheme is to be used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Contiguous | This field only appears if <code>N x DS0</code> is <b>yes</b> . It specifies whether to hunt contiguous <code>N x DS0</code> channels. The trunk/hunt algorithm to satisfy an <code>N x DS0</code> call is thus one of the following: <ul style="list-style-type: none"><li>— In the floating scheme (<code>Contiguous</code> is set to <b>yes</b>), an <code>N x DS0</code> call will be placed on a contiguous group of B-channels large enough to satisfy the requested bandwidth without any constraint being put on the starting channel (i.e., no fixed starting point trunk).</li><li>— In the flexible scheme (<code>Contiguous</code> is set to <b>no</b>), an <code>N x DS0</code> call will be placed on any set of B-channels on the same facility as long as the requested bandwidth is satisfied. There are absolutely no constraints such as contiguity of B-channels or fixed starting points.</li></ul> |

## Pages 5 - on — Trunk Group Form — Group Member Assignment

Assigning members to trunk groups is the same for ISDN PRI trunks as for any other with the exception that in G3V2 systems, the signaling group must be entered for each member unless all members of a DS1/CEPT1 board are in the same signaling group. For each member in the trunk group, enter the signaling group for that member in the `Sig Grp` field. This information can be found by displaying the DS1 board administration for the port.

## Network Facilities Form

The purpose of the network facilities form is to define new services that are not already recognized by the system. AT&T customer support personnel are responsible for administering this form when necessary. Customer logins do not have the permissions needed to perform this administration. Displaying the network facilities form will display all services currently recognized by the system.

## Routing Patterns Form

This screen is used to build the routing patterns for calls using AAR or ARS. The patterns are selected using the HNPA, FNPA, RHNPA, and RNX tables. This form also implements bearer capability routing, called the Generalized Route Selection feature. Calls from data endpoints are routed to digital trunk groups based on several parameters, including the bearer capability class and the information transfer capability of the call. The ISDN PRI fields in this form are the `IXC`, `BCC Value`, `ITC`, and `Service/Feature`. DS1/CEPT1-specific fields only include the `BCC`. The `BCC` value fields can be used to route calls based on their data characteristics, either as administered (non-ISDN endpoints) or from the ISDN bearer capability and low-layer compatibility IEs. The subnet trunking feature is also present in this screen in the `No. Del Digits` and `Inserted Digits` fields.

The following list describes the DS1/CEPT1 and ISDN PRI-specific settings for this administration form.

IXC

*Values:*

A valid three digit interexchange carrier code or blank.

*Reference:*

Section [“Network Specific Facilities IE in U.S.”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field applies only to ISDN PRI trunk groups. Enter the code of the long distance carrier you want to carry calls in this pattern. 288 is the interexchange (long distance) carrier code for AT&T.

**NOTE:**

This field overrides the dialed IXC, if any.

BCC Value

*Values:*

A BCC value from 0 to 4 as follows:

BCC Value	Description
0	Voice or voice-grade data
1	Mode 1 data
2	Mode 2 data
3	Mode 3 data
4	Mode 0 data
W	Wideband (G3V2-only)

*Reference:*

Sections [“Bearer Capability IE”](#) and [“Low Layer Compatibility IE”](#) in [Chapter 5, “Layers 2 and 3”](#).

This is where Generalized Route Selection (GRS) is implemented.

If you want only certain types of calls to be routed to specific trunk groups, enter a **y** for those types of calls in the desired preference. Enter **n** for those types of calls you do not want routed over that trunk group. For example, if you want only mode 0 calls (64 kbps raw data) routed only on the trunk group in the second preference, you would enter a **y** in the second preference under BCC value 4 and **n** for every other field in the BCC 4 column. If another type of call tries to go out over that trunk group, it will skip to the next preference.

TSC

G3V2-only

*Values:*

yes

no

*Reference:*

Section [“Temporary Signaling Connections”](#) in [Chapter 5, “Layers 2 and 3”](#).

If this trunk group is to be used for tandeming or establishing TSCs, enter **yes**.

CA-TSC  
Request

G3V2-only

*Values:*

as-needed

at-setup

*Reference:*

Section [“Temporary Signaling Connections”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field appears only if the TSC field is **yes**. It specifies whether CA-TSCs on that trunk group will be set up with the call setup or upon request after the call is set up. For private network ISDN PRI trunk groups, enter **at-setup**. For public network ISDN PRI trunk groups, enter **as-needed**.

ITC

G3V2-only

*Values:*

res

unr

both

*Reference:*

Sections [“Bearer Capability IE”](#) and [“Low Layer Compatibility IE”](#) in [Chapter 5, “Layers 2 and 3”](#).

This field appears only if one or more of the fields in BCC is **y**. The ITC of the originating endpoint, which can be an ISDN or DCP data module, is compared to the value in this field to determine if the call can use this preference. Following are the rules for this:

- If the ITC of the originating endpoint is restricted and the ITC of the preference is restricted, the call is allowed.
- If the ITC of the originating endpoint is restricted and the ITC of the preference is unrestricted, the call is blocked with intercept.
- If the ITC of the originating endpoint is unrestricted and the ITC of the preference is restricted, the call is blocked with intercept.
- If the ITC of the originating endpoint is unrestricted and the ITC of the preference is unrestricted, the call is allowed.
- If the ITC of the preference is **both**, then the call is allowed regardless of ITC of the endpoint. In this case, a decision must be made as to how the ITC in the BC IE and the LLC IE is coded. This is done by using the value in the BCIE field. If this field is set to **ept**, the ITC from the endpoint is used. If set to **unr**, the ITC sent will be unrestricted.
- The ITC of the endpoint is administered in the data modules administration form for non-ISDN endpoints. For ISDN data modules, mode 2 calls are always restricted. Modes 0, 1, and 3 can be set to restricted or unrestricted with an option setting on the data module. Wideband data is always unrestricted.

BCIE

*Values:*

ept

unr

See the previous field for a description of this field.

Service/ Feature	<p><i>Values:</i> <b>accunet, i800, inwats, lds, mega800, megacom, operator, other, outwats-bnd, sdn, sub-operator, wats-max-bnd</b>, and any other services defined in the network facilities form. The default is blank.</p> <p>For ISDN PRI call by call trunk groups only, enter the outgoing network service for each preference. This information is used to populate the Network Specific Facilities information element in the ISDN PRI message.</p> <p>Note that the bearer capabilities assigned to the preference must match the bearer capabilities of the services. For example, Megacom service calls can be voice or voice-grade data. If a service does not match the bearer capability for that preference, the call will not complete.</p>
Band	<p><i>Values:</i> A number from 0 to 255</p> <p>If the service is <b>outwats-bnd</b>, this field appears. The WATS band for this call must be entered here to populate the MSF value for the call.</p>

## CPN Prefix Table Form Settings

This form allows you to decide which extensions will be used to send calling party and/or connected party number for ISDN PRI calls. The following list describes the administration settings for the ISDN PRI-specific fields in this administration form. For more information on implementing this form, see the sections [“Calling Party Number IE”](#) and [“Connected Number IE”](#) in [Chapter 5, “Layers 2 and 3”](#).

Ext Len	<p><i>Values:</i> Valid entries include a blank (to clear the field) and all values between 0 and 5, inclusive.</p> <p>This field and the next constitute a key that determines which row of the table to apply to a call. Enter the number of extension digits in the dial plan. For example, if you are on a five digit dial plan, enter <b>5</b>. You can also use this table if you have a mixed numbering plan.</p> <p>This value must correspond to the extension lengths allowed by the dial plan if the <code>Ext Code</code> entry is not <b>attd</b>. If the <code>Ext Code</code> entry is <b>attd</b>, the <code>Ext Len</code> must be <b>0</b>.</p>
---------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

Ext Code	<p><i>Values:</i> Extension digits up to 5 digits long. attd blank (default)</p> <p>This field allows groups of extensions to be administered. If 12 is entered here, for example, and 5 was administered in the first field, then all extensions of the form 12XXX will match this row. If 12 is administered here and 123 is also administered, then all numbers of the form 12XXX except for 123XX will match this row. For example, if you wanted all extensions of the form 12XXX except for 123XX to be sent with the CPN prefix 30346 and the 123XX extensions to be sent with the CPN prefix 30353, then you would administer both 12 and 123 in this field in two different rows.</p>
CPN Prefix	<p>For G3V2, enter any number of digits, up to 15, to form a CPN of any length, up to 15 digits.</p> <p>In G3V2, the sum of the <code>Ext Len</code> field and the number of digits in the <code>CPN Prefix</code> field can be a number equal to or greater than (but not less than) the number in the <code>Total CPN Length</code> field.</p>
Total CPN Length	<p>G3V2-only</p> <p><i>Values:</i> A number from 0 to 15 or blank. Blank is the default.</p> <p>Total CPN Length is the total number of digits to be included in the final CPN number. If the <code>Total CPN Length</code> is set to <b>0</b>, no digits will be sent - regardless of the values entered in the <code>Extension Code</code>, <code>Extension Length</code>, and <code>CPN Prefix</code> fields. The <code>Total CPN Length</code> field may be blank if and only if the <code>Extension Code</code> and <code>Extension Length</code> fields are also blank. If the sum of the <code>Ext Len</code> field and the <code>CPN Prefix</code> field is greater than the total CPN length, the CPN prefix is prepended to the least significant digits of the extensions to form the CPN.</p>

## Terminating Extension Group Form Settings

The only field on this screen applicable to ISDN PRI is the `ISDN Caller Display` field. You must enter either **grp-name** or **mbr-name** to specify whether the TEG group name or member name is sent to the originating user when a member of a TEG answers.

## Hunt Group Form Settings

---

The only field on this screen applicable to ISDN PRI is the `ISDN Caller Display` field. You must enter either **grp-name** or **mbr-name** to specify whether the hunt group name or member name is sent to the far end when a member of a hunt group answers.

## G2.2 Administration

---

The following sections describe the procedures that must be administered for various DS1 trunk capabilities in G2.2 systems. The sections occur in a suggested order of administration.

### NOTE:

Depending on whether the switch provides private network ISDN service or public network ISDN services, and whether the switch functions as an endpoint or as a tandem node, will determine whether other features should be administered before ISDN-PRI. Primarily, these other features include tandem tie trunk access, trunk-to-trunk calling, and miscellaneous trunk restrictions. When applicable, these features are administered with procedures 275, word 1, 110, 111, 102, and 010, word 3.

## Administration Summary

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- Procedure 275 Word 4: ISDN Service — Enable/Disable
- Procedure 276 Word 1: Other Feature Groups
- Procedure 250 Word 1: SC/DS1 — Carrier Designation
- Procedure 260 Word 1: DS1/DMI/ISDN-PRI Physical Interface
- Procedure 262 Word 1: Additional DMI-MOS/ISDN-PRI Facility Options
- Procedure 262 Word 2: ISDN-PRI D-Channel Backup
- Procedure 262 Word 3: ISDN-PRI Codeset Map Assignments
- Procedure 280 Word 1: ISDN-PRI Receive/Transmit Codeset Mapping
- Procedure 354 Word 3: NPA-NXX Digits Assignment
- Procedure 000 Word 3: Line-Side BCCOS Designator
- Procedure 000 Word 4: NPA-NXX Index Designator
- Procedure 210 Word 2: LDN, NPA, and NNX Attendant Partition Assignments
- Procedure 014 Word 1: BCCOS Routing Options
- Procedure 014 Word 2: BCCOS Data Options
- Procedure 010 Word 4: Line Side (B-Channel) ISDN Routing Options



- Procedure 100 Word 1: Trunk Group Type Signaling and Dial Access (ID) Code
- Procedure 100 Word 2: Trunk Group Data Translations
- Procedure 100 Word 3: ISDN Trunk Group Signaling Options
- Procedure 101 Word 1: ISDN Trunk Group, CDR, and Digital Loss Plan
- Procedure 101 Word 3: Prefix Digits
- Procedure 103 Word 1: Network Trunk Group Translations
- Procedure 116 Word 1: DS1/DMI/ISDN-PRI Trunk Assignments
- Procedure 012 Word 1: Name Database
- Procedure 012 Word 2: Name Database
- Procedure 012 Word 3: Name Database
- Procedure 107 Word 1: ISDN Trunk Verification by Terminal, Attendant, and ATMS
- Procedure 108 Word 1: ISDN Trunk Group TTL Number (Digits)
- Procedure 279 Word 1: Network Facilities Coding
- Procedure 322 Word 1: WCR Outgoing ISDN Feature Parameters
- Procedure 318 Word 1: ISDN Sending Index and Digit Sending Index
- Procedure 318 Word 2: Assigns a BCCOS to a Preference

### **Procedure 275 Word 4: ISDN Service — Enable/Disable**

---

Screen-based procedure 275 is used to translate the system COS assignments as well as several other miscellaneous services and features.

### **Field 14**

For Generic 2, field 14 must always be translated. Field encodes and their descriptions are:

- (Dash) required when ISDN is not provided. Current policy is to always ship ISDN-PRI software with the switch. However, the administration software still provides the option to assign this software as unprovided.
- 0** Must be translated when ISDN is provided but disabled.
- 1** Must be translated to enable ISDN service.

## Procedure 276 Word 1: Other Feature Groups

Use this procedure to turn on optional networking features such as AAR, DCS, SNC, Look-Ahead Interflow, and Integrated Telemarketing Gateway (ITG) or to see which of these features are turned on.

## Procedure 250 Word 1: SC/DS1 — Carrier Designation"

This procedure is used to assign the equipment carriers to a module and cabinet. Additionally, it is used to assign the type of carrier, the carrier port electrical number, and whether the carrier is equipped with a TN463 synchronization clock (SC).

DS1 circuit packs may only be installed within DS1 port carriers. Each Generic 2 that is equipped with one or more DS1s will also contain either a TN463 SC or a TN2131C. For single-module systems, the SC is located in the module control carrier along with the TN460 module clock. For multimodule systems, the SC is located in the TMS carrier.

### Fields 1-3

Identifies a module number, cabinet number, and physical carrier position. The appropriate encodes are determined based on whether the module is traditional or universal and the physical equipment location, refer to [Table 6-1](#).

### Field 4

Translates a particular type of carrier (such as DS1/MFAT, module control, or TMS) to the equipment location identified by fields 1-3.

For DS1/DMI/ISDN-PRI applications, field encodes and their descriptions are:

- |    |                              |
|----|------------------------------|
| 2  | Universal Module Control 0   |
| 3  | Universal Module Control 1   |
| 4  | TMS 0 Control                |
| 5  | TMS 0 Growth                 |
| 6  | Traditional Module Control 0 |
| 7  | Traditional Module Control 1 |
| 8  | TMS 1 Control                |
| 9  | TMS 1 Growth                 |
| 10 | Universal port               |
| 11 | DS1 port carrier             |

Depending on whether the purpose for translating this procedure is to assign the SC or to assign a DS1 port carrier will determine which encode to select.

### Fields 5-10

DS1/DMI/ISDN-PRI does not place any additional requirements on translating these fields.

### Field 11

Field encodes and their descriptions are:

- |   |                                                                                                                            |
|---|----------------------------------------------------------------------------------------------------------------------------|
| 0 | Translated for external synchronization, when the carrier (which is identified by fields 1-10) is not equipped with an SC. |
| 1 | When the carrier (module control or TMS) is equipped with an SC                                                            |



**NOTE:**

The network synchronization diagram should be available, and is required, to determine how to properly synchronize the switch.

### Fields 12-15

Not applicable for DS1/DMI/ISDN-PRI applications. Therefore, a dash (-) is appropriate.

## Procedure 260 Word 1: DS1/DMI/ISDN-PRI Physical Interface

---

Procedure 260 is required to administer each DS1. For traditional modules, the ANN11 circuit pack provides DS1/DMI-BOS services while the ANN35 provides DMI-MOS/ISDN-PRI services. For universal modules, the TN767 circuit pack provides DS1/DMI services while the TN767/TN555 pair provides ISDN-PRI services.

### Fields 1-4

Assigns the circuit pack to an equipment location. [Table 6-1](#) depicts the permitted ranges for these encodes.

**Table 6-1. Equipment Parameters and Permitted Translation Encodes**

Equipment Parameter	Traditional Module	Universal Module
Module Number	0-30	0-30
Cabinet Number	0-7	0
DS1 Carrier ID	0-3	c-e
Slot Numbers (Note 1)		
ISDN-PRI Trunks	5 and 18 (Note 2)	1-19 (Note 3)
Line+Trunk Mode	5 and 18 (Note 2)	1-19 (Note 4)
OPS Line-Only Mode	0,5,13, and 18	1-19 (Note 5)

**Notes:**

1. The circuit pack application type (Field 14) will to a large degree determine which slots may be used.
2. When a DS1/MFAT carrier is configured with two DS1s, physical slots 3, 8, 16, and 21 are available for other applications. If only one DS1 is configured, then six additional slots are available for other applications.
3. When the slot is used for ISDN-PRI trunk applications the adjacent right slot must be configured with the TN555 circuit pack, except in nonfacility associated signaling (NFAS) arrangements that have no D-channel on this DS1 link.
4. When used for a mixture of lines and trunks (two slots are required) the adjacent right slot must remain vacant.
5. When used for OPS line applications, there is no requirement to leave a vacant slot to the right. Actually, all 19 slots (1 through 19 consecutively) may be used to provide OPS. However, it is still recommended that the slot to the right remain vacant to accommodate future changes.

**Field 6**

Used for assigning the framing format. The choices are D4 and ESF.

The choice of framing format is totally dependent on the equipment connected to the interface (such as D4-channel bank, CDM, BCM32000, host computer, and other switches). Normally the format is not dependent on facilities used, but there could be some older digital radio equipment that only supports D4. The ESF format consists of a better framing algorithm and therefore provides more reliable error detection than D4.

## Field 7

If field 14 is defined as non-ISDN (**0**, **1**, or **2**) this field is equivalent to the Per-Channel Signaling and common channel signaling options used with System 85 R2V4. However, the terms have been changed to facility associated signaling (FAS) and NFAS.

If field 14 is defined as ISDN (**5**), this field is used to specify the method used to construct signaling bits for each DS0 B-channel. The 23B + 1D option is also called FAS. If this interface contains a D-channel (23B + 1D), if it is a DS1/DMI link, or if it is an ISDN-PRI link that transmits B-channel signaling information with that particular DS1 link, assign a **0** here.

If this facility contains all ISDN B-channels (24B), assign a **1** here. The 24B option is also called NFAS. It is required for those ISDN-PRI links that have their B-channel signaling information transmitted over a different ISDN-PRI link. For each ISDN-PRI facility using NFAS, that facility must be translated as part of a D-channel group in procedure 116, word 1. Each D-channel group number must be associated with a particular ISDN-PRI facility that transmits the signaling for all links within the group. The (23B + 1D) ISDN-PRI equipment location that provides this capability is called the *primary D-channel*. Reliability may be increased by administering an alternate (23B + 1D) ISDN-PRI equipment location as the backup D-channel (as administered with procedure 262, word 2).

## Field 8

Offers the choice of 24th-channel or RBS. The choice of signaling method used is dependent on the application. The DS1/DMI-BOS applications may be translated for either option. However, non-NFAS ISDN-PRI applications always require that 24th-channel signaling be selected. With NFAS, it is possible that no D-channel exists for this DS1 link.

24th-channel signaling multiplexes all signaling information for channels 1 through 23 into the 24th channel. This makes available the full 64K-bps bandwidth (of channels 1 through 23) for voice and/or digital data transmission.

## Field 9

Assigns the line coding format that will be used to forcibly ensure that the data meets T1-carrier ones-density requirement. Field encodes and their descriptions are:

Zero Code Suppression (ZCS)

Bipolar 8 Zero Code Suppression (B8ZS).

The ZCS line-coding format (restricted) scans each byte for the all-zeroes octet and, on detecting this bit sequence, substitutes a one for the zero in bit position 2. The ZCS format is the most common and is used widely. The ZCS format can be used (without any consideration of the communications protocol) to transmit

7-bit characters/data at rates up through 56K-bps via modems and multiplexers that do bit-stuffing. If the data communications protocol is based on the high-level data link (HDLC) protocol (that is, mode 2/3) and data is transmitted as inverted-HDLC, then the ZCS option can be used for data rates up through 64K-bps. The data modules (both DCP and BRI) use the DCP protocol and BRI protocol respectively. Both DCP and BRI are based on the null based DMI specification, and therefore meet these requirements.

Those DS1/T1 facilities that use RBS and are optioned for ZCS maintain the ones-density requirement by converting all-zero octets in the transmit PCM stream of each channel to a string of seven zeros and a one. This does not significantly affect voice and voiceband data since it is in analog (PCM) form. For DS1/T1 facilities that use 24th-channel signaling and are optioned for ZCS, the data communications protocol/communications equipment used must prevent the all-zeroes octet from occurring; otherwise, the ZCS method will forcibly alter the data (causing errors) to guarantee proper ones-density.

The B8ZS line-coding format (unrestricted) substitutes a unique code (bipolar violation code) for any eight consecutive zeros. This bipolar violation code is detected at the receiving end and converted back to the original string of eight zeros. The B8ZS encoding method permits data transmission at rates up through 64K-bps without consideration of the protocol clear channel transmission.

#### NOTE:

Several different types of network digital facilities may be linked together to complete the end-to-end connection. Typically, these will be multiplex-derived facilities. Usually, the multiplexers will contain a bipolar violation monitor and removal circuit that corrects all bipolar violations (alters B8ZS type data) and also produces an all ones if a loss of input signal occurs. This bipolar violation monitor and removal feature is currently an inherent part of the MX3, M13, MX2, and M1C multiplexers, as well as most vendor's multiplexers.

## Field 10

This option enables (1) or disable (0) collection of slip data to support excessive slip rate based on switching between the primary, secondary, or internal high-accuracy clocks. The decision to switch from one source to the other is normally based on an internal slip count calculation (software record). However, hardware events (such as primary link failures) may take precedence over any software controls.

Slips are caused by differences in clock frequencies. A slip results in the deletion or repetition of a single frame. Slips are not caused by noise on the line.

Those DS1/T1 spans that are used to provide the primary and secondary synchronization reference should be administered for slip enable (1). Since the switch software does this automatically, this task is not mandatory but is a good procedure to follow. Typically, those other DS1/T1 spans that are used for data applications and that are deemed important should also be administered for slip

enable. This excludes all T1-spans connecting channel banks, unless the channel bank is externally timed. Normally, those DS1/T1 spans that are used exclusively for voice and that are not assigned as the primary or secondary synchronization source should be administered for slip disable (**0**). The goal is to keep that reference on-line, which minimizes slips for all those DS1s for which slips can't be tolerated.

The digital switch always maintains a slip count record for each DS1. Slip counts are calculated on a 24-hour continuous interval. As a historical record, the slip counts for each DS1 are maintained for the last 24 consecutive intervals. The slip count is used to determine if a DS1-span is experiencing errors and, if so, the severity of the errors (type alarm).

If the primary facility uses 24th-channel signaling and if the secondary facility uses RBS, then the primary will always be on-line unless a hardware event forces a switch to the secondary. A software algorithm is used to select the facility (primary or secondary) that is on-line for the cases where:

1. Both primary and secondary facilities use the same type of signaling (either 24th-channel or RBS)
2. The primary uses robbed-bit and the secondary uses 24th-channel signaling

If as many as 50% of those spans that are administered for slip enable are experiencing slips (with respect to the primary), then a decision is made to switch to the secondary. On switching to the secondary, a software bit is set making the primary appear as though it has exceeded its maximum slip limit. At this point, the primary is not evaluated again for 1 hour.

At the end of the 1-hour interval, the slip count is analyzed. If the primary slip count is less than 2, then a switch back to the primary is made. Also, if the primary has a slip count of 44 or less and if the secondary and 50% of those DS1s that are enabled for slip enable have reached their maximum slip count of 88, then a switch back to the primary is made.

## Field 11

Offers the options external loop not available (**0**) or available (**1**).

The external loop available option should be selected only when demand diagnostic maintenance is done and then only after the interface has been busied out. This option is used with procedure 620, test 2, to extend the range of the test to include the network channel-terminating equipment (NCTE) and the connecting facility (any external equipment to the point of the DS1 loop around). The test requires that either the colocated or the distant NCTE be physically optioned for loopback mode.

The external loop available option should be used only for the duration of a test.

## Field 12

Specifies whether (1) or not (0) the associated T1-span is used as an incoming synchronization source to the switch. The network synchronization diagram should show those transmission facilities that are used for synchronization. Each switch permits a maximum of two interfaces (one primary and one secondary) to be translated here. However, there is no requirement to have both.

When a Generic 2 is the master timing server, neither primary or secondary is administered. Each Generic 2 that is equipped with a DS1 will also contain a TN463 synchronization clock synchronizer (SC). For single-module systems, the SC is located in the module control carrier along with the TN460 module clock. For multimodule systems, the SC is located in the TMS carrier. The SC should have previously been assigned in procedure 250.

## Field 13

Assigns whether a DS1 facility (translated in field 12) will be used as the primary or secondary synchronization source to the switch. Field encodes and their descriptions are:

- |   |                                                                   |
|---|-------------------------------------------------------------------|
| 0 | Assigns that the facility is not used as a synchronization source |
| 1 | Assigns that the facility is the primary synchronization source   |
| 2 | Assigns that the facility is the secondary synchronization source |

### NOTE:

The primary must be administered before the secondary. The secondary must be removed before the primary.

Traditional modules may be configured with the ANN11 and/or ANN35 circuit packs. Only the slot translated 1 (primary) and/or the slot translated 2 (secondary) must be configured with synchronization cables. These cables connect the backplane of the translated DS1 to the backplane of the TN463. The cables are identified as group 334 for intercabinet and group 361 for intracabinet applications. When traditional modules are translated, field 20 will display the number (code 99) which shows that the switch could not read information from the DS1 circuit pack.

Universal modules may be configured with the TN767 circuit pack. The intercabinet cable (group 503) is required to connect to the TN463 SC, which will always be located in the TMS cabinet. For universal modules, whenever this field is translated, field 20 displays a number which corresponds to:

1. Whether the circuit pack is used as a synchronization source
2. If it is a synchronization source, then which type
3. Which cable connector (cable 0 or cable 1) contains the circuit pack synchronization leads



**⇒ NOTE:**

A loop-timing problem can be created if synchronization sources are not administered correctly. The loop-timing problem exists as the result of an error where both switch endpoints (for the same T1-span) are administered as the primary. This causes the clock frequency to vary widely and can bring down the switch. Loop-timing problems can be avoided by following a correctly engineered network synchronization diagram.

**⇒ NOTE:**

Depending on the application type (encode) translated, there may be additional administration, slot, and port grouping restrictions.

## Field 14

Field encodes and their descriptions are:

- 0 Assigns that the DS1/DMI-BOS channels can be used for both trunks and lines (mixed); the latter is frequently called off-premises stations (OPS).

.IX "Off-premises--station (OPS)--channel assignments"

- 1 Assigns that the interface is used to provide DMI-BOS trunks.

The DMI-BOS trunk groups are defined using procedure 100, word 1 (encode 108 and/or 109). DMI-BOS applications use the switch's DS1 to provide a high-speed multiplexed data interface for connecting to compatible computers. The computers may be located on the same customer premises as the switch or many miles away. The DS1/T1-carrier facilities are used between the switch and remote computers.

The DMI-BOS application provides 23 data channels plus 1 signaling channel. Each data channel can be considered a 64K-bps clear-channel. However, permissible data rates depend on the trunk group translations selected in procedure 100, word 2.

24th-channel signaling is the only required service/facility option. All others (framing format and line coding format) are DMI application independent. However, the distant computer and all intermediate T1 transmission equipment must be compatible; refer to the caution regarding B8ZS line format and data communication protocols.

The ACCUNET switched digital service can be provided by setting up a trunk group with encode 109. However, a DS1 must be optioned for RBS (procedure 260 field 8). The only other administration requirement is that the trunk groups translation (field 3 of procedure 100, word 2) be enabled for 56K-bps encode one.

The trunk group used to provide ACCUNET switched digital service may contain as few as 1 or as many as 24 members. Therefore, the same DS1 may also be used to provide CO, FX, WATS, DID, and Remote Access trunks.

- 2 Assigns that the DS1 provides 24 lines. These are generally called off-premises stations (OPS).

When a DS1 facility is used exclusively for lines, it must be administered for RBS. Also, the facility cannot be used as a synchronization reference.

When a DS1 is administered for lines (OPS), it provides 24 channels that terminate in a remote D4-channel bank, CDM, or their equivalent.

Analog equipment location assignments are administered by procedure 000, word 1, with field 8 translated to a 2. The DS1/OPS channels are translated to equipment locations (individual extensions) with procedure 000, word 1, with field 8 translated to a 9, rather than with procedure 116 that was used for trunks.

- 5 Assigns that the DS1 is used to provide DMI-MOS or ISDN-PRI trunk facilities.

When encode 5 is administered, procedure 262 is automatically translated with standard default options. These default options should be rechecked later for consistency with the distant end (refer to procedure 262, word 1).

## Field 15

Some facilities require that the contents of the D-channel be inverted to guarantee that the minimum ones density be maintained (that is, ZCS line coding is used). This field shows whether the D-channel is inverted or not. Field encodes and their descriptions are:

- (Dash) not applicable or ZCS line coding is translated in field 9. The dash is appropriate for all applications of the ANN11 circuit pack. RBS does not use the 24th-channel to transmit signaling information. 24th-channel signaling via the BOS interface uses A and B bits for signaling and the channel structure is such that the ones-density is never violated.

- 0** Assigns that the signaling information, contents of the D-channel, is inverted.

Either 0 or 1 must be administered for ISDN-PRI. Recall that B8ZS is recommended for ISDN-PRI applications. However, not all transmission facilities will permit B8ZS on an end-to-end basis. Administration must be coordinated with the network facilities/distant end to ensure compatibility.

This field must be a dash – when ZCS line coding is selected with ISDN and for automatic inversion of the D-channel.

- 1** Assigns that the signaling information, contents of the D-channel, is not inverted. Option 1 (no inversion) is strongly recommended for use when B8ZS is administered in field 9.

When connected to a 4ESS, you must inform the 4ESS on the order form whether bits are or are not inverted.

## Field 16

Field encodes and their descriptions are:

- (Dash) DS1/DMI-BOS applications should be administered with a dash (–).

- 0** Indicates that DMI-MOS/ISDN-PRI applications use metallic cable facilities.

- 1** Indicates that DMI-MOS/ISDN-PRI applications use nonmetallic cable facilities.

Terminating fiber cable directly on the DS1/MFAT carrier or universal module port carrier is not currently supported. Therefore, this option is not applicable.

## Field 17

This field is added to bring G2.2 into compliance with EIA specification PIN-1429.

This EIA specification relates to bit-oriented-signaling (BOS); message-oriented-signaling (MOS) is defined by a CCITT specification.

Field encodes and their descriptions are:

- (Dash) not applicable  
The dash is appropriate for all applications of the ANN35 and TN767 circuit packs (both DMI-MOS and ISDN-PRI).
- 0 Appropriate for all applications of DS1/DMI-BOS except when connecting to a switch that uses the Canadian style of signaling.
- 1 Used when connecting to a DS1/DMI-BOS that uses the Canadian style signaling as specified in PN-1429.

## Field 18

Loop length refers to the total cable distance between the switch and the NCTE, CDM, BCM32000, DSX-1 cross-connect, and T1 office repeater. Traditional modules may contain the ANN11 and/or ANN35 circuit packs. Both circuit packs contain DIP switches for setting the compensation value. Therefore, software administration is not applicable and the – should be administered for traditional modules.

Universal modules may contain the TN767 circuit pack. Line compensation value be administered in software. [Table 6-2](#) identifies the appropriate administration encode for distance intervals of 133 feet up to a maximum distance of 655 feet.

**Table 6-2. TN767 Compensation Values**

Distance to Midpoint or Endpoint (FT)		Compensation
22 AWG ABAM & 24 AWG PDS	26 AWG PDS	Value
0 to 133	0 to 90	0
133 to 266	90 to 180	1
266 to 399	180 to 270	2
399 to 532	270 to 360	3
532 to 665	360 to 450	4

Compensation values assume 22-gauge ABAM or 24-gauge PDS cables. Two switches (colocated) can be up to 1310 feet apart with maximum compensation

on both systems. If 26-gauge PDS cables are used, distances are reduced as assigned.

The T1 office repeaters or T1 line repeaters can be used when the on-premises distance limitation is exceeded. A T1 office repeater is required at each end of the connection to provide an interconnection range of up to 3000 feet. Each repeater only provides regeneration for the receive direction. The T1 line repeaters can be used to accommodate distances up to 6000 feet between switches. The T1 line repeaters can be used in tandem to accommodate greater distances.

## Field 19

Field encodes and their descriptions are:

- (Dash) required option for all traditional modules. It is also required for all ISDN-PRI links provided with universal modules.
- 0** Preferred for DS1 service provided with universal modules (shows that a DS1 provides standard DMI-BOS).
- 1** Assigns that the DS1 provides the AT&T proprietary method of signaling on the 24th channel.

This option is required when connection to System 75 that uses TN722 circuit packs.

When connecting to a TN722B or ANN11 circuit pack, the recommended option is (**0**).

## Field 20

This display-only field serves to show which cables contain which synchronization cables.

## Procedure 262 Word 1: Additional DMI-MOS/ISDN-PRI Facility Options

Procedure 262 is used to administer the ANN35 and TN767 circuit packs.

## Fields 1-4

Assigns the circuit pack to an equipment location. These include the module number, cabinet number, port carrier number, and slot number.

Entries for these four fields are the default values from translating a **5** in field 14 of procedure 260. These entries should always be correct.

**Field 5**

*BRI Only* for ISDN-PRI and DMI-MOS applications, the dash (-) is appropriate.

**Field 6**

Assigns this interface as the user (0) or the network (1) side. When connected to a 4ESS, the customer premises switch is always the user side. When not connected to a 4ESS (that is, when connected to another switch), one switch is the user side and the other the network side.

For MOS facilities (such as DMI-MOS and ISDN-PRI), each link must be segmented into user and network sides. At a Generic 2, each MOS-based facility connected to the public network is administered as the user side, while other connections (such as that to a 4ESS) are administered as the network side. For private network DMI-MOS and ISDN-PRI connections, additional care must be exercised in defining user and network sides. Specifically at each facility, only one end must be administered as the user side (0) while the alternate must be defined as the network side (1). If the private network node is a tandem switch, then that node may function as both user side and network side depending on the particular facility. Whenever a Generic 2 connects to a host computer via MOS, the computer should always be assigned as the network side.

**⇒ NOTE:**

When a G3V2 DS1/CEPT1 interface administered with a user-network protocol is connected to a G2.2 interface, the G3V2 interface must be administered as network and the G2.2 interface as user. This is because the user-network administration on the G2.2 is only implemented for layer 2. The layer 3 user/network relationship in G2.2 is user by default, which means the layer 3 user/network identification must be network in the G3V2, which in turn means the layer 2 user/network is also network, which in turn means the layer 2 user/network on the G2.2 must be user. If a G3V2 administered for the ECMA peer protocol is connected to a G2.2, you must make sure that if the G2.2 is administered as user at layer 2 then the G3V2 is administered as peer-master and conversely, as peer slave if the G2.2 is network. The following table shows the recommended ways to administer the user-network and peer protocols when a G2.2 is connected to a G3V2:

G2.2					
Administered as	Layer 2	Layer 3	Administered as	Layer 2	Layer 3
user	user	user	network	network	network
user	user	user	peer-master/side A (G3V2 only)	master	side A
network	network	network	peer-slave/side B (G3V2 only)	slave	side B

## Field 7

This field is used for administering one of four facility test codes. For most installations it is desirable to enable or establish permission, thus allowing selected maintenance software to test the DMI-MOS/ISDN-PRI transmission facility on a demand basis.

Procedure 648 contains several tests that may be done on a demand basis (by executing procedure 648) whenever facility test codes 1, 2, or 3 are administered.

The DMI-MOS/ISDN-PRI communication protocol consists of three layers or levels. Level 1 is the physical layer. Level 2 is the data link layer. Level 3 is the network layer [also called the link access procedure on the D channel (LAPD)].

Field encodes and their descriptions are:

- 0** Disables or prohibits maintenance testing from being done on the specified (module, cabinet, carrier, and slot) transmission facility.
- 1** Assigns that a level-2 test may be executed via procedure 648.  
Encode 1 should be translated for all DMI-MOS to host computer links.
- 2** Assigns that only the level-3 network layer may be tested.
- 3** Permits both level-2 and level-3 tests to be done.  
Encode 3 should be used for all ISDN-PRI connections that terminate on a 4ESS if the Generic 2 is equipped with an SN261C analog/digital facility test circuit pack. If an SN261C is not present, use encode 1 instead.  
Fields 8-12 are assigned the default values when the ANN35/TN767 circuit pack is assigned in procedure 260.

## Field 8

This field accepts encodes from 0 to 126. However, all point-to-point (nonswitched) links, such as a System 85 R2V4 or Generic 2 DMI-MOS link to a host computer, must be administered with encode **0** (the default value).

## Field 9

The field accepts encodes from 0 through 255, which correspond to 1 second intervals for a maximum elapsed time of 4 minutes and 15 seconds. The default value for this T203 timer is 30 (30 seconds). This timer functions to monitor the facility data link and specifies the maximum time allowed without frames being exchanged on a data link layer connection.

### Field 10

The field accepts encodes from 0 through 255, which correspond to 0.1 seconds per increment for a maximum range of 25.5 seconds. The default value for this T200 timer is 10 (1 second). This timer functions to monitor multiple frame operation on the data link layer.

### Field 11

This field defines a value for the N200 counter. The value determines the maximum number of frame retransmissions. Permitted are 1 to 10, with 3 being the default value.

### Field 12

This field defines a value for the K counter. The value determines the maximum number of outstanding or unacknowledged information I frames. Permitted values are 1 to 10, with 7 being the default value.

Administration values for these procedure 262 timers and counters must be coordinated with the other terminating end.



## Field 13

NFAS-PRI only. Use to specify NFAS arrangements (populate the ISDN interface ID within the channel ID IE). This information must match exactly on each end of the facility and the encode must come from the premise switch (as described in *Technical Publication 41459*). Field encodes and their descriptions are:

- (Dash) The only value for non-NFAS arrangements.  
Any number within the range of (0 through 31) for NFAS arrangements.

## Procedure 262 Word 2: ISDN-PRI D-Channel Backup

---

This procedure is currently only applicable for certain ISDN-PRI connections. Specifically, those B-channel groups that use NFAS. Each of these groups is identified by a unique number known as the D-Channel group number. For NFAS, fields 2 through 5 define the D-channel for a signaling group.

### Field 1

Identifies a particular D-channel group number. The range of encodes is 1 through 255.

ISDN trunks are assigned to a specific equipment location in procedure 116. Procedure 116 is also used to assign ISDN-PRI circuits to the D-Channel group numbers.

### Fields 2-5

Assigns a particular circuit pack as providing the primary D-channel for the identified D-channel group number. [Table 6-4](#) depicts the permitted equipment ranges.

The ISDN-PRI facility (slot) that is translated as the primary must have also been translated for (23B + 1D) signaling, procedure 260, field 7, must use encode 0.

## Fields 6-9

Assigns a particular circuit pack as providing the backup D-Channel (which is optional) for the identified D-Channel Group Number. [Table 6-4](#) depicts the permitted equipment ranges.

A prime objective for the design of each D-channel group is to have members from two or more modules. By accommodating this objective, it is highly recommended that the Backup D-Channel equipment location be a different module from that selected as the Primary D-Channel. The ISDN-PRI facility (slot) that is translated as the backup must be translated for (23B + 1D) signaling, procedure 260, field 7, must have encode (0).

## Procedure 262 Word 3: ISDN-PRI Codeset Map Assignments

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Depending on the terminating switch it may be necessary to administer a Codeset Map Assignment and convert from one codeset or codepoint to a different codeset or codepoint. This administration assignment is required for ISDN-PRI links originating on a Generic 2 and terminating on a System 85 R2V4.

## Fields 1-4

Assigns a particular equipment location/circuit pack to be given a codeset map number. [Table 6-4](#) depicts the permitted equipment ranges.

## Field 5

Assigns whether the circuit pack is BRI or PRI. dash (-) is appropriate for ISDN-PRI.

## Field 6

Assigns a codeset map number. The permitted range is (0 through 15). Number selection is arbitrary, however; a suggestion is start with 0 and select higher numbers as needed.

When Codeset map numbers are translated they are assigned on a D-Channel Group number basis. All ISDN-PRI circuits within a D-Channel Group must be administered with the same Codeset Map Number.

## Field 7

Assigns whether hyperactivity management will be enabled for the ISDN-PRI link. Hyperactivity is defined as erratic behavior by the D-signaling channel. Typically, a hyperactive link will generate an excessive amount of meaningless traffic. Excessive D-channel traffic may overload the module processor and degrade system performance.

Field encodes and their descriptions are:

- (Dash) not applicable. This would be administered for all ISDN-BRI links.
- 0** Disables hyperactivity management for the particular ISDN-PRI link (this is the recommended option for SNC links).
- 1** Enables hyperactivity management (recommended for all ISDN-PRI links except SNC links). This software (hyperactivity management) functions to monitor link performance, detect when certain error thresholds have been exceeded, busyout the link on exceeding the threshold, and record the failure reason as FAULT CODE 337 in the maintenance log.

### Procedure 280 Word 1: ISDN-PRI Receive/Transmit Codeset Mapping

This procedure is used to translate Codeset Mapping parameters. Because switches sometimes differ in the codesets in which certain ISDN IEs are sent and also in the values of the opcodes of those IE, Generic 2 has the capability to map the codesets and opcodes to accommodate these different implementations across systems. For example, System 85 R2V4 implements the TCM IE in codeset 7 whereas Generic 2 implements it in codeset 6 by default. If Generic 2 must pass TCMs to or from a System R2V4, it must map the TCM IE from codeset 6 to codeset 7. When connected to a 4ESS, this mapping is necessary only if an R2V4 is present in an all-ISDN SDN network. Also note that the opcode value of the TCM IE and display does not need to be mapped to a different value.

Codeset mapping is implemented here as follows:

1. In field 1, assign an index in the range 0 to 15
2. In field 2, select **Incoming**
3. In field 3, select a codeset to be mapped in the incoming direction
4. In field 4, select an opcode (IE) belonging to the selected codeset
5. In field 5, select the codeset on the Generic 2 to which the incoming codeset from field 3 is to be mapped
6. In field 6, select the opcode on the Generic 2 to which the incoming opcode from field 4 is to be mapped
7. Steps 2 through 6 can be repeated up to 256 times for the incoming case.
8. When **Outgoing** is selected in field 2, repeat steps 3 through 7. For every incoming mapping there should be an identical outgoing mapping.
9. All of the above steps can be repeated up to 16 times (the number of map numbers available).

10. For each ANN35 or TN767 containing a primary D-channel to which you want codeset mapping, assign the map numbers in procedure 262, word 3.

Different interfaces can have different map numbers assigned. For example, one interface can map the TCM to codeset 7 while another interface can map the TCM to codeset 0.

[Table 6-3](#) summarizes the current codeset mapping requirements for Generic 2:

**Table 6-3. Codeset Mapping Requirements**

IE	Codeset Map	Opcode Map	When Required
TCM	Map from codeset 6 to codeset 7 outgoing. Map from codeset 7 to codeset 6 incoming.	Map from opcode 8 to opcode 8 in both directions.	If a System 85 R2V4 is present in an end-to-end ISDN network with Generic 2, this codeset mapping is required.
Display	Map from codeset 6 to codeset 7 outgoing. Map from codeset 7 to codeset 6 incoming.	Map from opcode 40 to opcode 40 in both directions.	If a System 85 R2V4 is present in an end-to-end ISDN network with a Generic 2, this codeset mapping is required.

### Field 1

Assigns a codeset map number (such as defined in procedure 262, word 3). Field encodes and their descriptions are:

Dash (-), which disables codeset mapping.

Any number between 0 and 15 that is previously defined with procedure 262, word 3.

### Field 2

Specifies whether codeset mapping is for incoming messages or outgoing messages. Field encodes and their descriptions are:

**0** Assigns mapping for incoming messages.

**1** Assigns mapping for outgoing messages.

From a Generic 2 perspective, incoming means mapped from Codeset 6 to Codeset 7. While outgoing means Codeset 6 is mapped to Codeset 7. Two-way trunk groups will normally have a Codeset Map translated for both incoming and outgoing.

### Field 3

Specifies a mapped from codeset number. Permitted encodes are 0 to 7. These numbers correspond to the respective codesets on a number-per-number basis.

Currently, codeset 1 through codeset 5 are reserved for future use. Thus, only encodes 6 and 7 are applicable for the codeset fields.

If field 2 is translated (0) for incoming then encode (7) is appropriate for field 3.

If field 2 is translated (1) for outgoing then encode (6) is appropriate for field 3.

### Field 4

Identifies the IE code to be mapped from. Field encodes and their descriptions are:

- (Dash) is available but not recommended. If a dash were translated, all IEs would be mapped from one codeset to the other codeset on a one-to-one basis. Because some codeset 7 IEs are different from their numerical equivalent in codeset 6, it is generally NOT desirable to map on a one-to-one basis.

[Table 6-4](#) identifies current IE differences between codeset 6 and codeset 7.

Table 6-4. Codeset Differences

IE Name	Codeset 6	Codeset 7
Traveling Class Mark	8	8
Logical Link Identification	26	4
Display	40	40
Packet Layer Parameters	62	2
Link Layer Parameters	64	1

#### **number**

Any number within the range of (0 through 127).

### Field 5

Specifies a mapped-to codeset number. Permitted encodes are numbers within the range (0 through 7) These numbers correspond to the respective codesets on a number-per-number basis.

If field 2 is translated one for incoming, then encode seven is appropriate for field 5.

## Field 6

Identifies the IE code to be mapped to. Permitted encodes are the same as field 4.

## Field 7

Each code set map number may contain up to a maximum of 255 incoming and 255 outgoing mappings. This display-only field shows the number of mappings that remain (the number of unassigned mappings).

## Procedure 354 Word 3: NPA-NXX Digits Assignment

---

This word and procedure are used to administer the ISDN numbering plan. Depending on the switch configuration, there may be more than one ISDN numbering plan. Contents of these fields make up a part of the station identification number (SID). The SID is transmitted in the calling number IE (part of the setup message) or connect party number (part of the connect message).

This word need not be translated unless the application requires that SID or the connected number be transmitted to the network. If the SID is to be passed through the ISDN network, then it must also be administered here and in procedure 000, word 4.

## Field 1

This field should be translated for both private and public network connections. The NPA-NXX designator is a 2-digit field and within the range of 1 through 99.

## Field 2

This 3-digit field should contain the Numbering Plan Area (NPA), which is also called the area code. The NPA is the area code in which the switch resides. Assignment is therefore dependent on the particular location and application.

## Field 3

This 3-digit field should specify the NXX, which is also called the office code of the local exchange company. Permitted values must be those numbers within the range of 200 through 999 and must be the office code of the local exchange.

## Field 4

This 1-digit field specifies the thousands digit. When not used, it should contain (-). When used, digits 0 through 9 may be assigned. Use this field only with three-digit dial plans. Do not use it with four- or five-digit dial plans.

## **Procedure 000 Word 3: Line-Side BCCOS Designator**

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This procedure assigns a BCCOS in field 5 to the extension shown in field 1. One implication of this COS is the pattern or preference selected for this extension on outgoing calls (see the Procedure 309 Word 5 and Procedure 321 Word 5 sections later in this chapter).

The 10 BCs are defined in field 16 of procedure 014, word 1. This definition codes the BC information element (IE) in the setup message when the extension (that is, the extension in field 1 of procedure 000, word 3) accesses an ISDN-PRI trunk for an outgoing call.

## **Procedure 000 Word 4: NPA-NXX Index Designator**

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Depending on how the switch is used, procedure 000, word 4, may or may not be translated. Specifically, word 4, field 4, is used for partitioning, ISDN, or both, and must be translated when:

1. The switch transmits SID or connected number to the network
2. The switch provides unique extension number partitions

Field 4 of procedure 000, word 4, need not be translated when: the switch does not transmit SID or connected number to the network (public or private).

If the switch contains more than one office code, multiple NPA/NNX designators may be needed.

### **Field 1**

Assigns a single extension number or the first extension number for a block of numbers. The single number or block of numbers will be unique in terms that they relate to a single extension partition identification.

### **Field 2**

Assigns the last extension number for a block of numbers.

### **Field 3**

Assigns the extension partition identification for the tenant services feature. This number associates the single or block of extension numbers to a particular ISDN facility (NPA-NXX Designator).

## Field 4

Associates an NPA-NXX Designator with the previously defined extension.

## Procedure 210 Word 2: LDN, NPA, and NNX Attendant Partition Assignments

This procedure is used to configure the attendant consoles into groups known as attendant partitions. Also, LDN and NPA-NXX assignments are completed, thus relating these assignments to a particular attendant console or attendant partition.

### Field 1

Translates a console number. Permitted encodes are any 2-digit number within the range of 1 through 40.

This console must be previously assigned in procedure 210, word 1.

### Field 2

Assigns the attendant partition number. Permitted encodes are any unused number within the range of 0-40.

### Field 3

Assigns the one console in the attendant partition that will be the controlling console. All other members of this group must have control denied. Field encodes and their descriptions are:

- 0 For all but the controlling console
- 1 Only for the controlling console

### Field 4

Assigns or associate the LDN with a particular console or console partition. The number is dependent on the switch or private network numbering plan.

### Field 5

Assigns or associate the NPA-NNX designator with the console or console partition. The encode must be the same as that defined in procedure 354, word 3.



## Procedure 014 Word 1: BCCOS Routing Options

This procedure is required to administer the attributes of each BCCOS assignment. Generic 2 permits up to a maximum of 256 different numeric assignments. The switch software is supplied with numbers (0 through 8) already defined. Each number (0 through 8) has different default parameters. Therefore, each number is unique and may be applied to a different type of routing configuration. It is currently believed that these numbers may be applied to meet the needs of most routing configurations.

If it is determined that the existing BCCOS numbers do not meet the needs of a particular routing configuration, then new numbers may be defined. New numbers should begin with 255 and continue in descending order.

The differences between System 85 R2V4 and Generic 2 are:

1. With System 85 R2V4, BC and ISDN routing are administered in procedure 010, word 4; but, with Generic 2 these are moved to procedure 014, word 1.
2. With System 85 R2V4, the switch assumes that all user data/information will be presented for transmission in a form called Restricted. Restricted means that the data/information is encoded so that the all-zeroes octet will not occur. The DCP data modules encode user data into the form Restricted.

With Generic 2, the switch administration software (procedure 014 word 1, field 3) assigns whether user data/information is presented to the switch as Restricted or Unrestricted. Unrestricted means that the data may contain the all-zeroes octet.

3. With System 85 R2V4, the AVD bit shows when a modem pool is required. With Generic 2, the BCCOS with AAR and ARS shows whether a modem pool is required.

### Field 1

Translates new (additional) BCCOS numbers. Field encodes and their descriptions are:

Dash (–) is used when the BCCOS does not support new numbers

Numbers between (0 and 255)

## Field 2

Assigns the transport mode.

Field encodes and their descriptions are:

- 0 Circuit switch the call
- 1 Packet switch the call
- 3 Both circuit and packet

## Field 3

Specifies whether the endpoint is unrestricted (1) or restricted (0) with respect to incoming calls.

It is the AAR/ARS software that routes calls. This software will block calls from an unrestricted type to a restricted type. As a contrast, the software will route calls from a restricted type to an unrestricted type. Furthermore, the software will route calls from restricted to restricted, depending on other attributes of the two BCCOS encodes.

## Fields 4-13

The translation parameters administered for fields 4 through 13 determine what actions the switch will take for the BCCOS specified in field 1. Regarding Generic 2, it is important to remember that the administration (of the BCCOS) determines when a modem pool member is added and not the particular trunk type. By administering the BCCOS on an AAR/ARS preference basis allows a single trunk group to support both circuit switched and modem pooled calls. Field encodes and their descriptions are:

- 0 Circuit switch the call
- 1 Insert a mode 2 modem pool
- 3 Block the call

Fields 14 through 16 are the default capabilities assumed by the switch for an originating facility (on this switch) that does not have a BCCOS IE (non-ISDN). The switch assumes these default capabilities are acceptable to the originating facility when it tries to connect the originating facility to the terminating facility. These default capabilities are not the predefined BCCOSs that default through administration.

## Field 14

Assigns a packet switched (1) or a circuit switched (0) call transport mode

### Field 15

Assigns a clear (1) or a restricted (0) channel type. This relates to calls outgoing from an endpoint, except for DMI modes 0 or 3.

### Field 16

The default BC class (BCC). Used for an outgoing call BC IE (*except for BRI modes*).

- 0 Voice
- 1 Mode 1
- 2 Mode 2
- 3 Mode 3
- 4 Mode 0
- 5 Voice grade data
- 6 Unknown digital
- 7 Unknown analog
- 8 Mode 3/2
- 9 X.25

## Procedure 014 Word 2: BCCOS Data Options

This procedure is used to define the data capabilities for the modem pools. The data rates selected are dependent on local requirements and the particular type of analog modem used.

### Field 1

Translates BCCOS modem pool support. Field encodes and their descriptions are:

Dash (-) is used when the BCCOS does not support modem pools  
Numbers between (0 and 255)

### Fields 2-10

These fields select the data rates (64000, 56000, 19200, 9600, 4800, 2400, 1200, 300, or low speed) supported by this modem pool. Field encodes and their descriptions are:

- 0 Not supported
- 1 Supported

### Field 11

Defines if synchronization is (1) or is not (0) supported.

### Field 12

Defines if half (1) or full (0) duplex operation is supported.

### Field 13

Defines if an external (1) or an internal (0) clock source is used.

### Field 14

Whenever a modem pool supports more than one data rate it is generally desirable to assign one data rate as a default or first choice. Field encodes and their descriptions are numbers (1 through 9; which correspond to Low, 300,...64000-bps respectively).

## Procedure 010 Word 4: Line Side (B-Channel) ISDN Routing Options

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### Field 1

When ISDN is administered, each COS assignment must have an associated BC and ISDN routing assignment. That is to say that whenever ISDN is enabled, all COS assignments must also be translated for procedure 010, word 4. COS assignments must be within the 2-digit range of 1 through 63.

### Field 2

This field's encodes are only useful for AUTOVON applications. Dash (-) is appropriate for ISDN applications.

### Field 3

This field shows the ISDN-PRI routing option. Field encodes and their descriptions are:

- 0** Any type of trunking facility is OK. The 0 option should be used when there are no specific requirements for ISDN-PRI trunks. Generally, this will include all voice and voice-grade data applications (BC code = 0) except those where user-to-user information transfer is desired (for example, SID/display).

- 1 ISDN-PRI trunking facilities are required. Generally, these applications include those COS groups established for Mode 1 data (BC code = 1), Mode 3 data (BC code = 3), and Mode 0 data (BC code = 4).  
  
Mode 0 data, depending on its origin, may require a restricted channel. Recall that an unrestricted channel is only provided by those ISDN-PRI facilities that use the B8ZS line-coding format.
- 2 Any trunking facility will work but ISDN-PRI trunk facilities are preferred. This may include voice and voice-grade data (BC code = 0) and Mode 2 data (BC code = 2).

### **Procedure 100 Word 1: Trunk Group Type Signaling and Dial Access (ID) Code**

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Translating word 1 is the first step in establishing trunk groups. Those trunk groups established for ISDN applications may be of the same design as those for non-ISDN applications, except for the type of signaling used. Or, they may (optionally) be designed to take maximum advantage of the ISDN capabilities (such as with the Integrated Telemarketing Gateway or ITG).

#### **Field 1**

Assigns a trunk group number. Permitted entries include any not already used number within the range of 18 through 999.

#### **Field 2**

Assigns the first digit of the trunk access code. Permitted entries are 0 through 9 for digits 0 through 9 and with 11 and 12 for the symbols \* and #, respectively.

#### **Field 3**

Assigns the second digit of the trunk access code. Permitted entries include digits 0 through 9.

#### **Field 4**

Assigns the third digit of the trunk access code. Permitted entries include digits 0 through 9.

#### **Field 5**

Assigns the fourth digit of the trunk access code. Permitted entries include digits 0 through 9.

## Field 6

Defines the trunk type of a specific trunk group. The ISDN-PRI facilities may be used to support several different trunk types. These may include both conventional trunk types as well as the ISDN-dynamic trunk type. An important point to remember is that the particular service application and the incoming digits are the primary determining factors that control which trunk type is selected. Most service applications may be supported (over ISDN facilities) by either a conventional trunk type or ISDN-dynamic. [Table 6-5](#) shows some permitted field entries that support signaling type 20.

Trunk types not included in the categories listed in [Table 6-5](#) below may not be translated for ISDN-PRI service. Most conventional trunk types specify, as a part of their name, an in/out signaling sequence. Actually, these signaling sequences are disabled and type 20 signaling is used exclusively over ISDN facilities.

**Table 6-5. Trunks Supporting Signaling Type 20**

Trunk Description	Trunk Type
2-way CCSA/APLT	12—15
CO	16, *17 (Note), 18—20
Data	100—107
DID	*30, *31
DMI	*108, *109
FX	21—25
ISDN	120
M/S TIE	70—78
Special	2, 5, 6, 50—58, 62, 65—67, 90—93
TIE	32—40, *41, *42, *43, 44, 45, *46, *47
WATS	26, *27, 28

Trunk types preceded with an asterisk (\*) may be selected by trunk type 120 on an as needed CBC Service Selection basis.

For ISDN trunk groups as well as other types of trunk groups, the entered type defines feature operation for the trunk group. For example, if a trunk group is assigned the type of 19, incoming calls over this trunk group are routed to the attendant console. On DID trunk type groups, the switch expects station number digits on all incoming trunks; on tie trunk type groups the switch can handle either station number digits or network numbers.

### Field 7

Assigns the dial access code restriction.

Field encodes and their descriptions are:

- 0** Allows access to the trunk group via a dial access code.
- 1** Restricts and only allows access to the trunk group for trunk testing and for providing unattended console service.

### Field 8

Assigns the trunk group as a Multifunction Terminal CO line appearance. This is not applicable to ISDN so assign encode **0** here.

### Field 9

Assigns the type of network access for the trunk group. Encodes are:

- 0** Allows access to the public network
- 1** Allows access to private network facilities

### Field 10

Displays and verify that the type of trunk signaling is correct. ISDN uses message-oriented signaling. Therefore, encode 20 should be displayed.

## Procedure 100 Word 2: Trunk Group Data Translations

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This word is used to administer data characteristics for each trunk group (including BCCOS).

### Field 1

Specifies a particular trunk group. The field encode will be the same as previously translated in procedure 100, word 1.

## Field 2

Assigns a BCCOS to the trunk group. This field is used for non-ISDN to ISDN tandem connections. The permitted range of encodes is (0 through 255). Field encodes and their descriptions are:

0	Voice
1	Mode 2 Data
2	Voice
3	Unknown Digital
4	Unknown Analog
5	Voice Grade Data
6	Mode 0 data
7	Mode 1 data
8	Mode 3 data
9	X.25 Packet Switched on B-channel

All calls use the BCCOS assigned to preferences in routing patterns as administered in procedures 309 word 1 and 321 word 5. If not assigned to preferences, the preference will default to the BCCOS of the associated trunk group.

## Procedure 100 Word 3: ISDN Trunk Group Signaling Options

---

The trunk type and signaling type attributes are translated as individual parameters.

### Field 1

Specifies a trunk group. Permitted entries include any not already used number within the range of 18 to 999.

### Field 2

Specifies the signaling type for the trunk group. For ISDN, use signaling type 20.



### Field 3

For all ISDN trunking applications except DCS, glare is resolved by the ISDN protocol. Therefore, this field is ignored for ISDN applications.

Specifically, ISDN negotiates the losing call to a different channel if the original channel is preferred. Exclusive calls (such as DCS) are not negotiated and the user hears the reorder tone. In either case, the network has priority over the user when both calls are preferred or exclusive. This capability is administered in field 5 of procedure 262, word 1.

### Field 4

Retry permits multiple attempts to seize a busy trunk from the specified trunk group.

This field is primarily applicable for those trunk groups routed over analog facilities and uses trunk types 41, 42, 43, 46, or 47. Depending on the particular configuration, retry may or may not be applicable for ISDN applications. Field encodes and their descriptions are:

- 0 Multiple retry is not desired, that is retry not active. The ISDN-PRI protocol contains an automatic retry capability. Whenever trunk type 120 is selected, the zero (0) encode is required.
- 1 Recommended for ISDN applications where the 40-series of trunk types is used. This encode enables a double try single retry and thus provides slightly improved call completion, particularly for large trunk groups that span across more than one transmission facility.

### Field 5

Not applicable for ISDN applications (encode must be 0 for not active).

### Field 6

Not applicable for ISDN applications (encode must be 0 for not active).

### Field 7

Not applicable for ISDN applications (encode must be 0 for no failure threshold).

This field is only applicable for analog trunk facilities. It permits the user to establish a trunk failure threshold that, when exceeded, will generate an alarm. The threshold limit will affect service availability and, on an indirect basis, the customer's maintenance costs.

## Field 8

Permits user control of whether optional ISDN IEs are transmitted and whether access to other ISDN network features is desired.

The optional ISDN IEs include the following:

- Calling number display
- \*Connected party number
- \*User-to-user information
- \*Called party name
- \*Calling party name
- \*Data mode 3 parameters
- \*Traveling class marks

Items preceded with an asterisk (\*) are only transmitted on an end-to-end basis whenever all public network links are provided with CCITT interoffice communication.

Field encodes and their descriptions are:

- (Dash) only applicable whenever ISDN is not available.
- 0** Recommended for all ISDN configurations, both public and private network arrangements.
- 1** Do not transmit the optional ISDN IEs.
- 2** When set to **2**, the optional IEs are sent, but if the trunk group is a DCS trunk group on an ISDN facility and an ISDN call from another trunk group is routed to it, the DCS name message is suppressed.

## Field 9

Specifies the network service that is requested for trunk verification by station (TVS). [Table 6-6](#) shows permitted field entries that support signaling type 20.

**Table 6-6. Trunks Supporting Signaling Type 20**

Trunk Description	Trunk Type
CO	16, *17 (Note 1), 18, 19, 20
Data	100 — 107
DID	*30, *31
DMI (Note 2)	*108, *109
FX	21 — 25

**Table 6-6. Trunks Supporting Signaling Type 20**

---

Trunk Description	Trunk Type
ISDN	120 (Note 3)
M/S TIE	70 — 8
Special	2, 5, 6, 50 — 58, 62, 65 — 67, 90 — 93
TIE	32 — 40, *41, *42, *43, 44, 45, *46, *47
WATS	26, *27, 28

---

**Notes:**

1. Trunk types preceded with an asterisk (\*) may be selected by trunk type 120 on an as needed Call-By-Call (CBC) Service Selection basis.
  2. Trunk types not included in these categories may not be translated for ISDN-PRI service. Most conventional trunk types specify, as a part of their name, an in/out signaling sequence. Actually, these signaling sequences are disabled and type 20 signaling is used exclusively over ISDN facilities.
  3. Beginning with the 1.0 software load of Generic 2 and the 1.2 software load of System 85 R2V4 digits may be inferred when using the ISDN-dynamic trunk type. The default of 30 infers DID (if necessary). A default of 46 infers AAR/ARS.
- 

**Field 10**

Used as a display-only field. This field displays the trunk type that was administered in procedure 100, word 1.

**Procedure 101 Word 1: ISDN Trunk Group,  
CDR, and Digital Loss Plan**

---

Procedure 101, word 1, is used (primarily) to turn on CDR, as well as translate the digital loss plan.

**Field 1**

Displays the trunk group number, such as previously translated in procedure 100.

**Field 2**

Assigns whether the trunk group has (1) or does not have (0) balanced transmission facilities. Encode 1 is required for ISDN-PRI.

### Field 3

Assigns whether the trunk group has (1) or does not have (0) the battery reversal option. Encode 0 is required for ISDN-PRI.

### Field 4

Assigns the number of prefix digits. Field encodes and their descriptions are:

Dash (-) is always applicable for ISDN-PRI applications except for DID trunks (trunk types 30 and 31).

Any single digit number (0 through 9).

The number is determined by the trunk group and its application.

### Field 5

Assigns whether the trunk group is (1) or is not (0) used for DCS applications.

### Fields 6-7

This field is ignored for ISDN applications and either encode (0 or 1) may be translated.

### Field 8

Assigns or not assign the trunk group to CDR record keeping. Field encodes and their descriptions are:

- 0 Trunk group usage not applicable for CDR recording.
- 1 Trunk group usage will be recorded by CDR.
- 2 Trunk group usage will be recorded, account code is required.

### Fields 9-11

Not used for ISDN applications.

### Field 12

This field is only applicable when CDR is being used, and then only to change the default CDR timer value. Field encodes represent intervals in 1-second increments. The range is 1 through 99 with dash (-) being the default timer value of 6 seconds.

## Field 13

Administers the optional transmission loss assignments. The encode translated depends on the network configuration and service application. Field encodes and their corresponding loss plan are listed as follows:

- 0 The Digital FIXED Loss Plan
- 1 ISL Tie Trunk
- 2 EIA Tie Trunk  
This is the recommended option for Speedial Access Connections to a 4ESS.
- 3 ISL Digital Central Office
- 4 EIA Digital Central Office
- 5 Digital Toll Office
- 6 Analog Toll Office
- 7 AUTOPLEX<sup>®</sup> NETWORK Interface V
- 8 AUTOPLEX<sup>®</sup> NETWORK Interface Y

## Fields 14-16

These fields are ignored by ISDN software. Either encode (0 or 1) is satisfactory.

## Procedure 101 Word 3: Prefix Digits

This procedure allows you to prepend up to four digits to the incoming called party number on a trunk group basis given the type of address in the called party number. This prefixing is done before any digit analysis is performed. You do this by entering a type of address in field 2. This is the type of address field in the incoming called party number IE. If you want calls with this type of address to have digits prepended to the called party number digits, enter the desired digits in fields 3-6.

## Procedure 103 Word 1: Network Trunk Group Translations

This procedure is used to translate the trunk group network parameters. Two screens are shown.

## Field 1

Displays the trunk group number, such as previously administered in procedure 100 and 101.

## Field 2

The ISDN-PRI does not place any new or additional considerations on translating these fields. The encodes that are translated are generally dependent on each trunk group, its application, and the associated trunk groups.

## Field 3

Determines the number of traveling class marks (TCMs) a trunk group will send and receive. Encodes are:

- 0** Do not send or expect to receive any TCMs.
- 1** Send or expect to receive the FRL TCM.
- 2** Send or expect to receive the FRL and conditional routing TCMs.

## Field 4

Used to select **(1)** or disallow **(0)** symmetrical routing.

Procedure 285 field 5 is used to administer the symmetrical routing depth. If a call enters the switch on a trunk which has the network/tandem fields in procedure 103, word 1, set to 1,1 and the symmetrical routing depth field is set to a non-zero value, then the trunk group is part of a symmetrical route. After a pattern is selected, preferences for which the outgoing trunk group has the network/tandem fields in Procedure 103 set to 1,1 and for which the preference number is greater than the symmetrical routing depth are ignored.

If a call enters the switch on a trunk group that is part of a symmetrical route (that is, procedure 103, word 1, field 4 is set to 1) and the symmetrical routing depth field for the switch is set to a non-zero value, then symmetrical routing occurs. After a pattern is selected, preferences for which the outgoing trunk group has the symmetrical routing field in Procedure 103 set and for which the preference number is greater than the symmetrical routing depth are ignored.

## Fields 5-8

The ISDN-PRI does not place any new or additional considerations on translating these fields. The encodes that are translated are generally dependent on each trunk group, its application, and the associated trunk groups.

## Field 9

The digit sending index for a given preference (digit sending index field in procedure 318, word 1) and Dial Tone Detect Ignore field for the trunk group (procedure 103, word 1, field 9) determine when digit sending begins. An outgoing trunk sequence is started after the outgoing trunk is seized. If Dial Tone is detected during the trunk sequence, the switch remembers the detection.

When the trunk sequence completes, if Dial Tone was detected and the Dial Tone Detect Ignore field for the trunk group is set to '0', digit sending begins immediately (the first pause is skipped).

If Dial Tone was not detected during the trunk sequence or the trunk group is administered to Ignore Dial Tone, a timer is set based on the pause length of the first digit sending group. If the first pause is '0', digit sending begins immediately.

If Dial Tone is detected while pausing before sending the first group and Dial Tone Detect Ignore is set to '0', pausing is discontinued and digit sending begins immediately. Otherwise, digit sending begins when Pausing completes.

Encodes are:

- 0 Dial Tone Detection Active (default). If dial tone is detected during the outgoing trunk sequence begin sending as soon as the sequence completes (ignore the first pause specified in field 3 of procedure 321, word 2). If dial tone is detected during the first pause interval, begin sending immediately.
- 1 Do not do dial tone detection, begin sending only after the pause interval specified in field 3 of procedure 321, word 2.

## Fields 10-12

The ISDN-PRI does not place any new or additional considerations on translating these fields. The encodes that are translated are generally dependent on each trunk group, its application, and the associated trunk groups.

## Field 13

This field affects how Network Digit Collection operates and when route selection is attempted for network calls arriving on a trunk group. The differences between the two options for this field are easily illustrated with a simple example.

Suppose a network's dialing plan has been administered in Procedure 314 and that the plan consists entirely of seven digit address strings that are differentiated by their first three digits (i.e. they all have three digit string identifiers).

When a call that arrives on a trunk group for which this field is zero enters Network Digit Analysis, an attempt will be made to collect seven digits, and any applicable traveling class marks. Once these digits have been collected, they are applied to the network's dialing plan, a Virtual Nodepoint Identifier is determined and route selection commences.

When a call that arrives on a trunk group for which this field is one enters Network Digit Analysis, an attempt will be made to collect three digits. Since all strings can be identified (and a Virtual Nodepoint Identifier determined) by the first three digits, a route could be selected after reception of the third digit. Whether or not

overlapped sending will occur for the remainder of the seven digit number depends on the option provisioned in Field 14 of this word for the trunk group referenced in the selected route. Please see Field Help for Field 14.

Setting this field to one could adversely affect processor occupancy in high volume situations.

Setting this field for trunk groups which have ISDN signaling is inconsequential since Network Digit Analysis assumes that all digits which are to be applied to the Network Dial Plan can be discerned from information contained in the incoming Setup message.

Encodes are:

- 0 Commence route selection after entire number has been dialed.
- 1 Attempt route selection as soon as a Virtual Nodepoint Identifier has been determined.

#### Field 14

If the route selection method for the calling facility indicates that route selection should be attempted as soon as a Virtual Nodepoint Identifier has been determined (field 13=1) and this field is set to 1 for the trunk group referenced by the chosen route then overlapped sending will occur for the remainder of the dialed number. This is the only means by which overlapped sending is accomplished. Encodes are:

- 0 Collect all digits before sending.
- 1 Overlap sending

#### Field 15

Suppress Dial Tone

- 0 Apply Dial Tone
- 1 Suppress Dial Tone

This field is used to suppress dial tone after a WCR DAC is dialed or inferred via procedure 101 Word 3.



## Procedure 116 Word 1: DS1/DMI/ISDN-PRI Trunk Assignments

---

Each analog trunk circuit pack provides four circuits that are administered by using procedure 150. Conversely, each DS1 provides 24 circuits (channels) that are administered by using procedure 116.

For traditional modules, each DS1/MFAT carrier will support a maximum of two DS1s, each occupying one slot and located in slots 5 and 18. When a DS1/DMI/ISDN interface (trunk applications) is located in slot 5, it uses the six slots 0, 1, 2, 5, 6, and 7. When the interface is located in slot 18, it uses the six slots 13, 14, 15, 18, 19, and 20.

The DS1 channels are assigned to slot and circuit locations according to the order in which the module processor scans the equipment carrier as shown in [Table 6-7](#)

When the traditional module DS1/MFAT carrier is configured with two DS1s, physical slots 3, 8, 16, and 21 are available for other applications. If only one DS1 is configured, then six additional slots are available for other applications.

**Table 6-7. DS1/ISDN-PRI Administration — Channel vs. Trunk Assignments**

DS1 Channel	Slot/Circuit	DS1 Channel	Slot/Circuit
1	5/0 or 18/0	13	0/0 or 13/0
2	6/0 or 19/0	14	1/0 or 14/0
3	7/0 or 20/0	15	2/0 or 15/0
4	5/1 or 18/1	16	0/1 or 13/1
5	6/1 or 19/1	17	1/1 or 14/1
6	7/1 or 20/1	18	2/1 or 15/1
7	5/2 or 18/2	19	0/2 or 13/2
8	6/2 or 19/2	20	1/2 or 14/2
9	7/2 or 20/2	21	2/2 or 15/2
10	5/3 or 18/3	22	0/3 or 13/3
11	6/3 or 19/3	23	1/3 or 14/3
12	7/3 or 20/3	24	2/3 or 15/3

When the traditional module DS1-MFAT carrier is configured with two DS1s, physical slots 3, 8, 16, and 21 are available for other applications. If only one DS1 is configured, then six additional slots are available for other applications.

To minimize confusion and eliminate the need for maintaining elaborate trunk to channel cross-reference tables, trunk group member assignments should match the DS1 channel assignments; for example, trunk group member 1 on channel 1. For example, using procedure 116, word 1, refer to [Table 6-7](#) to determine which slot and circuit to translate for channel 1. Repeat this procedure by sequentially selecting DS1 channels (2, 3, and so on) and translating the appropriate slot and circuits as required.

## Fields 1-5

These fields are used to translate the equipment location, including slot and circuit (channel) location, and to associate the equipment location (channel) with the particular trunk group translated in field 6.

## Field 6

Translates the trunk group. Permitted encodes must be numbers with the range of 18 through 999.

## Field 7

Translates a particular number that functions as the night service number. The digits depend on the particular application and its numbering plan.

## Field 8

Disables a channel's signaling. This disable function is required for establishing a dedicated switched connection. Field encodes and their descriptions are:

- 0 Signaling is enabled (default value).
- 1 Signaling is disabled.

This option is only translated for the channels that is used as a dedicated switched connection.

## Field 9

Not applicable for ISDN-PRI.

## Field 10

Assigns the function of the terminating endpoint. For PRI nodal services, this endpoint is the network. Field encodes and their descriptions are:

- 0 Another customer premises switch
- 1 A private network connection to a host computer

**2** Public network connections

**Field 11**

Translates the D-channel group number. These numbers should be coordinated with field 1 of procedure 262, word 2. Field encodes and their descriptions are:

Dash (-), for non-NFAS arrangements.

Numbers within the range 1 through 255 for all NFAS arrangements.

**Procedure 012 Word 1: Name Database**

---

The name database is used by those features (such as DCS, ISDN-PRI) which provide display type information to voice terminals. Some examples of common display information are: calling party name, vector directory number, and trunk group name. For ISDN-PRI applications, the name database information is used to populate the display IE.

**Field 1**

Assigns either an extension number, vector directory number, or trunk group. Field encodes and their descriptions are:

000 through 99999, for extension and directory numbers.

Whether the number is three, four, or five digits depends on the numbering plan.

18 through 999, for trunk group numbers.

**Field 2**

Specifies whether the encode for field 1 is a trunk group or extension/vector directory number. Field encodes and their descriptions are:

**0** Trunk groups

**1** Extension numbers and vector directory numbers

**Field 3**

This field is only applicable for the identified extension's display module. It controls the number of blank spaces that are inserted before the first displayed character of the name, dialed number, or trunk group name. Permitted encodes are numbers from 1 to 30.

## Field 4

The main function of this field is to provide some administration control over what is displayed on the voice terminals digital display. Field encodes and their descriptions are:

- (Dash) all incoming only trunk groups
- 0 The user (extension) does not want the outgoing trunk group name displayed but does desire the dialed number to remain on the display.
- 1 The user desires to display the name of the outgoing trunk group (for example, ISDN/SDN, MEGACOM, CBC).

For a tandem interworking call the name of the incoming trunk group is transmitted in the display IE of the ISDN-PRI outgoing trunk group.

## Field 5

Assigns the method used to define the name. Field encodes and their descriptions are:

- 0 Add a new name or change an existing name; requires that the name change be made with word 2
- 1 Copy the name from the extension or trunk group displayed in field 6

## Field 6

This field is used with field 5 to copy an existing name to the extension or trunk group identified in field 1. Field encodes and their descriptions are:

000 through 99999, for extension and directory numbers. Whether the number is three, four, or five digits depends on the numbering plan.

18 through 999, for trunk group numbers.

## Procedure 012 Word 2: Name Database

This word is used to translate a name (up to a maximum of 30 characters).

## Field 1

Identifies one-of-three 10 character fields. Field encodes and their descriptions are:

- 1 Characters 1 through 10
- 2 Characters 11 through 20

### 3 Characters 21 through 30

There exist 94 different encodes (00-12, 14, 15, 17-96) which correspond to numbers 0 through 9, lower case letters, upper case letters, and special characters. The Manager II help screen or the document *DEFINITY Communications System Generic 2 Administration Procedures* (555-104-506) may be used for determining the desired encodes.

### Fields 2-11

Each field should be translated with the encode that corresponds to the desired character.

### Procedure 012 Word 3: Name Database

Since the name database has the potential to use a large amount of memory it is generally desirable to run the compact operation whenever all names have been added.

#### Field 1

Assigns whether the name database is (1) or is not (0) to be compacted.

#### Fields 2-4

Are display only and serve to show status of the database.

### Procedure 107 Word 1: ISDN Trunk Verification by Terminal, Attendant, and ATMS

#### Field 1

Identifies those ISDN-PRI trunk groups to be accessed by the trunk verification features. Permitted encodes are previously defined trunk group numbers within the range of 18 through 999.

#### Field 2

Dash (-), is appropriate for voice terminal and attendant console applications.

If a transmission test line is used, its type should be specified.

#### Fields 3-18

Assigns digits for the terminating test line and TVS.

Procedure 107, words 2-7, need only be translated whenever ATMS is used.

## **Procedure 108 Word 1: ISDN Trunk Group TTL Number (Digits)**

---

This procedure is used to assign the terminating test line number (used in test 3 of maintenance procedure 648) that identifies the particular B-channel used for ISDN-PRI testing purposes. This test line number must be assigned for both private and public network configurations. Whether more than one terminating test line number is needed depends on the number of ISDN-PRI links and whether they terminate on more than one switch.

### **Field 1**

Translates the trunk group that identifies the ISDN terminating test line. The terminating test line is required for B-channel maintenance testing. As part of the installation and ISDN-PRI services provisioning, the terminating test line number assignment must be coordinated with the terminating switch.

### **Fields 2-17**

Assigns digits for the terminating test line. If B-channel signaling control is used on the D-channel of another facility, you must use NFAS (see procedures 260, word 1; 262, word 1; 262, word 2; and 262, word 3).

## **Procedure 279 Word 1: Network Facilities Coding**

---

Each interexchange carrier (which provides public network ISDN service) must have a unique identifier number. Furthermore, each carrier may provide multiple ISDN services and ISDN features that must be individually identified via a Network Specific Facility (NSF) coding value. A NSF is an ISDN IE (sent in the setup message) that is used to identify the network or feature associated with the call. When connected to a 4ESS, a Generic 2 must send the appropriate NSF for MEGACOM, SDN, GSDN, and ACCUNET switched digital service calls. (MEGACOM 800 service calls do not require an NSF since it is an incoming-only service and the Generic 2 cannot tandem it to another switch as a MEGACOM 800 call.)

All NSFs must be defined in field 1 of this procedure prior to use in procedure 322 word 1.

### **Field 1**

Translates Network Service. This field is an arbitrary index number that you use to identify the NSF defined in the rest of the fields.

.' For MEGACOM, SDN, and ACCUNET switched digital service calls, assign this same index number in field 5 of procedure 309, word 5, and in field 4 of procedure 321, word 5.

Field encodes and their descriptions are:

Dash (-), whenever a carrier identifier number is not applicable.  
Numbers (1 through 511).

For most ISDN public network connections it is expected that the CBC Service Selection capability will be implemented.

With this capability the ISDN B-channels must (on a per-call basis) support multiple ISDN features and services. The public network CO originates an incoming call by transmitting a call-setup message to the switch. The call-setup message contains a NSF IE that identifies the ISDN feature/service. At the switch, fields 2 through 11 are used to define the various ISDN public network features and services. [Table 6-8](#) lists the currently available AT&T ISDN network services and features and their further defining attributes.

**Table 6-8. Network Services/Network Features**

Name	Recommended NSV	Parameterized (0) or Binary (1)	Feature (0) or Service (1)	Facility Coding Value
International 800	8	1	1	8
Out-WATS band	33-288	0	1	1
WATS maximal subscribed band	324	1	0	5
Pre-subscribed CC operator	325	1	0	6
SDN/GSDN	352	1	1	1
AT&T World Connect	353	1	1	7
MEGACOM 800 service	n/a	n/a	n/a	2
MEGACOM	354	1	1	3
In-WATS	355	1	1	4
WATS maximal subscribed band	356	1	1	5
ACCUNET switched digital services/Switched Digital International	357	1	1	6

*Continued on next page*

Table 6-8. Network Services/Network Features — *Continued*

Name	Recommended NSV	Parameterized (0) or Binary (1)	Feature (0) or Service (1)	Facility Coding Value
Electronic tandem network	n/a	n/a	n/a	11
Private line	n/a	n/a	n/a	12
AT&T MultiQuest	n/a	1	1	16

## Field 2

Assigns whether the service/feature is binary (1) or parameterized (0).

All codeset NSFs are classified as binary services. As an option, fields 5-11 may contain additional defining parameters (refer to [Table 6-8](#)). However, even though a service/feature may be defined as parameterized, it is generally not required that fields 5 through 11 be translated.

For a binary service/feature, fields 5-11 cannot be translated.

## Field 3

Assigns whether the facility coding value represents a feature (0) or a service (1). Refer to [Table 6-8](#).

## Field 4

Assigns the facility coding value. Field encodes and their descriptions are:

Dash (–), not applicable

Numbers.  
(refer to [Table 6-8](#))

## Fields 5-11

There are no default values.



## Procedure 322 Word 1: WCR Outgoing ISDN Feature Parameters

---

In this procedure you define an ISDN sending index and then assign that index to a preference or a trunk group in procedure 318 word 1. The following list describes how to administer this procedure:

1. Display the desired ISDN sending index in field 1. If this index has not yet been administered, it will have default values for all the fields.
2. In field 2, enter the network service value you want associated with this index. This service value must be built first in procedure 279. This value will be used to populate the facility coding portion of the NSF IE for calls on trunk groups or preferences assigned to this ISDN sending index in procedure 318.
3. In field 3, enter the type of address you want to populate the called party number IE for calls on preferences or trunk groups assigned to this ISDN sending index. Following are the possible values:
  - 0 - Unknown (default)
  - 1 - International Number
  - 2 - National Number
  - 3 - Network Specific Number
  - 4 - Subscriber Number
  - 6 - Abbreviated Number
  - 7 - Reserved for Extension
4. In field 4, enter the numbering plan identification you want to populate the called party number IE for calls on trunk groups or preferences assigned to this ISDN sending index. Following are the possible values:
  - 1 - ISDN/Telephony Numbering Plan
  - 0 - Unknown (default)
  - 1 - ISDN/Telephony Numbering Plan
  - 2 - Telephony Numbering Plan
  - 3 - Data Numbering Plan
  - 4 - Telex Numbering Plan
  - 8 - National Numbering Plan
  - 9 - Private Numbering Plan
  - 15 - Reserved for Extension
5. In field 5, enter either **0** to send the IXC in either the NSF IE or the transit network selection (TNS) IE, or **1** to send it in the CDN IE. You define the IXC in procedure 321, word 1, fields 7-11 and associate that IXC with a given digit sending index. This index is then entered in procedure 318, word 1, field 8 for a given trunk group or preference. For calls to that trunk group or preference, the IXC associated with the digit sending index will be used to populate either the NSF, TNS, or CDN IE, depending on the value in this field.

## **Procedure 318 Word 1: ISDN Sending Index and Digit Sending Index**

---

This procedure is used to populate several ISDN IEs on outgoing calls to preferences or trunk groups as follows:

- The digit sending index in field 8 determines which IE the IXC is sent in. An IXC is first defined in procedure 321, word 1, fields 7-11 for a given digit sending index. If field 7 is a **2** or **3**, then the IXC assigned in fields 8 through 11 will be used to populate the network identifier in the NSF. When this digit sending index is assigned to a trunk group or preference in field 8, the associated IXC will be used to populate the outgoing ISDN message. The IXC will populate one of three possible IEs, depending on the setting in procedure 322, word 1, field 5 for the ISDN sending index in field 9.
- The ISDN sending index in field 9 determines how the called party number and NSF IEs are populated for outgoing calls to this trunk group or preference. The sending index is defined in procedure 322, word 1.

## **Procedure 318 Word 2: Assigns a BCCOS to a Preference"**

---

This procedure is used to assign the bearer capability class of service to a preference. The BCCOS is defined in procedure 014.

# G2 ISDN PRI Implementation in Administration



---

This appendix describes how ISDN PRI has been implemented in the administration procedures in G2. It covers the same subjects found in the ISDN PRI sections of [Chapter 5, “Layers 2 and 3”](#), but organized by administration procedure rather than by ISDN PRI subject.

## Procedure 000 Word 3

Field 1 of this word assigns the bearer capability (BC) class of service (COS) number for the extension number. One implication of this COS is the pattern or preference selected for this extension on outgoing calls (see the [“Procedure 309 Word 5”](#) section later in this appendix).

The 10 BCs are defined in field 16 of procedure 014, word 1. This definition codes the BC information element (IE) in the setup message when the extension (entered in field 1 of procedure 000, word 3) accesses an ISDN-PRI trunk for an outgoing call.

The following defines the encoding of the BC IE for the 10 possible BCs.

- Voice
  - Opcode: 4 (assuming no codeset mapping)
  - Information transfer capability: speech
  - Coding standard: CCITT
  - Information transfer rate: 64K-bps
  - Transfer mode: circuit mode
  - Layer and protocol identification: CCITT Mu-law speech (layer 1)

- Mode 1
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: restricted digital information  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode  
Layer and protocol identification: rate adaption as specified in I.461 (layer 1)  
User rate: 56K-bps  
Synch/asynch: synch
- Mode 2
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: restricted digital information  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode
- Mode 3
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: either unrestricted digital information or restricted digital information depending on the translation specified for the bearer capability COS in field 15 of procedure 014, word 1.  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode
- Mode 0
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: either unrestricted digital information or restricted digital information depending on the translation specified for the bearer capability COS in field 15 of procedure 014, word 1.  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode
- Voice Grade Data
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: 3.1K-Hz audio (modem)  
  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode  
Layer and protocol identification: CCITT Mu-law speech (layer 1)  
User rate: coded according to the translation entered in field 14 of procedure 014, word 2.  
Synch/Asynch: coded according to the translation entered in field 11 of procedure 014, word 2.

- Unknown Digital
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: either unrestricted digital information or restricted digital information depending on the translation specified for the BCCOS in field 15 of procedure 014, word 1.  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode  
Layer and protocol identification: CCITT Mu-law speech (layer 1)  
User rate: undefined  
Synch/Asynch: asynch
- Unknown Analog
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: speech  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode  
Layer and protocol identification: CCITT Mu-law speech (layer 1)
- Mode 3/2
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: restricted digital information  
Coding standard: CCITT  
Information transfer rate: 64K-bps  
Transfer mode: circuit mode
- X.25
  - Opcode: 4 (assuming no codeset mapping)  
Information transfer capability: unrestricted digital information  
Coding standard: CCITT  
Information transfer rate: coded to a **0**  
Transfer mode: packet mode  
Layer and protocol identification: recommendation X.25 link level (LAPD) (layer 2)  
Layer and protocol identification: recommendation X.25 packet level (layer 3)

#### Procedure 000 Word 4

Field 4 of this word is used to assign an NPA-NXX designator to an extension or range of extensions. If an extension is not assigned an NPA-NXX designator, calls originated from this extension over ISDN-PRI trunks do not have a calling party number IE in the setup messages. Likewise, calls terminating to this extension over ISDN-PRI trunks do not have connected number IEs in the connect messages.

The same designator can be assigned to a range of extensions via one change execute operation if no unassigned numbers are within the entered range (see the [“Procedure 354 Word 3”](#) section in this appendix for more information).

## **Procedure 010 Word 4**

---

This word is used to assign ISDN routing parameters to extensions. Field 3 applies.

## **ISDN Routing Parameters**

While many parameters are associated with route selection (for example, Facility Restriction Levels or FRLs, compatible match of BCs, and clear channel versus restricted channel), the effect of the ISDN routing parameter field as it relates to route selection is discussed next. There are three possible encodes that may be entered in the applicable field:

- 0** Use any available facility in a pattern. For example, based on the specific dialed digits, you could have a call routed to a specific pattern that may have one or more preferences. The first available trunk found in the highest preference will be used (for example, 1 is a higher preference than 2 and 2 is a higher preference than 3). Therefore, if an available trunk is found in preference 1, it is used.
- 1** Use an ISDN-PRI trunk exclusively. When routed to a specific pattern, the first available ISDN trunk found in the highest preference is used. Non-ISDN trunk group preferences are skipped in the routing algorithm. If an ISDN-PRI trunk group is not translated in this pattern, the calling party hears intercept tone.

This encode can be used to ensure that an ISDN digital trunk is used for a certain set of users (such as high-speed data endpoints).

- 2** Use an ISDN trunk if one is available; otherwise use a facility of another type. The routing algorithm selects the first available ISDN trunk of the highest preference; otherwise it selects the first available non-ISDN trunk of the highest preference associated with the pattern.

Using this encode can, when possible, provide user-to-user information for a particular call (such as transporting of calling party name and number). When it is not possible to provide this information, call completion can still be achieved by selecting a non-ISDN facility.

## **Procedure 012**

---

This procedure is used to assign names to extension users or trunk groups. This data is used in building the Display IE used in setup and connect messages. If data is not assigned for a calling party using an ISDN-PRI trunk, a display IE is not created. The following are some basic rules on the display IE:

1. If an extension user originates a call over an ISDN-PRI trunk, the name assigned the user in procedure 012 is used for the Display IE.
2. On a call tandeming through the switch where both the calling and called trunks are ISDN-PRI, the display IE received over one trunk (if there is one) is tandemed over the other trunk. That is, on this type of call a display IE is never created by the switch.
3. On an interworked tandem call through the switch (that is, one trunk ISDN-PRI and one trunk not ISDN-PRI), the display IE is built from the name associated with trunk group of the non-ISDN-PRI trunk.
4. If an attendant originates or receives a call over an ISDN-PRI facility, the string **Woperator** is used to build the display IE.

### Procedure 100 Word 1

Field 6 of this word is used to define the trunk type of a specific trunk group.

For ISDN trunk groups as well as other types of trunk groups, the entered type defines feature operation for the trunk group. For example, if a trunk group is assigned the type of 19, incoming calls over this trunk group are routed to the attendant console. On Direct Inward Dial (DID) trunk-type groups, the switch expects station-number digits on all incoming trunks; on tie-trunk-type groups, the switch can handle either station-number digits or network numbers.

For an ISDN trunk group, a dynamic trunk type (120) can be assigned to the group. This trunk type allows the group to process calls with a different trunk type on a call-by-call (CBC) basis. For example, one incoming call over the group may expect station number digits (such as a MEGACOM call), while the next call over the group may expect a network number (such as a Software Defined Network call, also called a SDN call).

This trunk type allows flexibility in processing calls as opposed to a static trunk type. Both an Automatic Alternate Routing/Automatic Route Selection (AAR/ARS) prefix digit (procedure 103) and a DID additional digit (procedure 101) can be administered for ISDN dynamic trunk groups. (This cannot be done for any other type of trunk group.) The dynamic trunk type is recommended in CBC service.

The following rules are used to determine how to process an incoming call over a trunk group whose type is ISDN dynamic:

1. If a network-specific facility (NSF) IE is present in the setup message and the feature/service indication is **service**, then:
  - If the service indicated is **SDN, electronic tandem network (ETN)**, or **private line**, process the call like a call with a trunk type of 46.
  - Otherwise, process the call like a call with a trunk type of 31.

2. If either an NSF IE is present in the setup message and the feature or service indication is **feature**, or there is no NSF at all, the following rules are used to determine trunk type (these rules are based on the interface endpoint translated for the applicable channel in field 10 of procedure 116):
  - If the endpoint specified is **PBX**, process the call with a trunk type of 41.
  - If the endpoint specified is **host computer**, process the call with a trunk type of 108.
  - If the endpoint specified is **network**, process the call with a trunk type of 31.

### Procedure 100 Word 2

Field 1 of this word specifies the trunk group number and field 2 specifies a BCCOS number for this trunk group.

For interworked tandem calls through the switch where the calling trunk is not ISDN-PRI trunk and the called trunk is, the BCCOS of the non-ISDN-PRI trunk is used to define a BC for the outgoing setup message over the ISDN-PRI trunk. (See the "[Procedure 000 Word 3](#)" section in this appendix for encodings of the BC IE.)

This COS also defines other routing parameters. These parameters are discussed in the "[Procedure 309 Word 5](#)" and "[Procedure 321 Word 5](#)" sections of this appendix.

### Procedure 100 Word 3

- |         |                                                                                                                                                                                                   |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Field 2 | Used to assign a trunk group as ISDN-PRI that has ISDN-PRI signaling (type 20). This causes ISDN-PRI message-oriented signaling (MOS) to occur for the trunk group.                               |
| Field 3 | Not applicable for ISDN-PRI trunk groups. ISDN-PRI specifications explain the procedures to be used when glare is encountered. These specifications are implemented in the ISDN-PRI feature code. |



- Field 8                    Used to prevent the sending of various IEs over the trunk group specified in field 1. If the entry in this field is **0**, there is no restriction on sending IEs over the trunk group.
- For Generic 2, this field allows or prevents the sending of the following IEs:
- Connected number
  - Low-layer compatibility
  - Calling-party number
  - Display
  - Logical-link identification
  - TCM
  - Link-layer parameters
  - Packet-layer parameters
  - Look-Ahead interflow

## Procedure 103

- Field 14                    This field must be set to **1** for all trunk groups whose signaling type is DMI ISDN MOS (type 20). This insures that all outgoing address digits are collected before the switch selects an outgoing ISDN-PRI trunk and assuring that a correct called party number IE in the outgoing setup message.

## Procedure 107 Word 1

This procedure is used to assign terminating test line telephone number digits to ISDN-PRI trunk groups. When placing a trunk verification by station (TVS) or trunk verification by customer (TVC) test call, these digits are used to build the called party number IE in the setup message for the trunk group under test. If digits are not translated for a trunk group and a TVC/TVS call is made for a channel in this trunk group, the resulting called party number IE will not contain address digits.

The following rules are used in building this IE. These rules apply to all types of calls made out of the switch and not just test calls. The rules are checked by the system in the order shown below. The first true rule encountered results in the IE being built as shown for that rule.

- For international calls (that is, a dial **011** calls)

Opcode: 7 (assuming no codeset mapping)

Numbering plan identification: telephony numbering plan

Type of address: international number (address digit octets follow)

- For ARS calls  
Opcode: 7 (assuming no codeset mapping)  
Numbering plan identification: telephony numbering plan  
Type of address: national number (address digit octets follow)
- For calls placed over a channel whose interface endpoint in procedure 116 specifies **network**  
Opcode: 7 (assuming no codeset mapping)  
Numbering plan identification: telephony numbering plan  
Type of address: national number (address digit octets follow)
- For AAR calls and calls placed over a channel whose interface endpoint in procedure 116 specifies either **host** or **PBX**  
Opcode: 7 (assuming no codeset mapping)  
Numbering plan identification: private numbering plan  
Type of address: unknown (address digit octets follow)

### Procedure 108 Word 1

This procedure is used to assign the terminating test-line telephone digits to an ISDN-PRI trunk group.

These are the address digits used to build the called party number IE in the setup message when making a demand test call via procedure 648 test 3. If digits are not translated, address digits do not appear in the IE.

The coding rules for the called party IE given in the [“Procedure 107 Word 1”](#) section of this appendix also apply to this word.

### Procedure 116 Word 1

This procedure is used to assign ISDN-PRI B channels to trunk groups.



**NOTE:**

Ensure that the interface endpoint field is assigned correctly for each B channel.

Field 10 determines the encoding of the called party IE as discussed in the [“Procedure 107 Word 1”](#) section of this appendix. If the B channel is in an ISDN dynamic trunk group, this field determines how an incoming call over the trunk is processed (see the [“Procedure 100 Word 1”](#) section earlier in this appendix).

Field 11 specifies the D-channel group associated with the channel. This information is used in constructing the channel-ID

## Procedure 210 Word 2

Field 5 of this word is used to assign an NPA-NXX designator to an attendant console.

If an attendant console is not assigned this designator, calls originated from this console over an ISDN-PRI trunk do not have a calling party number IE in the setup message. Likewise, calls terminating to this console over ISDN-PRI trunks do not have connected number IEs in the connect messages (see the ["Procedure 354 Word 3"](#) section of this appendix).

## Procedure 260 Word 1

This procedure is used to assign DS1 or ISDN characteristics to physical locations. Setting field 14 (application type) to **5** enables ISDN functionality for the specified physical location.

## Procedure 262 Word 1

This procedure defines various ISDN board parameters. Default values are automatically assigned when a board is added in procedure 260 with an application type of **ISDN-PRI**.

Field 5 of this word specifies an interface type of network or user. For an ISDN-PRI point-to-point link to function, one end must be translated as network and the other end as user.

This field also determines how glare is handled on this board. The following rules apply to glare handling:

- P** Requests the channel as a preferred channel (this is done in the channel-ID IE of the setup message)
- E** Requests the channel exclusively (this is done in the channel-ID IE of the setup message)
- U** Specifies that the switch's side of the interface is the user side
- N** Specifies that the switch's side of the interface is the network side  
.IX "Network side specification"
- X** Specifies that it is not important which is the network side or the user side
- 1** Specifies that the incoming call gets the channel and outgoing call waits to be negotiated
- 2** Specifies that the outgoing call gets the channel and the switch negotiates the incoming call to another channel
- 3** Outgoing call gets the channel and the switch gives a release (REL) complete (COM) on the incoming call

- 4 Specifies that the incoming call gets the channel and the switch waits for the other end of the interface to respond (the switch would expect the other end of the interface to reject its outgoing call attempt)

Table A-1. Internal Definition Translations

Internal Definition	Channel Characteristics on Outgoing Call from Switch	Channel Characteristic on Incoming Call to Switch	Result
X	P	E	1
X	E	P	2
N	P	P	2
U	P	P	1
N	E	E	3
U	E	E	4

Generic 2 calls request channels as preferred except for ISDN-DCS calls which requests channels as exclusive.

Field 6 of this word controls whether level-2 and level-3 tests may be performed on this board via procedure 648.

Field 7 of this word identifies the terminal endpoint for an ISDN-PRI board (this must always be translated as **0**).

Fields 8, 9, and 10 of this word define T203, T200, and N200 respectively. By varying these fields, the level-3 timer values can be changed. N200 and T200 affect the T303, T305, T308, and T313 timers according to the following equation:

$$(\text{timer value}) = (N200 + 1) * T200$$

The default value of these four timers is 4 seconds  $[(3 + 1) * 1]$ .

T321 is defined as T203 + 10 seconds. As T203 defaults to 30 seconds, T321 is defined as a 40 second timer. If the physical location is part of a nonfacility associated signaling (NFAS) arrangement, field 13 identifies this interface from other interfaces in the arrangement. This information is also used in the coding of the channel-ID IE.

### Procedure 262 Word 3

---

This word is used to enable or disable the codeset mapping and D-channel hyperactivity detection features for Generic 2. These features are defined on a PRI interface basis.

### Procedure 275 Word 4

---

Field 14 of this word is used to enable ISDN. No ISDN messaging or feature processing occurs unless this field is set to a 1.

### Procedure 279 Word 1

---

This procedure defines information that is sent out in the NSF IE of the setup message for Generic 2. This IE requests a service or feature from the remote end of the ISDN link for a particular call.

All known features or services requested by or of the Generic 2 switch must be translated in this procedure. The correct encodings for the feature or service are to be obtained from the *AT&T ISDN Primary Rate Interface Specification*. Examples of such services are SDN, MEGACOM 800, MEGACOM, INWATS, WATS, and ACCUNET switched digital service.

The encoding of the NSF IE is discussed further in the Procedure 309 Word 5 section of this appendix.

### Procedure 280 Word 1

---

This procedure can alter opcode values of IEs and affect the codeset associated with an IE. In System 85 R2V4 user-to-user information is associated with codeset 7 while in Generic 2 it is associated with codeset 6.

The following IEs have changed opcode values between System 85 R2V4 and Generic 2:

**Table A-2. System 85 R2V4 to Generic 2 IE Opcode Translations**

Information Element (IE) Name	IE Opcode Value	
	R2V4	G2
Link layer parameters	1	64
Packet layer parameters	2	62
Logical link identification	4	26

The following two user-to-user IEs kept the same opcode values in their move from codeset 7 to codeset 6:

Table A-3. User-to-User IE Opcodes

Information Element (IE) Name	Opcode Value
Traveling class mark	8
Display	40

Generic 2 switches map outgoing user-to-user information to codeset 7 if communicating with a System 85 R2V4. Also, incoming codeset 7 information from a System 85 R2V4 is mapped to codeset 6 for interpretation by a Generic 2 switch.

In general, the following mappings are recommended for Generic 2 switches when they are in a network that contains at least one System 85 R2V4 switch:

Table A-4. Codeset Map Number to Incoming and Outgoing Translations

Procedure 280			
Mapped From: Codeset Map Number	Mapped To: Incoming/ Outgoing	Codeset/ Opcode Value	Codeset/ Opcode Value
X <sup>1</sup>	I	7/1	6/64
X	I	7/2	6/62
X	I	7/4	6/26
X	I	7/8	6/8
X	I	7/40	6/40
X	O	6/64	7/1
X	O	6/62	7/2
X	O	6/26	7/4
X	O	6/8	7/8
X	O	6/40	7/40

1. X represents any codeset map number

## Procedure 309 Word 5

This word deals with the sending of a particular NSF IE in the setup message and with rules of route selection.

### **Field 4, ISDN Trunk Type**

This field can only contain a value when the trunk group associated with the plan, pattern, or preference has a type of ISDN dynamic. Here, it must have a value entered or the outgoing call over this preference will fail. The selection of a trunk type is not crucial since the ARS feature determines code flow more so than does the trunk type. However, an appropriate trunk type should be selected for the calls associated with this plan, pattern, or preference.

### **Field 5, Network Service Value**

The value entered in this field along with the value entered in field 12 of procedure 309, word 1 (the IXC/ISDN network identifier) determine the

NSF IE for calls routed over this plan, pattern, or preference. An NSF IE is not sent if a value is not entered. If field 5 has no value but an IXC/ISDN network identifier is specified, the network identification is specified with the transit network selection IE instead of the network-specific facilities IE.

The following subsections examine the layout of this IE.

#### **OUTWATS Band NSF**

These values specify that the plan, pattern, or preference is requesting service for OUTWATS bands 0-255 respectively.

Opcode: 2

The following three items are sent only if field 12 of procedure 309, word 1, is nonzero procedure 309, word 1, is nonzero.

Network identification plan: carrier identification code

Type of network identification: national network identification

Network identification: (three octets show the value entered in field 12 of procedure 309, word 1)

Facility coding value: 1

Feature/service: service

Parameter/binary: binary

#### **MEGACOM NSF**

Opcode: 2

The following three items are sent only if field 12 of procedure 309, word 1, is nonzero.

Network identification plan: carrier identification code  
Type of network identification: national network identification  
Network identification: (three octets show the value entered in field 12 of procedure 309, word 1)  
Facility coding value: **3**  
Feature/service: service  
Parameter/binary: binary

### WATS NSF

Opcode: 2

The following three items are sent only if field 12 of procedure 309, word 1, is nonzero.

Network identification plan: carrier identification code  
Type of network identification: national network identification  
Network identification: (three octets show the value entered in field 12 of procedure 309, word 1)  
Facility coding value: **5**  
Feature/service: service  
Parameter/binary: binary

### ACCUNET NSF

This value requests ACCUNET switched digital service from a 4E13 or later generic.

Opcode: 2

The following three items are sent only if field 12 of procedure 309, word 1, is nonzero.

Network identification plan: carrier identification code  
Type of network identification: national network identification  
Network identification: (three octets show the value entered in field 12 of procedure 309, word 1)  
Facility coding value: **6**  
Feature/service: service  
Parameter/binary: binary

In Generic 2, services and features are administered in procedure 279. The number entered in field 5 is not a fixed number as in System 85 R2V4; instead it is the ISDN network service value number assigned to the feature or service in procedure 279.

The list below defines how the following fields of the NSF are coded:

- Facility coding value
- Feature/service



- Parameter/binary
- Parameterized field

The following fields of the NSF follow the same rules as given for System 85 R2V4 NSFs:

- Network identification plan
- Type of network identification
- Network identification

Rules for requesting ACCUNET services from different generics of 4ESS are the same as those for System 85 R2V4. That is, when dealing with 4E13 or later, set up a definition of a binary service with a value of **6**. This definition is used in field 6 of procedure 309, word 5, that sends an NSF (this is the parallel to the above example for System 85 R2V4 where a value of **357** was used).

For generics before 4E13, NSF is not sent; instead, the setup message needs a mode 1 code. For Generic 2, there is no special encode that causes message creation to do this automatically. Therefore, the calling party wishing to access ACCUNET from generics before 4E13 must have a BCCOS of mode 1.

## BC

BC is assigned with field 6 for Generic 2. This field has implications as far as call routing is concerned. Some routing rules are discussed in the [“Procedure 010 Word 4”](#) section of this appendix. Additional routing rules based on the bearer capability translation associated with a plan, pattern, or preference are described next.

### Field 6 (Generic 2)

Field 16 of procedure 014, word 1, defines the BC for the calling party's COS. Fields 4 through 13 of procedure 014, word 1, define the bearer capability COS of the preference. Field 6 of procedure 309, word 5, defines how to handle calling parties. If a calling party with a particular BC is to be blocked from using this preference, the next preference is checked. If all preferences block this particular BC, the call is denied.

In addition, Generic 2 also implements the following routing rules:

- When searching the preferences, the highest preference number is used that can handle the call via circuit switching instead of using a modem pool member (where the number  $\backslash E3 \ 1 \ E1$  is the highest possible preference). This is done to conserve the use of modem pool members. (Of course, all other routing rules discussed in this appendix must also be met for this preference.) If a circuit switched preference cannot be found, the highest non-circuit switched preference is used. Fields 4 through 13 of procedure 014, word 1, define circuit versus non-circuit switching for the BCCOS entered in field 6 of procedure 309, word 5.

- A calling party with clear channel characteristics is blocked from using a preference with restricted channel characteristics.  
.IX "Restricted channel"  
All other calling party and preference clear or restricted combinations are allowed.

The calling party's clear or restricted characteristic of the calling party's BCCOS is defined in field 15 of procedure 014, word 1.

The preference's characteristic is found by examining field 3 for the BCCOS entered in field 6 of procedure 309, word 5.

### Procedure 321 Word 5

This word defines for AAR patterns and preferences what procedure 309, word 5, defines for ARS plans, patterns, and preferences. The fields in these two procedures are similar. Refer to the "[Procedure 309 Word 5](#)" section earlier in this appendix for information on how to administer this procedure (all rules and field definitions are identical).

### Procedure 354 Word 3

This word is used to assign up to 99 unique NPA-NXX pairs. For example, a location can have two distinct designators: one for voice extensions (such as 303-538) and one for data endpoints (such as 303-255).

Generic 2 sends out 10 address digits for calling party number and connected number. The NPA-NXX portion of the number is defined in this word via fields 2 and 3. These 6 digits are prepended to the last 4 digits of the extension number to create the 10 address digits. (If a console is involved, the last 4 digits of the assigned listed directory number (LDN) are used.)

In addition, a thousands digit can be assigned in field 4. This digit must be assigned in 3-digit switches for the calling party number and connected number to make sense. If assigned in a 4 or 5-digit switch, it is used for the thousands digit in the address digit stream regardless of what the thousands digit is for the extension or LDN.

- Calling-party number IE  
Opcode: 6C (assuming no codeset mapping in Generic 2)  
Numbering plan identification: telephony numbering plan (The exception to this is in Generic 2 on a BRI-to-BRI call within the switch where **Private Numbering Plan** is used)  
Type of address: national number (The exception to this is in Generic 2 on a BRI-to-BRI call within the switch where **Unknown** is used.) The 10 address-digit octets follow the above information.

- Connected number IE

Opcode: C (assuming no codeset mapping in Generic 2)

Numbering plan identification: telephony numbering plan

Type of address: national number (the 10 address-digit octets follow the above information)

## Procedure 420

---

Type-2 data can be useful in determining which regular tasks are using an abnormally high amount of processor time. The data in field 3 of this procedure multiplied by 100 is the number of times this task has been interrupted by the 10-ms interrupt. An unusually high number in field 3 (compared to the other regular tasks) shows that the task number in field 2 is currently a processor-occupancy hog. This condition is normally an error condition and can point to problems with the feature controlled by the regular task. The following are ISDN-related tasks and their task numbers for Generic 2:

Task 35	ISDN queue server task
Task 47	ISDN level-3 timing task
Task 55	ISDN JUMBO I/O task
Task 61	ISDN incoming message-verification task
Task 62	ISDN applications service element queue server
Task 70	ISDN applications call-processing queue server
Task 79	ISDN applications 100-ms timing task
Task 85	ISDN applications 2-sec. timing task
Task 93	ISDN BRI terminal initialization
Task 108	SNC trunk group audit task

# Digital Trunk Administration Summary for U.S. Applications

# B

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The tables in this appendix serve as a quick reference to some of the trunk group administration settings for DS1-based trunks in the U.S. given the applications for the trunks.

- The tables are organized by the bearer capability class (BCC) of the information they transport, as follows:
  - Digital trunks can carry voice or voice-grade data.
  - Digital trunks can carry 64 kbps data per channel. Digital multiplexed interface (DMI) modes 0, 2, and 3 all use 64 kbps channels.
  - Digital trunks can carry 56 kbps data per channel, also called DMI mode 1.
- Each table is divided into several categories, as follows:
  - *Trunk application* identifies the type of equipment to which the DEFINITY system is connected via the trunk, such as a local exchange switch, a toll switch, another PBX, or to some other specialized equipment.
  - *Service* is the purpose for which the trunk is used.
  - *Connectivity* is the specific equipment to which the far end of the trunk is connected.
  - *Administration* options are the key items that must be administered for the trunks on the DEFINITY systems. These are the recommended administration settings and often the only correct ones.
  - *Interface circuit* is the circuit pack on the DEFINITY system to which the trunk connects.

**B Install and Wire Telephones and Other Equipment**

**Table B-1. Digital Trunk Administration Summary for U.S. Applications — Voice BCC**

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Local Exchange Company Trunks	Direct outward dial (DOD) Attendant-completing inward dial	Connected to a local exchange carrier's central office switch via T1/E1 line	Regular CO Type 19	E&M auto/wink Type 19	CO	Ground start	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	Direct outward dial (DOD) Attendant-completing inward dial	Connected to a foreign exchange central office via T1/E1 line	Foreign exchange trunk Type 24	E&M auto/wink Type 24	FX	Ground start	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	Incoming and outgoing WATS	Connected to local exchange carrier's central office switch via T1/E1 line	WATS trunks Types 26, 27	E&M auto/wink Type 24	WATS	Ground start	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	Direct inward dial (DID)	Connected to local exchange carrier's central office switch via T1/E1 line	DID trunk Type 31	Wink/wink -delay Type 11	DID	Wink start	NA	Robbed Bit	D4 or ESF	XCS	ANN11	TN767 TN464C (G3 only)
	CO, FX, DID, In WATS, Out WATS via ISDN PRI	Connected to 5ESS® or Meridian® SLI central office switch via T1 line with ISDN PRI	Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tie	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN35	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)

Continued on next page

**B Install and Wire Telephones and Other Equipment**

**Table B-1. Digital Trunk Administration Summary for U.S. Applications — Voice BCC — Continued**

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Special Access Trunks	MEGACOM service MEGACOM 800 service w/ DNIS MultiQuest service w/ DNIS Software-Defined Network service	Connected to 4ESS® via ACCUNET T1.5 access — non-switched special access provided by AT&T or LEC.	Tie trunk Type 41	4-wire E&M Wink/wink Type 21	Tie	Wink/ wink	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	MEGACOM 800, no DNIS MultiQuest service, no DNIS	Connected to 4ESS® via ACCUNET T1.5 access — non-switched special access provided by AT&T or LEC.	Regular CO Types 19 or 16	Auto/imm ediate or auto/wink Type 28 or 29	Tie	Wink/ wink	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	MEGACOM service via ISDN PRI MEGACOM 800 service via ISDN PRI MultiQuest service via ISDN PRI Software-Defined Network service via ISDN PRI	Connected to 4ESS® via ISDN PRI access — non-switched special access provided by AT&T or LEC.	Tie trunk Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tie. For international MEGACO M and international MEGACO M 800 services; you must use the call-by-call service type.	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities.	ANN35	TN767 TN464C (G3 only) <sup>2</sup> TN767 plus TN555 (G2)

Continued on next page

**B Install and Wire Telephones and Other Equipment**

**Table B-1. Digital Trunk Administration Summary for U.S. Applications — Voice BCC — Continued**

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Tie Trunks	ETN access	Access the trunk connecting an ETN main PBX to an ETN tandem PBX via private leased T1/E1 lines from the LEC and/or IXC.	Tie Type 46	4-wire E&M Wink/wink -delay Type 24	Tie	Wink/wink	Voice	Robbed Bit or 24th Ch.	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
			Special tie Type 78	4-wire E&M Delay/delay Type 17	Tie	Wink/wink	Voice	Robbed Bit or 24th Ch.	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
	ETN with DCS	Intermachine tie trunk connecting two ETN tandem PBXs via leased T1/E1 lines from LEC and/or IXC.	Tie trunk Type 41	4-wire E&M Wink/wink Type 17	Tandem	Wink/wink	Voice	Robbed Bit or 24th Ch.	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
			Tie trunk Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tandem	24th Ch.	D4 or ESF	ZCS	ANN35	TN767 TN464C (G3 only) <sup>2</sup> TN767 plus TN555 (G2)
Remote Access Trunks	Tandem tie trunk private network	Connected to another PBX via private T1/E1 lines leased from LEC and/or IXC.	Tie, dial repeating Type 36	4-wire E&M Immediate start Type 04	Tie	Immed/immed	Voice	Robbed Bit or 24th Ch.	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
			Remote access Type 50	E&M Immed/immed Type 04	CO, FX or WATS	Auto/auto	Voice	Robbed Bit	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)

1. The TN464C must be used for the trunk transporting the ISDN PRI D-channel on G3r. The B-channels can still utilize the TN767 if NFAS is used.  
 2. The TN464C must be used for the trunk transporting the ISDN PRI D-channel on G3r. The B-channels can still utilize the TN767 if NFAS is used. For simplicity, however, it is recommended that the TN464C be used for all ISDN PRI trunks in G3r.

B Install and Wire Telephones and Other Equipment

Table B-2. Digital Trunk Administration Summary for U.S. Applications — 64 kbps Channel — Modes 0, 2, 3 BCCs

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		C2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Release Link Trunks	Centralized Attendant Service	Connects to a branch PBX to a main PBX in a Centralized Attendant Service network	57 at branch, 66 at main	Release link trunk Types 13 at branch, 14 at main	RLT	Immed/ auto	Voice	Robbed Bit or 24th Ch.	D4 or ESF	ZCS	ANN11	TN767 TN464C (G3 only)
Local Exchange Company Trunks	Direct outward dial, attendant completing inward dial, direct inward dial, incoming and outgoing WATS	Connected to a 6ESS® central office switch via T1 line with ISDN PRI.	Tie Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tie	24th Ch.	D4 or ESF	ZCS or B8Z, depending on restrictions of facilities.	ANN35	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)
Special Access Trunks	ACCUNET Switched Digital Services via ISDN PRI Software-Defined Data Network (SDDN) service via ISDN PRI	Connected to 4ESS® via ISDN PRI access — non-switched special access provided by AT&T or LEC	Tie trunk Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tie	24th Ch.	D4 or ESF	ZCS or B8Z, depending on restrictions of facilities, International ACCUNET service only allows unrestricted data	ANN35	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)

Continued on next page



**B Install and Wire Telephones and Other Equipment**

**Table B-2. Digital Trunk Administration Summary for U.S. Applications — 64 kbps Channel — Modes 0, 2, 3 BCCs — Continued**

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Tie Trunks	Tandem tie trunk private network	Connected to another PBX with a DS1/CEPT interface via leased T1/E1 lines from LEC and/or IXC.	Tie, dial repeating Type 36 AVD	4-wire E&M Immediate start Type 04	Tie	Tie	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)
	ETN with DCS	Intermachine tie trunk connecting ETN tandem systems via leased T1/E1 lines from LEC and/or IXC.	Tie Type 41 AVD	4-wire E&M Wink/wink -delay Type 26	Tandem	Wink/wink	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)
	ETN with DCS Over ISDN PRI B-channel or D-channel	Intermachine tie trunk connecting two ETN tandem PBXs (AT&T or other vendors) via leased T1/E1 lines from LEC and/or IXC with ISDN PRI.	Tie Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tandem	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN35
	ETN access	Access tie trunk connecting an ETN main PBX to an ETN tandem PBX with a DS1/CEPT interface via leased T1/E1 lines from LEC and/or IXC.	Tie Type 46 AVD	4-wire E&M Wink/wink -delay Type 26	Tie	Wink/wink	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11 TN767 (G2)	TN767 TN464C (G3 only)
	Main/satellite private network Main/satellite with DCS	Trunk from main to satellite PBX via leased T1/E1 lines from LEC.	Special tie Type 78 AVD	4-wire E&M Delay/delay Type 17	Tie	Delay/delay	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)

1. The TN464C must be used for the trunk transporting the ISDN PRI D-channel on G3r. The B-channels can still utilize the TN767 if NFAS is used. For simplicity, however, it is recommended that the TN464C be used for all ISDN PRI trunks in G3r.

B Install and Wire Telephones and Other Equipment

Table B-3. Digital Trunk Administration Summary for U.S. Applications — 56 kbps Channel — Mode 1 BCC

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Local Exchange Company Trunks	Direct outward dial, attendant completing inward dial, direct inward dial, incoming and outgoing WATS	Connected to 5ESS® via T1 line with ISDN PRI	Tie Type 41	ISDN PRI Type 20	ISDN PRI	Tie	Tie	24th Ch.	D4 or ESF	ZCS or B8Zs, depending on restrictions of facilities.	ANN35	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)
			Tie Type 41	ISDN PRI Type 26	Tie	Robbed bit/AVD	Robbed Bit	D4 or ESF	ZCS or B8Zs, depending on restrictions of facilities.	ANN11	TN767 TN464C (G3 only)	
Special Access Trunks	ACCUNET Switched 56 service Software-Defined Data Network service	Connected to 4ESS® via ACCUNET T1.5 access — non-switched special access provided by AT&T or LEC	Type 41	4-wire E&M Wink/wink Type Z1	Tie	Data	Robbed Bit	D4 or ESF	ZCS or B8Zs, depending on restrictions of facilities.	ANN11	TN767 TN464C (G3 only)	
			Tie trunk Type 41	ISDN PRI Type 20	ISDN PRI	Tie	Tie	24th Ch.	D4 or ESF	ZCS or B8Zs, depending on restrictions of facilities.	ANN35	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)

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**B Install and Wire Telephones and Other Equipment**

**Table B-3. Digital Trunk Administration Summary for U.S. Applications — 56 kbps Channel — Mode 1 BCC — Continued**

Trunk Application	Service	Connectivity	Administration Options						Interface Circuit			
			G2		G1/G3		DS1 Board		G2 Traditional Module	G1/G3 and G2 Universal Module		
			Trunk Type	Trunk Signaling Type	Group Type	Trunk Type	Comm/Service Type	Signaling			Framing	Line Coding
Tie Trunks	Tandem tie trunk private network	Connected to another PBX with a DS1/CEPT1 interface	Tie, dial repeating Type 36	4-wire E&M immediate start Type 04	Tie	Immed/immed	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)
	ETN with DCS	Intermachine tie trunk connecting ETN tandem systems via leased T1/E1 lines from LEC and/or IXC.	Tie Type 41	4-wire E&M Wink/wink-delay Type 26	Tandem	Wink/wink	Robbed Bit/AVD	Robbed Bit	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)
	ETN with DCS Over ISDN PRI B-channel or D-channel	Intermachine tie trunk connecting two ETN tandem PBXs (AT&T or other vendors) via leased T1/E1 lines from LEC and/or IXC with ISDN PRI.	Tie Type 41	ISDN PRI Type 20	ISDN PRI	ISDN PRI	Tie	Robbed Bit	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN85	TN767 TN464C (G3 only) <sup>1</sup> TN767 plus TN555 (G2)
	ETN access	Access tie trunk connecting an ETN main PBX to an ETN tandem PBX with a DS1/CEPT1 interface via leased T1/E1 lines from LEC and/or IXC.	Tie Type 46	4-wire E&M Wink/wink-delay Type 26	Tie	Wink/wink	AVD	24th Ch.	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)
Main/satellite private network Main/satellite with DCS	Trunk from main to satellite PBX via leased T1/E1 lines from LEC.	Special tie Type 78 AVD	4-wire E&M Delay/delay Type 17	Tie	Delay/delay	Robbed Bit/AVD	Robbed Bit	D4 or ESF	ZCS or B8ZS, depending on restriction of facilities	ANN11	TN767 TN464C (G3 only)	

1. The TN464C must be used for the trunk transporting the ISDN PRI D-channel on G3r. The B-channels can still utilize the TN767 if NFAS is used. For simplicity, however, it is recommended that the TN464C be used for all ISDN PRI trunks in G3r.

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