TOTAL CONTROL™

Dual T1/PRI Card and Dual T1 NIC

Version 1.5

Installation/Operation Manual

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Chapter 1
Overview

The Total Control Enterprise Network Hub uses the Dual T1 Network Interface Card (NIC) and the Dual T1/PRI Network Application Cards (NACs) to terminate both ISDN PRI lines and T1 span lines, and process incoming calls.

This chapter begins with information specific to this release of the Dual T1/PRI Network Application and Interface Cards, followed by a summary of the contents of each chapter and information on additional sources for related technical information. An overview of ISDN and a brief discussion of ordering T1 service from your service provider concludes the chapter.

New In This Release

Version 1.5 of the Dual T1/PRI Network Application Card (NAC) and Network Interface Card (NIC) offers the following new feature:

- Support for Single-sided Quad Modem Card

> **Note:** Consult Chapter 6, *Call Processing and Routing*:, for a further description of this new feature.

Minimum Compatible Release Levels

In order to support the new features for release 1.5, the minimum compatible software version levels shown in Table 1-1 must be met or exceeded on the related cards in the chassis.

Table 1-1. Minimum Compatible Release Levels

System Entity	Minimum Release Level
Quad V.34 Analog/Digital Modem	Version 3.0
Network Management Card	Version 4.0
Total Control Manager/SNMP	Version 4.0

Digital Incoming Call Support

The Dual T1/PRI NAC version 1.5 supports digital incoming calls based on the Sync PPP, V.110, and V.120 protocols. Each of these protocols is described as follows:

Sync PPP Protocol, used primarily in the United States, that defines a fixed rate method for transmitting packets over serial, point-to-point links.

V.110 Protocol, used primarily in Europe and Japan, that defines the ISDN Data Terminal Equipment (DTE) specifications.

V.120 Protocol, used primarily in the United States, that defines the ISDN Data Terminal Equipment (DTE) specifications.

Inbound Call Configuration Menu

Connecting a VT100 terminal, or a PC using a terminal emulation program, to the RS-232 Operator Interface port on the Dual T1 NIC allows an operator to configure and manage the Dual T1/PRI NAC using menu-driven screens. Once the PC or terminal is connected and the terminal or emulation program settings are compatible (8-N-1 and COM port = to the DIP switch settings on the NAC), press the Return key to display the Operator Interface Main Menu.

NOTE: A remote operator configures the T1/PRI NAC by dialing into a modem connected to the RS-232 Operator Interface port. Once the modems are connected, pressing the Return key displays the following Main Menu on the remote terminal screen.

```
U.S. Robotics, Inc. © 1996
Dual T1/PRI Application Card Revision 1.5.0
Boot Code Linked Date:      Mon Dec 04 17:41:48 1995
Operation Code Linked Date: Sun Mar 10 16:24:40 1996
Main Menu
1 Command
2 Status
3 Card Configuration
4 Inbound Call Routing Configuration
5 Span Line 1 Configuration
6 Span Line 2 Configuration
7 SW Fault Manager Event Logging

Enter menu selection and press Return.
Menu Selection (1-7):
```

To select an option from the Main Menu, type the number of the desired selection, and press Return. At any point within the menu structure, press Esc to return to the previous menu.

Multiple PRI Card Configuration Support

The Total Control Chassis now supports multiple Dual T1/PRI Card configurations. The chassis allows for support of up to five Dual T1/PRI Cards in slots one through five. As a result, the Dual T1/PRI version 1.5 firmware has been revised to reflect multiple cards.

Single-sided Modem Support

The Total Control Chassis now allows for the support of single-sided Quad Modem Cards.

About This Manual

This manual covers both the hardware and software aspects of the Dual T1 Network Interface Card (NIC) and the Dual T1/PRI Network Application Card (NAC).

NOTE: For additional information, please consult the *NMC Reference Manual*, the *SNMP MIB Reference Manual*, and the *Total Control Manager/SNMP Software Guide*, and any other specific titles in the Total Control Reference Library. Contact your Sales Representative for further information.

The chapters contained in this manual are organized as follows:

- **Chapter 1 Overview**

  Contains a general description of ISDN service with an emphasis on PRI features and a description of some considerations to account for when ordering T1/PRI service.

- **Chapter 2 Dual T1 Network Interface Card**

  Contains a functional description of the card and a description of the chassis midplane interface connections.

- **Chapter 3 Dual T1/PRI Network Application Card**

  Contains a functional description of the card components and a description of how to configure hardware switches.

- **Chapter 4 Installation**

  Contains instructions for installing the cards into the chassis. In addition, it describes startup issues, including chassis configuration options and diagnostic information.

- **Chapter 5 RS-232 Operator Interface**

  Contains information on the user interface connections available for manually configuring the cards via software with a local console.

- **Chapter 6 Call Processing and Routing**

  Contains information describing the call types processed by the Dual T1/PRI. Call handling issues, including call recognition, routing decisions, and call routing tables, are described from setup to tear down. This chapter concludes by describing the impact of chassis configuration options on call routing.

- **Appendix A Dual T1/PRI Card Operator Interface**

  Contains a menu-by-menu description of the operator interface screens, which are used to manually configure the cards via software control and view the card alarm and status indicators.

- **Appendix B Technical Specifications**

  Provides detailed information about the interfaces and mechanics of the cards.

Conventions Used in this Manual

Although established international telecommunications standards and nomenclatures are widely used and accepted throughout the world, each country uses some words and abbreviations that are unique to that country or area. These terms include the following:

- TELCO is a commonly used acronym in the United States. Telekom is commonly used in Germany. The acronym PTT (Post Telephone and Telegraph) is used to represent a central switching and service provisioner.
- The terms E1/PRI line and E1 span line are used in place of European S2M lines where applicable.

To minimize confusion, terms are defined when first used.

For Additional Information

The Total Control directory (#15), located on both the U.S. Robotics BBS (847-982-5092) and the Internet ftp site (ftp.usr.com / dl15), is an additional source for technical information. Anonymous Internet ftp may be used to download the files. Each file listed in the following directory is available in Adobe Acrobat Portable Data Format (*.PDF):

- Regularly updated MIBs
  Information provided in ASCII text (*.MIB).
- Application Notes
- Technical Bulletins
- Reference Manuals
- Release Notes

PDF File Notes

The Adobe Acrobat *.PDF files located in the Total Control directory may be downloaded. The Acrobat Reader program is required to view the files.

Adobe provides free Reader software versions for the following operating systems:

- DOS
- Windows
- Macintosh
- UNIX

To contact Adobe directly, access either of the following locations:

- The Internet ftp:

  ftp.adobe.com/pub/adobe/Applications/Acrobat

- The World Wide Web Home Page:

  http://www.adobe.com/

U.S. Robotics provides Acrobat Reader software on its BBS in the MISC directory. To view a document in Adobe Acrobat *.PDF format, follow these steps:

1. Download the Reader software.
2. Install it on your computer.
3. Launch the program.
4. Open the *.PDF document file.

Comments or Suggestions

Every effort has been made to provide useful and accurate information. Direct any comments or suggestions to either of the following locations:

By voice mail: (847) 933-5200

Email: sysdocs@usr.com

ISDN Overview

Integrated Services Digital Network (ISDN) transports both voice and digital network services over a single medium. This section contains general information on the features and capabilities of ISDN with a focus on ISDN Primary Rate Interface (PRI).

ISDN utilizes out of band signaling techniques to provide data communications networks with universal connectivity over digital lines. ISDN architecture is based on the International Telephone Union-Telecommunications (ITU-T) standards.

ISDN provides three broad categories of service that support a wide variety of user requirements.

- **Bearer Services**. This category supports the following digital telephony requirements:
  - Inbound / outbound circuit switched
  - Packet switched
  - Frame relay
- **Teleservices**. This category supports the following services:
  - E-mail
  - Videotex
  - Teletex
  - Facsimile
- **Supplementary Services**. This category provides the following digital feature capabilities beyond call setup and tear down:
  - Fast dialing
  - Caller line identification (CLID)
  - Call waiting / forwarding
  - Conference calling

ISDN Service

ISDN provides digital transmission of the following:

- Voice
- Data
- Studio-quality sound
- Still and moving images

ISDN calls:

- maximize available resources.
- reduce call setup times.
- provide flexibility in call routing via software configuration.
- minimize call rejection.

Two types of ISDN transmission rates are currently available—Basic Rate Interface (BRI) and Primary Rate Interface (PRI).

Both the BRI and PRI services use two types of channels—B-channels and D-channels. The B-channels (bearer channels) carry user data and the D-channels carry signaling data.

Through the use of bonding or inverse multiplexing, several combinations of B- and D-channels are possible. When multiple channels are bonded or multiplexed, they are called H-channels. Examples of H-channels carrying both circuit and packed switched user data include:

H_0 Equal to 6 B-channels
64 Kbps x 6 = 384 Kbps

H_{11} Equal to 24 B-channels
64 Kbps x 24 = 1536 Kbps
(less the framing bit) using T1

NOTE: H_{11} is only possible in services that utilize multiple T1 span lines, where signaling is transmitted through another D-channel.

BRI Service

ISDN BRI transmits digital data by dividing the existing twisted pair local loop into three separate channels—two 64 Kbps B-channels and one 16 Kbps D-channel. This service is referred to as 2B+D. The B-channels carry user data and the D-channel carries signaling information and low-speed packet data.

PRI Service

ISDN PRI transmits digital data over 23 B-channels (64 Kbps) and 1 D-channel (64 Kbps) for a total bandwidth of 1.544 Mbps transmission over a span line. This service is referred to as 23B+D. The B-channels carry user data and the D-channel carries signaling information and low-speed packet data.

> **NOTE**: In countries using E1 span lines, ISDN PRI service utilizes 30 B-channels and 1 D-channel for a total bandwidth of 1.92 Mbps. This service is referred to as 30B+D.

Incoming B-channel and D-channel calls are sensed and routed—via device detection schemes—to the appropriate devices.

PRI User Data (B-Channels)

Each of the 23 PRI B-channels carry user data at a transmission speed of either 56 Kbps or 64 Kbps.

PRI Signaling Data (D-Channels)

The D-channel protocol is defined in ITU-T Q.921 and Q.931. The PRI D-channel transports signaling data at 64 Kbps for each B-channel riding on a T1 interface. Signaling information includes call setup and tear down messages, and out-of band information. This arrangement clears the B-channels to carry only user data.

Setup and tear down information includes called number, bearer capability, B-channel time slot assignment, etc. This message-based system allows calls to be setup much more rapidly than robbed bit (channelized) T1 setup times.

The T1 / PRI D-channel is assigned to time slot 24.

> **NOTE**: The E1 / PRI D-channel is assigned to time slot 16 while time slot 0 is used for frame alignment.

PRI Combined Data (H-Channels)

ISDN B-channel usage allocations are combined, through software control, into H-channel pipes to accommodate various load requirements.

PRI Protocols and Standards

Rate adaptation is a process whereby terminal adapters either negotiate or adjust bandwidth to meet the requirements of each call. Euro ISDN initiated calls exchange a burst of information to and from the customer site and PTT on the D-channel, including the following information:

- Nature of the call
- Type of bearer service requested
- Phone number called

The rate adaptation and signaling protocols, used to standardize the transmission of this information include:

ETS 300 011	ETSI standard that defines the Euro ISDN PRI user-network Layer 1 specification and test principles.
ETS 300 125	ETSI standard that defines the Euro ISDN user-network interface Layer 2, data link specification.
ETS 300 102-1	ETSI standard that defines the Euro ISDN user-network interface Layer 3 specifications for basic call control.
ETS 300 156	ETSI standard that defines the Euro ISDN attachment requirements for terminal equipment.
I.431	ITU-T standard that defines the ISDN user-network interface Layer 1 specifications.
Q.921	ITU-T standard that defines the D-channel protocol for Layer 2.
Q.931	ITU-T standard that defines the D-channel protocol for Layer 3 and provides out of band signaling on the local loop. Covers call control and call handling services. Q.931 messages are carried over the D-channel.

SS7	Switch to switch signaling standard. Defines the architecture of inter-switch signaling. Standards govern: ♦ message transfer protocol ♦ structure of special signaling network ♦ error and overload recovery ♦ call-related services out of band signaling
V.110	Protocol, used primarily in Europe and Japan, that defines the ISDN Data Terminal Equipment (DTE) specifications.
V.120	Protocol, used primarily in the United States, that defines the ISDN Data Terminal Equipment (DTE) specifications.

ISDN Information

Additional information on ISDN features and capabilities may be available through your service provider or through the following on-line resources:

- Bellcore's ISDN Guide

  http://www.bellcore.com/ISDN/ISDN.html

- European ISDN User Forum

  http://www.dcs.aber.ac.uk/Public/Research/Telematics/EIUF/index.html

- Dan Kegel's ISDN Page

  http://www.alumni.caltech.edu/~dank/isdn/

- Newspage ISDN Update

  http://www.newspage.com

Ordering T1/PRI Service

T1/PRI service provisioning requirements vary by application and availability of service. Two major elements must be considered when ordering T1/PRI service.

- The number of required T1 span lines
- The required application provisioning parameters for ISDN PRI service

NOTE: If additional T1/PRI ordering information is needed, contact U.S. Robotics Systems Product Support.

When ordering T1/PRI service for use with a Dual T1/PRI card, the following parameter information is likely required by a service provider:

- D-Channel Provisioning
- Switch Type
- Frame Type
- Line Coding
- Channel Service Units

D-Channel Provisioning

Provisioning of the PRI D-channel prior to installation of the E1/PRI cards is necessary to attain proper customized application performance.

Prior to contacting an E1/PRI service provider, determine which of the following applications will be used:

- The source of incoming calls—analog modems, BRI lines, PRI lines, etc.
- The origination and termination of calls—BRI to PRI, analog modem to PRI, PRI to PRI, etc.
- Type of site equipment or device into which the E1 lines terminate

The service provider will also need to know the switch type, frame type, line coding, and Channel Service Unit requirements of the Dual T1/PRI NAC.

Switch Type

Determine which digital switch types are available by contacting a service provider. The Dual T1/PRI NAC supports the following standard switch types:

- AT&T 4ESS
- AT&T 5ESS
- Northern Telecom DMS 100
- Northern Telecom DMS 250 (see note)

NOTE: The Northern Telecom DMS 250 switch is configured for DMS-100 or 5ESS at the TELCO. The Northern Telecom DMS 100 or the AT&T 5ESS switch settings work with DMS 250 switches.

Table 1-2 provides additional reference information on switches supported by the Dual T1/PRI cards.

Table 1-2. Dual T1/PRI Switch Type References

Switch Type	Reference
AT&T 4ESS	TR41449 AT&T Integrated Services Digital Network (ISDN) Primary Interface Specification, August 1991 TR41459 AT&T
AT&T 5ESS	TR41449 AT&T Integrated Services Digital Network (ISDN) Primary Interface Specification, August 1991 AT&T 235-900-342
Northern Telecom DMS 100 Northern Telecom DMS 250	NIS A211-1

Frame Type

The Dual T1/PRI NAC software supports the following two frame types for ISDN—Super Frame (SF) and Extended Super Frame (ESF).

- The ESF format contains 24 DS1 frames. The ESF alignment signal, data link sequence, and a Cyclic Redundancy Check (CRC) share the frame overhead-bit position. ESF is the recommended frame type for ISDN PRI service. ESF minimizes potential framing problems and false alarm events.
- The SF format, also called D4 framing, contains 12 DS1 frames, each with 193 bit positions. The first bit is the frame overhead-bit position, which is used for both frame and signaling phase alignment. SF is not recommended for the Dual T1/PRI NAC.

Line Coding

Line coding schemes ensure a sufficient density of 1's in the bit stream, as required by the Dual T1/PRI standard for clock synchronization. Although several line coding schemes are available, only Binary 8 Zero Substitution (B8ZS) is supported by the Dual T1/PRI NAC. B8ZS line coding provides clear, unrestricted channel access for sending data without any restrictions to content.

Channel Service Unit Interface

Channel Service Units (CSUs) provide the U reference point (between the customer and TELCO) for PRI service. CSUs provide the following services:

- Termination
- Pulse generation
- B8ZS conversion
- Idle code generation

- Frame error sequence
- Testing functionality

The T1 Network Interface Card's (NIC) Channel Service Unit interface supports a DS1 signal. This interface recovers T1 signals through a 6000 foot cable.

RECOMMENDED: Connect the T1 NIC interface directly to the TELCO Smart Jack interface during installation.

Chapter 2
Dual T1 Network Interface Card

This chapter provides information on the features, functions, and connectors available on the Dual T1 Network Interface Card (NIC). This card is a companion of the Dual T1/PRI Network Application Card (NAC).

The Dual T1 NIC is designed to be plugged into the Total Control Chassis midplane by inserting from the rear. The midplane contains NAC connectors on the front and NIC connectors on the rear. Both cards communicate through multiple data buses located on the midplane.

NOTE: See Chapter 4, *Installation* , for further information on installing this card in the chassis.

Dual T1 NIC Features

The Dual T1 Network Interface Card provides the following features:

- Performance of Channel Service Unit (CSU) critical functions
- Response to TELCO alarms and loopbacks for diagnostic purposes
- Bantam Monitor Jacks on the NIC for monitoring line performance
- Conformance to CSA, UL, and FCC Part 68 for protecting operator's equipment from lightening and power cross
- Signal continuation when the Dual T1/PRI NAC is removed from its chassis slot

Dual T1 NIC Functions

The Dual T1 NIC provides the line interface circuitry between the T1 span line(s) and the T1/CEPT framers on the Dual T1/PRI NAC. A line interface unit (LIU) provides the interface to each T1/PRI span line.

Line Interface Unit (LIU)

The NIC contains a built-in LIU, which provides the interface to each T1/PRI span line. The LIU offers automatic gain control (AGC), auto-equalization, and data recovery. It also recovers the T1 clock received from the network, which is used by the Dual T1/PRI NAC) for timing the data to the E1 framers. The network clock can be used as a timing source for the Total Control Chassis.

NIC Managed by NAC

The Dual T1 NIC contains the RS-232 serial interface drivers and receivers required during a software download. Since the T1 NIC does not contain a software-driven component, the NIC is managed by the T1/PRI NAC.

When the Dual T1/PRI NAC card is removed, a non-framed, all 1's pattern is sent to the PTT. This pattern is a standard alarm sequence that signals to the PTT that the transmitting equipment is down.

NOTE: When the Dual T1/PRI NAC card is removed for an extended period of time, the PTT elects to inactivate the span lines in some cases. Certain PTTs discontinue signal when the NAC card is either reset, removed, or powered-off on three consecutive occasions.

Channel Service Unit (CSU)

The Dual T1 NIC accomodates a DS1 signal capable of transmitting and receiving signals from distances of up to 6000 feet. When connecting to an external CSU, make sure the unit accepts a DS1 signal.

> **NOTE:** CSUs generally accept a DS1 signal. Contact U.S. Robotics Systems Product Support for further information regarding CSU support of the DSX template.

The dedicated CSU is in the default state when the Dual T1/PRI NAC is removed. During this time, the CSU sends a non-framed, all 1's pattern to the TELCO. This standard alarm sequence notifies the TELCO of the equipment status.

When the NAC is removed for an extended period of time, the TELCO is able to inactivate the span lines. The NIC does respond to network loopbacks while transmitting the all 1's pattern. This is a useful feature for diagnosing span line difficulties.

Span Power

Although it is not used as a power source, span power is terminated the NIC. The TELCO is then alerted that a CSU is attached to the span line.

Dual T1 NIC Connectors

The Dual T1 Network Interface Card (NIC) is a surface mounted card that contains both front and rear panel connectors. The front panel connector plugs into the Total Control Chassis midplane. The rear panel connectors are used for the operator interface, troubleshooting, and termination of T1 span lines.

The Dual T1 NIC contains an RS-232 serial port, Bantam Monitor Jacks, and two RJ48C connectors as shown in Figure 2-1 and described in Table 2-1. The RJ48C connectors provide a Channel Service Unit (CSU) interface, which recovers clock and data from incoming T1 signals.

The data recovered from the Dual T1 NIC passes on to the Dual T1/PRI NAC through the midplane connector. This midplane connector allows the Dual T1/PRI NAC CPU to manage the Dual T1 NIC.

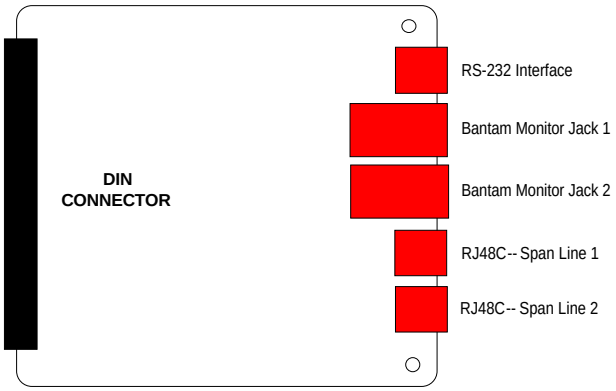

Figure 2-1. T1 Network Interface Card

Table 2-1. Dual E1 NIC Connectors

Connector	Purpose
DIN Connector	Plugs into the Total Control chassis midplane
RS-232	Connects the card to a PC or VT100 terminal for operator access using the interface cable supplied with the system
Bantam Monitor Jack	Used for troubleshooting and monitoring (not supported at this time)
RJ48C	Connects T1 span lines 1 and 2 cables (UTP 0.6 mm (22 AWG) 120 ohm impedance, terminated on one end by the RJ48C plug and on the other end as specified)

Rear Panel Connectors

The T1 NIC rear panel contains the following connectors:

- Two RJ48C connectors, one for each T1 span line
- Two Bantam jacks used for testing / troubleshooting
- RS-232 serial port

RJ48C Connectors

The RJ48C connectors provide an interface, which recovers both clock and data from incoming T1 signals. Recovered data from the T1 NIC passes through the midplane connector to the Dual T1 / PRI NAC. The midplane connector allows the Dual T1 / PRI NAC CPU to manage the T1 NIC. Since the T1 NIC does not contain a software-driven component, it is managed by the Dual T1 / PRI NAC.

The RJ48C connectors are dedicated to the T1 span lines that enter into the chassis. The T1 span line cables are UTP 0.6mm (22AWG) 120 ohm impedance. Each cable terminates by the RJ48C plug on one end and by country specific equipment on the other. T1 span lines generally contain 24 separate 64 Kbps B-channels that are multiplexed into the 2.048 Mbps rate of 23B+D.

Table 2-2 lists the supported functions and pin assignments of the RJ48C interface for the T1 span lines.

Table 2-2. RJ48C Pin Assignments

Pin	Function	T1 NIC ↔ TELCO
1	Receive Ring	←
2	Receive Tip	←
3	None	—
4	Transmit Ring	→
5	Transmit Tip	→
6–8	None	—

Bantam Jacks

Two Bantam Jacks are used for monitoring and troubleshooting equipment. The TX and RX jacks are passively coupled, thereby allowing the monitoring equipment to be installed while the NIC remains powered on, without causing any errors.

NOTE: Ensure that the monitoring equipment to be connected to the Bantam Jacks is in non-intrusive monitoring mode. Due to passive coupling, the received signal from the monitoring jack will be attenuated, and some test equipment may not be able to recover the signal.

RS-232 Operator Interface

The RS-232 operator interface is an 8-pin connector configured as Data Terminal Equipment (DTE).

Use the RS-232 cable provided with the cards to connect with any one of the devices listed in Table 2-3.

Table 2-3. RS-232 Connection Devices

Device	Local Configuration	Remote Configuration	Software Download
Modem	Not Available	Available	Available
PC	Available	Not Available	Available
Terminal	Available	Not Available	Not Available

Use the DB-25 female-to-male adapter provided with the card when connecting a PC to the RS-232 operator interface.

NOTE: Interface adapter must be supplied separately if application does not use a DB-25 connector.

Table 2-4 lists the supported functions and pin assignments of the RS-232 interface.

Table 2-4. RS-232 Pin Assignments

Pin	Function	NIC ↔ Device
1	Data Set Ready	←
2	Data Carrier Detect	←
3	Data Terminal Ready	→
4	Signal Ground	↔
5	Received Data	←
6	Transmitted Data	→
7	Clear to Send	←
8	Request to Send	→

Chapter 3
Dual T1/PRI Network Application Card

This chapter discusses Dual T1/PRI Network Application Card (NAC) configuration prior to installation in the Total Control Chassis. After the NAC is installed, further configuration of the card is possible through either an RS-232 operator interface or management software.

NOTE: For additional operator interface information, see Chapter 5, *RS-232 Operator Interface* and Appendix A, *Dual T1/PRI NAC Operator Interface* in this manual. The *Total Control Manager/SNMP Software Guide* is another source for further information.

The Dual T1/PRI Network Application Card (NAC) is a surface mounted board designed to fit into the front portion of the Total Control Chassis and connect to the chassis midplane.

The chassis midplane contains NAC connectors on the front and NIC connectors on the rear. Both cards communicate through multiple data buses located in the midplane.

NOTE: See Chapter 4, *Installation* for information on the chassis midplane location, individual card location and card installation procedures.

Dual T1/PRI NAC Features

The Dual T1/PRI NAC supports the following features:

- 64/56 Kbps Circuit Switched Data (CSD)
- Interoperability with existing analog fax and data modems calls from the Public Service Telephone Network (PSTN)
- Inbound call routing. Routes analog calls to a pool of modems. Routes digital calls to an ISDN Gateway NAC.
- Software download support via the Network Management Card (NMC) and the local console port. The operator can easily add features and software upgrades.
- Full Network Management and Local Console support
- Multiple Dual T1/PRI NACs in the same chassis
- ITU-T Q.931/I.451 Call Control Signaling Variants for AT&T 4ESS, AT&T 5ESS, and Northern Telecom DMS-100
- Full array of front panel LEDs indicating the status of both the Dual T1/PRI NAC and the T1 span lines
- Asynchronous out-of-band management port, enabling local status monitoring and configuration with either a PC, VT100 terminal, or remote modem
- PRI access for telecommuting
- Internet access
- Transaction processing
- High speed file transfer
- LAN interconnectivity
- Remote LAN access
- Casual access

Dual T1/PRI NAC Functions

The Dual T1/PRI NAC allows signaling information to be communicated out of band over the PRI D-channels, thereby transmitting a full 64 Kbps of user data. The Dual T1/PRI NAC utilizes a message-based system to communicate signaling information for each channel. It also interfaces with and distributes calls to either the Quad Modem cards (QBCH-mdm) by way of a time division multiplex (TDM) bus, or a NETServer PRI (ISDN-GW) NAC.

The Dual T1/PRI NAC provides the following functions:

- Automatic timing source selection and fall back. When the primary timing source fails, a specified alternate source is automatically engaged.
- Software download into on-board Flash ROM, enabling the operator to easily add features and software upgrades
- A full array of front panel LEDs indicating the status of both the Dual T1/PRI NAC and the T1 span lines
- Support for an asynchronous management port, enabling local status monitoring and configuration with a PC, a VT100 terminal, or a remote modem

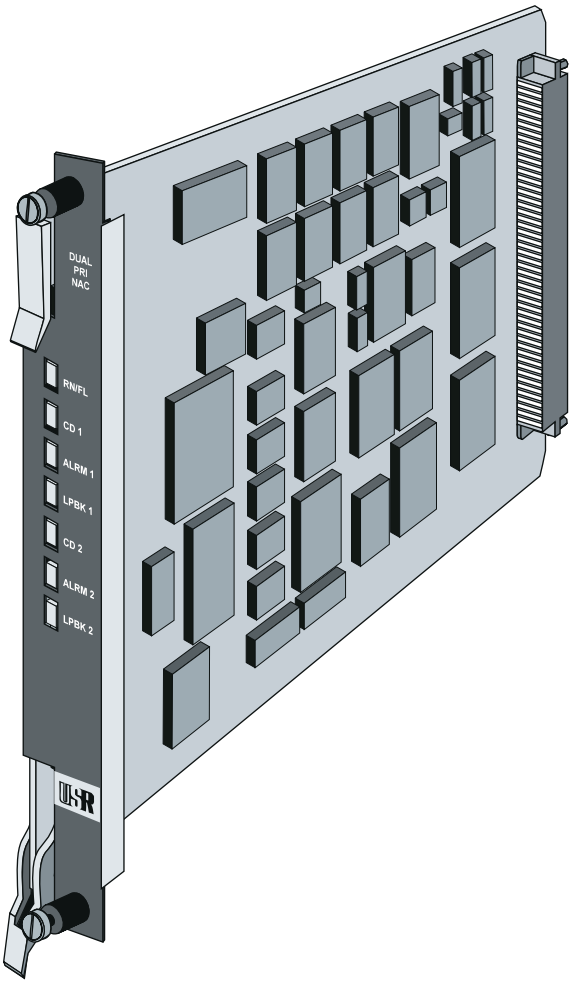

Figure 3-1. Dual T1/PRI Network Application Card

The Dual T1/PRI NAC is a surface mounted board containing a midplane DIN Connector. The standard configuration includes 4 MB of DRAM SIMM.

NOTE: Both 1 MB and 16 MB configurations are used for customized applications. However, the DRAM SIMMs are not field upgradeable with these configurations.

DIP Switches

Ten DIP switches are located below the indicator LEDs on the Dual T1/PRI NAC. Only DIP switches 1 and 2 are functional at this time. DIP switches 1 and 2 are used to set the serial port rate of the RS-232 interface.

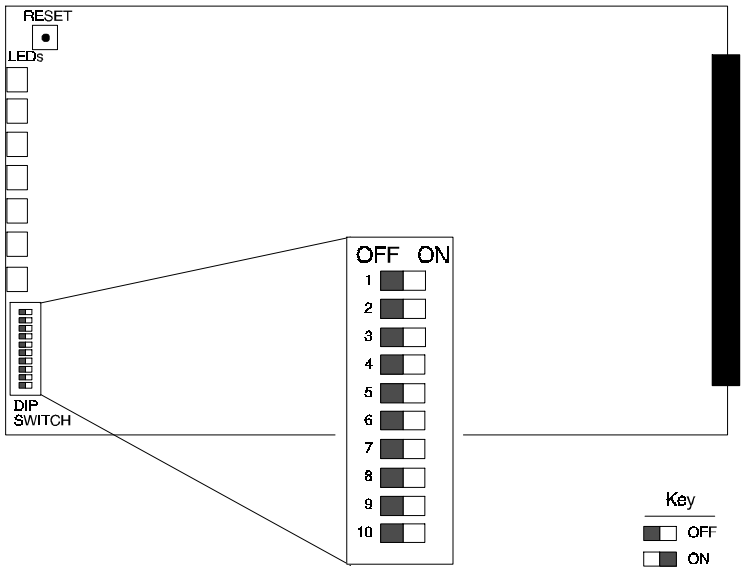

Figure 3-2. Dual T1/PRI NAC DIP Switches

The DIP switches are sequentially numbered one through ten from top to bottom. Slide switch to the right to turn ON and to the left to turn OFF.

IMPORTANT!
Ensure DIP switches are set to the required specifications before installing the Dual T1/PRI NAC. See Table 3-1 for additional information.

Table 3-1. T1/PRI NAC DIP Switches

Switch	Factory Setting	Function		
1, 2	OFF, OFF	RS-232 Serial Port Rate Select		
		DIP 1	**DIP 2**	**Selects**
		OFF	OFF	9600 bps
		OFF	ON	19.2 Kbps
		ON	OFF	38.4 Kbps
		ON	ON	Reserved
* 3–10	OFF	Reserved		

* Do *not* change settings of reserved DIP switches unless directed by U.S. Robotics Systems Products Support.

The operator interface for the T1/PRI NAC is accessed by attaching either a PC or a VT100 terminal to the RS-232 serial port on the T1 NIC. Using this interface, the operator is able to:

- configure the Dual T1/PRI NAC.
- view B-channel and modem status.
- perform software downloads using a PC.

NOTE: See Chapter 2, *T1 Network Interface Card* and Chapter 5, *E1/PRI Operator Interface*, for additional information on using the RS-232 port features.

Check either the PC or terminal documentation to determine the maximum serial port rate supported by the equipment, prior to installing the card, to verify the DIP switch settings.

NOTE: If using a portable/notebook computer, many of the provided serial ports do not support data rates over 19.2 Kbps. When losing characters at 38.4 Kbps, drop to either 19.2 Kbps or 9600 bps. Then change the DIP switch settings and set the PC to the specified baud rate.

Front Panel LEDs

The Dual T1/PRI NAC features seven front panel indicator LEDs. These LEDs are labeled as shown in Table 3-2:

Table 3-2. Dual T1/PRI NAC Front Panel LEDs

Label Silkscreen	Function
RN/FL	Run/Fail (1)
CD 1	Carrier for T1 line 1
ALRM 1	Alarm for T1 line 1
LPBK 1	Loopback for T1 line 1
CD 2	Carrier for T1 line 2
ALRM 2	Alarm for T1 line 2
LPBK 2	Loopback for T1 line 2

NOTE: This section provides information on operating and alarm/event LED status information. See Chapter 4, *Installation*, for LED startup sequence and information.

The status of the operating LED can be viewed and monitored via the front panel. LED status can also be viewed using *Total Control Manager/SNMP* software.

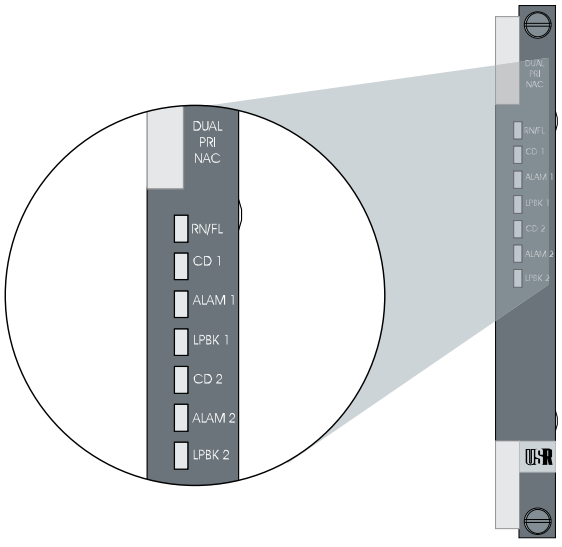

Figure 3-3. Dual T1/PRI Front Panel LEDs

Table 3-3. Dual T1/PRI NAC Front Panel LEDs

LED	Status	Meaning
RN/FL	Solid Green Solid Red Flashing Red/Green Flashing Green	Normal Critical Failure Non-Critical Failure Power-Up Self-Test, or Software Download in Process, or EEPROM is re-initializing
CD 1 & 2	Solid Green Solid Red Off	Present Unframed Signal Not Present
ALRM 1 & 2	Off Solid Red	No Alarm Alarm Condition
LPBK 1 & 2	Off Green	No Loopback Loopback Mode

- **Run/Fail (RN/FL).** The RN/FL LED indicates whether the Dual T1/PRI NAC is in normal operation mode, or critical failure mode due to a hardware and/or software failure.
- **Carrier (CD).** The Carrier LEDs indicate the presence of a carrier on a T1/PRI span line. An Unframed Signal results due to an Out of Frame (OOF) condition. The signal is present but not usable. Carrier is assumed to be not present when a Loss of Signal (LOS) condition occurs. The signal is thus reported as not present.
- **Alarm (ALRM).** The Alarm LEDs indicate an alarm condition on a T1 span line. The Alarm LED is activated when at least one of the following conditions exists: Remote Frame Alarm, Alarm Indication Signal, or Out of Frame.
- **Loopback (LPBK).** The Loopback LEDs indicate whether a remote loopback test, initiated by the TELCO, is in progress.

Dual T1/PRI Interfaces

Through the Total Control Chassis midplane connector, the Dual T1/PRI NAC provides access to the interfaces shown in Table 3-4.

Table 3-4. Dual T1/PRI NAC Interfaces

Interface	Function(s)
TDM Bus	Time Division Multiplex (TDM) Bus Interface
NuBus (Packet Bus Interface)	Transfers call setup and tear down information Clock loss detection Bus timeout generation Packet Bus clock generation between T1/PRI and other chassis devices
Management Bus Interface	Communicates with the Network Management Card (NMC) located in chassis slot 17
LIU (Line Interface Unit)	Interface between the NIC and NAC for controlling the T1 NIC's LIU

Chapter 4
Installation

This chapter contains the following information on the Total Control chassis configurations required when using the T1 cards:

- Procedures for installing the Dual T1 NIC in the chassis
- Procedures for installing the Dual T1 / PRI NAC in the chassis
- LED startup sequence
- LED diagnostics

Chassis Configuration

The Total Control chassis contains seventeen available NIC and NAC slots. A Network Management Card (NMC) is typically located in slot 17. The NIC and NAC connect through the chassis midplane. The midplane contains multiple data buses that enable the NACs to communicate with each other as well as with the NMC.

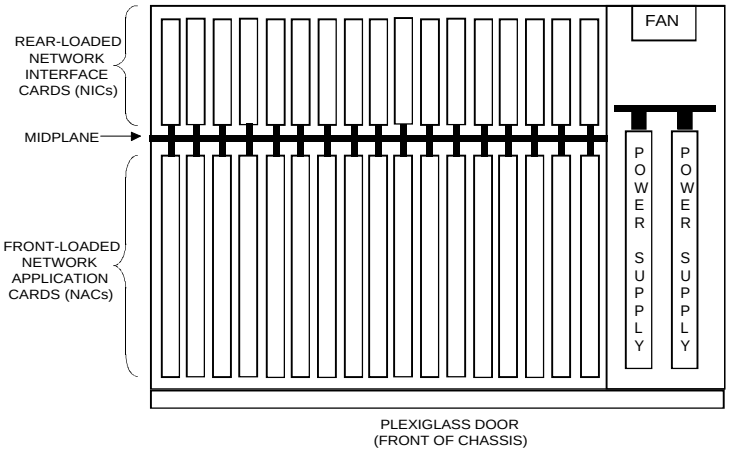

Figure 4-1. Total Control Chassis (Top View)

The Dual T1/PRI NAC supports several standard chassis configurations. These configurations allow the chassis to handle both analog and digital calls. Compatibility with analog modems and Robbed Bit Signaling (RBS) T1 lines is also available using these configurations.

Fully Loaded Chassis (Configuration A)

Configuration A supports up to 2 PRI trunks capable of handling a total of 46 B-channel calls. Both analog and digital originated calls are supported by the configuration shown in Figure 4-2.

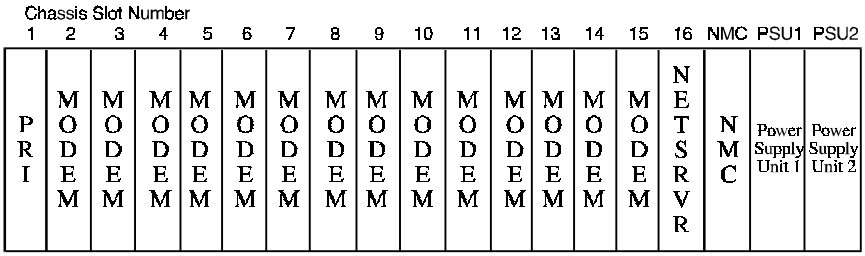

Figure 4-2. Configuration A

Fully Loaded Plus 2 ISDN Only Trunks (Configuration B)

Configuration B is the same as Configuration A with the addition of PRI and NETServer cards. This configuration supports 46 B-channels of ISDN originated calls only as shown in Figure 4-3.

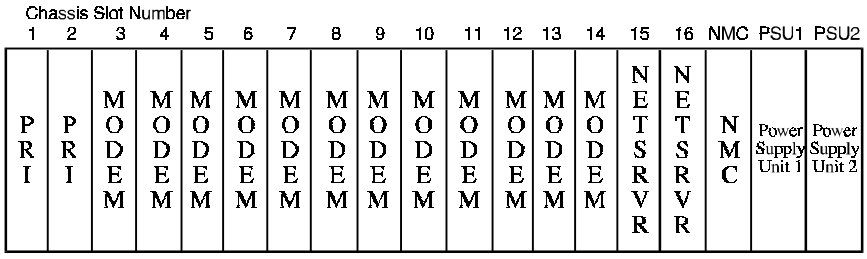

Figure 4-3. Configuration B

ISDN Only (Configuration C)

Chassis configuration C supports ISDN operation only, and allows for a combination of PRI / NETServer card sets (from 1 card set to 2 card sets). The configuration shown in Figure 4-4 provides up to 92 active B-channels.

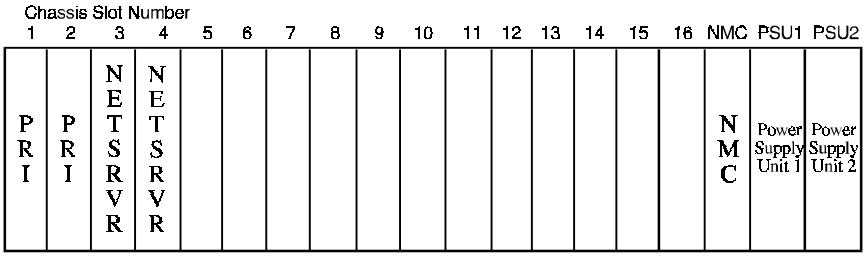

Figure 4-4. Configuration C

PRI and T1 Cards Mixed (Configuration D)

Chassis configuration D allows both standard T1-to-Modem-to-API Gateway calls and ISDN originated PRI-to-API Gateway calls to take place at the same time. In this configuration, as shown in Figure 4-5, the T1 NAC must be in Slot 1.

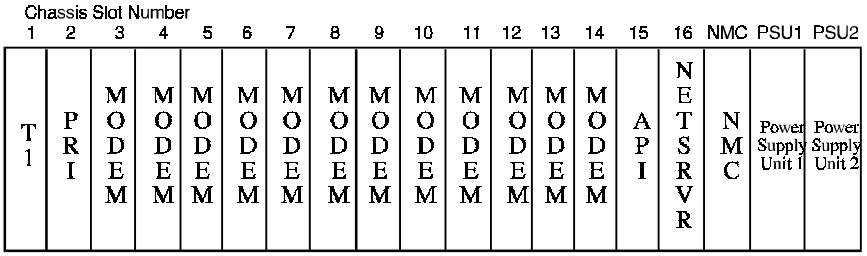

Figure 4-5. Configuration D

Installing the Dual T1 NIC

CAUTION! Always use ESD protection when working with electrostatic sensitive components.

1. Remove the safety panel from the appropriate slot at the rear of the chassis by unscrewing the top and bottom screws. Save both the panel and screws.
2. With the T1 RJ48C and RS-232 interfaces facing outward, slide the T1 NIC into the slot using the upper and lower card guides. Press firmly on the NIC until the midplane connector snaps into position.
3. Tighten the thumb screws attached to the Dual T1 NIC rear panel.

   NOTE: Pay careful attention to the alignment of the screws before tightening them. Problems could arise if the screws are not threaded properly.

4. Attach the serial port cable supplied with the card.
5. Attach the T1 span line cables.

Installing the Dual T1/PRI NAC

CAUTION! Always use ESD protection when working with electrostatic sensitive components.

Cards may be inserted and removed while the chassis is powered-on. This change-out method is called hot-swapping. After the Dual T1/PRI NAC is successfully inserted into a powered-on chassis, the front panel indicator LEDs flash in sequence during a series of diagnostic or power-up self tests.

NOTE: Refer to the subsection on Diagnostics for information describing the LED sequence during start up.

1. Ensure all DIP switches are set to the appropriate specifications.

   NOTE: Refer to Chapter 3, *T1/PRI Network Application Card*, for specific DIP Switch information.

2. Unscrew and remove safety panel from the appropriate slot at the front of the chassis. Save both the panel and the screws.

3. With the DIN connector facing the rear of the chassis and the LEDs facing toward the front, lift the ejector tabs and slide the modem card into the slot using the upper and lower card guides. Press firmly on the NAC until its rear connector is properly positioned in the chassis midplane.

4. Ensure the ejector clips are secured by pressing on the tabs until they click into position.

5. Once the DIN connector is plugged in and the Dual T1/PRI NAC is powered-on, the front panel indicator LEDs flash in sequence during a series of diagnostic or power-up self tests. The power-up sequence completes within one minute during normal system behavior.

   NOTE: Refer to the subsection on Diagnostics for additional information concerning these tests.

6 Tighten the captive screws to secure the panel to the chassis.

> **NOTE:** Pay careful attention to the alignment of the screws before tightening them. Problems could arise if these screws are not threaded properly.

Diagnostics

When the Dual E1/PRI NAC is installed into a powered-on chassis, the boot code performs various initializations and power-up self-tests specific to the chipset. The sequence of events varies depending on whether the startup is a standard power-up or a new software download. The LED sequence varies for each scenario.

> **NOTE:** Refer to Chapter 3, *Dual T1/PRI Network Application Card*, for additional information on the front panel indicator LEDs.

Normal Start-up Power-up/Self Test LED Sequence

During the standard power-up self tests, all of the front panel LEDs flash in sequence: red, then amber, then green. The Run Fail (RN/FL) LED then turns red, then amber, then green. This process completes within 20 seconds during normal system behavior.

As the software is loaded from ROM to RAM, the RN/FL LED alternates between off and green. The time required to complete this portion of the LED sequence varies depending upon the amount of software being loaded.

Software Download LED Sequence

When new software is downloaded, the LED power-up sequence is similar to the standard power-up sequence except that the duration varies according to the amount of software being downloaded. The card reboots after download completion and the normal LED power-up sequence repeats.

Ready for Operation

If no failures are found after all the tests are performed, the RN/FL LED turns solid green, indicating that the card is properly installed and ready for operation.

Critical Failures During Power-up

When a critical failure is detected during the power-up sequence, the RN/FL LED turns either solid red or amber and the card reboots. A failure is considered critical when execution is affected. Contact U. S. Robotics Technical Support at 1-800-231-8770 in the event of a critical failure during power-up.

Debug Procedure

In the event of a critical failure during installation, the following steps may help to quickly resolve the problem.

1. Undo the ejector clips and pull the card forward to unplug it from the midplane. Then reseat the card and secure the clips. This may resolve the problem.
2. If reseating the card in the midplane does not resolve the critical failure, try re-downloading the software.
3. If neither reseating the card in the midplane nor re-downloading the software resolves the critical failure, contact U.S. Robotics Systems Product Support.

Shipping

Dual T1/PRI NACs and NICs are shipped in one of three ways, depending on the ordering specification:

- Ordered as part of a pre-assembled system—(a Total Control chassis with all of the components factory-installed)
- Ordered as part of a set consisting of one NAC and one NIC
- Ordered as a separate component installed in the Total Control chassis

Chapter 5
T1/PRI Operator Interface

NOTE: EIA-232 is synomous with each reference to RS-232 contained in this document.

This chapter provides information on managing the Dual T1/PRI NAC through either the RS-232 serial port interface using a PC or VT100 terminal or through the *Total Control Manager/SNMP* software. Steps required to connect a VT100 terminal or PC to the T1 RS-232 interface located on the Dual T1 NIC are described. These steps are necessary in order to perform configuration and software download tasks on the Dual T1/PRI NAC.

For a detailed description of the menu structure that is displayed when either a PC or terminal connection is made via the RS-232 serial port, refer to Appendix A, *Dual T1/PRI NAC Operator Interface.*

NOTE: A PC, not a VT100 terminal, must be used to perform a software download.

A dedicated PC is connected to the RS-232 port at all times. When performing configuration tasks, running a terminal emulation program recognizes the PC as a terminal. Windows offers a terminal option. Many communications software programs also allow an established TTY connection.

Managing the Dual T1/PRI NAC

The Dual T1/PRI NAC supports applications accessible on the T1/NAC (robbed bit) and new applications available only through ISDN/PRI. The Dual T1/PRI NAC sets up B-channel connections between the PRI B-channels and Quad Modem NACs through the TSI to the TDM time slots.

The ISDN PRI B-channels originate and/or terminate from RS-232 ports in the Total Control Hub:

- RS-232 synchronous/asynchronous through the Quad Modem NAC/NIC
- Ethernet through the ISDN-GW (NETServer PRI) NAC/NIC
- Token Ring through the ISDN-GW (NETServer PRI) NAC/NIC

The data/application format supported between the Dual T1/PRI and the ISDN-GW (NETServer PRI) via Dual T1/PRI access is PPP (synchronous over an ISDN B-channel).

The Dual T1/PRI Card is managed by using either of the following two methods:

- The Dual T1 RS-232 Operator Interface requires that the T1 NIC be connected to either a VT100 terminal or a PC using the provided RS-232 cable.
- *Total Control Manager/SNMP* is an SNMP-based, Windows-compatible application. This application runs on a PC that is connected to the Network Management Card (NMC) NIC by either an RS-232, a LAN connection, or a remote site modem. The software allows for SNMP GET and SET operations on the Dual T1/PRI card.

> **NOTE**: Refer to the *NMC Reference Manual*, the *SNMP MIB Reference Manual*, and the *Total Control Manager/SNMP Software Guide* for additional information.

Connecting to the RS-232 Port

An RS-232 cable and a DB-25 female connector for a DB-25 null modem are both provided with the Dual T1/PRI package. To connect to the Dual T1/PRI RS-232 port using either a terminal or PC, both the RS-232 cable and the DB-25 female-to-DB-25 null modem are needed. To configure a Dual T1/PRI Card from a remote site, connect a modem to the T1/PRI RS-232 interface using the RS-232 cable provided.

NOTE: A separate interface adapter is needed if the hardware uses something other than a DB-25 connector. See Chapter 2, *Dual T1 Network Interface Card*, for additional RS-232 serial port information.

RS-232 Serial Port Settings

The default serial port rate at the Dual T1 NIC RS-232 port is set at 9600 bps. The baud rate is changed by adjusting DIP Switch setting 1 and 2 on the Dual T1/PRI NAC, as shown in Table 5-1.

NOTE: See Chapter 3, *Dual T1/PRI Network Interface Car*d, for additional DIP Switch setting adjustment information.

Table 5-1. DIP Switch Serial Port Rates

DIP 1	DIP 2	Selects
OFF	OFF	9,600 bps (default)
OFF	ON	19,200 bps
ON	OFF	38,400 bps
ON	ON	Reserved

NOTE: The data format is 8 data bits, no parity, and 1 stop bit.

Chapter 6
Call Signaling

This chapter provides the following information detailing the processes for call signaling and routing performed by the Dual T1/PRI card:

- Call recognition
- Routing decisions
- Chassis configuration options
- Call routing and chassis slot device configuration tables

The Dual T1/PRI NAC andNIC support both analog modem calls and ISDN Terminal Adapter (TA) calls over identical ISDN Primary Rate trunks (PRI). The Total Control System determines the call type and internally routes the traffic through the appropriate device. Analog modem traffic is passed from Digital or Analog/Digital Quad Modem cards to a Network Access Card as shown in Figure 6-1.

NOTE Release 1.5 of the Dual T1/PRI Network Application Card (NAC) and the T1 Network Interface Card (NIC) provides support for Single-sided Quad modems.

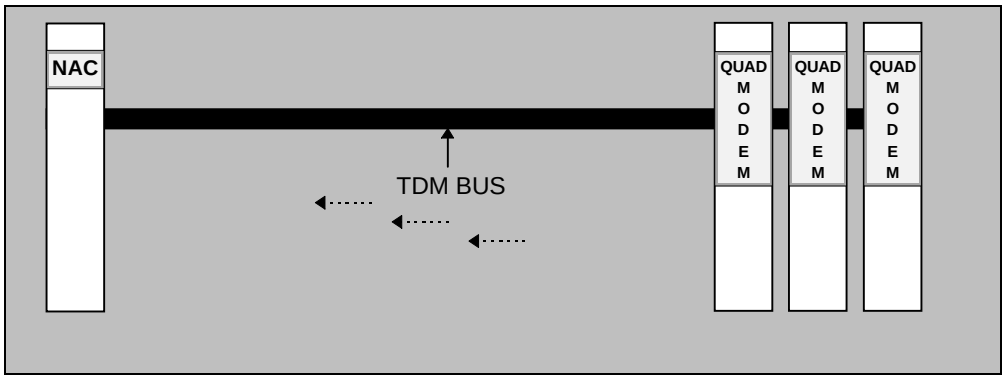

Figure 6-1. Total Control System Analog Traffic Flow Diagram

ISDN originated calls are passed directly to an ISDN Gateway Card (NETServer PRI).

NOTE: See the NETServer documentation for additional information.

Call Processing

The Dual T1/PRI NAC communicates with the TELCO over the 64 Kbps D-channel on each PRI span line. The following setup and tear down information is transmitted to an ISDN application NAC over a packet bus:

- Called number
- Bearer capability
- TDM time slot

Once a call is setup, the Dual T1/PRI NAC establishes a full duplex connection between the PRI B-channel and the TDM time slot in the NAC being used for the call. The Dual T1/PRI NAC monitors the D-channel packet bus for call tear down messages while a call is established.

The Dual T1/PRI NAC utilizes standard signaling software messages including Layer 2 (Q.921) and Layer 3 (Q.931). As a result, the Dual T1/PRI NAC is compatible with the following United States switching standards:

- AT&T 4ESS
- AT&T 5ESS
- Northern Telecom DMS-100
- Northern Telecom DMS-250 (using DMS-100 or AT&T 5ESS emulation).

When the Dual T1/PRI NAC receives a dial-in call, the Q.931 call setup messages are interpreted and the information is communicated to the appropriate NAC via the packet bus. The Dual T1/PRI NAC receives a proprietary setup message for dial out calls from either the QBCH-mdm (Quad Modem) or the ISDN-GW (NETServer PRI) NAC, and sends a setup message to the TELCO.

NOTE: Release 1.5 of the Dual T1/PRI Network Application Card (NAC) and the T1 Network Interface Card (NIC) provides support for Single-sided Quad Modem Cards.

Call Types

The Dual T1/PRI NAC supports the following types of calls:

- Setup circuit switch ISDN end-to-end at 64 Kbps
- Setup circuit switch ISDN end-to-end at 56 Kbps using V.110 Rate Adaptation
- Setup circuit switch call with another BRI/PRI using V.120 Asynchronous Rate Adaptation
- Setup circuit switched call with an analog modem/fax in the Public Switched Telephone Network (PSTN)

Setup circuit switch data call ISDN end-to-end at 64 Kbps

This type of circuit switched call is made between the Dual T1/PRI interface and either an ISDN Basic Rate Interface (BRI) or Primary Rate Interface (PRI) user. The call is end-to-end ISDN and the data rate over the B-channel is either 56 Kbps or 64 Kbps. When this call type is recognized, the Dual T1/PRI NAC terminates the call to the ISDN-GW (NETServer PRI) NAC.

Setup circuit switch data call ISDN end-to-end at 56 Kbps

This type of circuit switched call is made between the ISDN PRI interface and either an ISDN BRI or PRI user at 56 Kbps. ISDN data is transferred end-to-end at a rate of 56 Kbps. The call is end-to-end ISDN, but the information transfer rate is 56 bps.

Certain networks support only a 56 Kbps information transfer over the B-channel. This type of message requires rate adaptation using the V.110 protocol. When this type of call is recognized, the Dual T1/PRI NAC terminates the call to the ISDN-GW (NETServer PRI) NAC.

Setup circuit switch data call with another BRI/PRI (Using V.120 Asynchronous Rate Adaptation)

This type of circuit switched call is made between the ISDN PRI interface and either an ISDN BRI or PRI user. ISDN data is transferred end-to-end at a rate less than 64 Kbps.

If the user is connected to an ISDN terminal adapter that is running asynchronous data, protocol V.120 is used to adapt the user data rate to either the 56 Kbps rate or the 64 Kbps rate. When this type of call is recognized, the Dual T1/PRI NAC terminates the call to the ISDN-GW (NETServer PRI) NAC.

Setup circuit switched voice or 3.1 kHz audio call with an analog modem/fax on the PSTN

This type of circuit switched call is made between the PRI interface and an analog modem/fax on the Public Switched Telephone Network (PSTN). This call is not end-to-end ISDN.

A Q.931 message communicates the call nature to the Dual T1/PRI and informs it when tones are available on the B-channel. The ISDN cuts through the B-channel to allow an audible ringing tone to be sent from the far end. The Dual T1/PRI NAC routes the call based on bearer capability (3.1 kHz audio or voice).

Call Handling and Routing

Call routing involves sending a call to another Network Application Card (NAC) device and establishing the data path connection between the B-channel and the TDM time slot chosen for the call. The way a call is handled or routed is determined by the call type, either analog or digital, and the available device configuration.

NOTE: When the Dual T1/PRI NAC is configured to accept ISDN calls only, the following does not apply.

The routing and acknowledgment of analog and digital calls by the Dual T1/PRI NAC is accomplished through a call routing process in which analog calls are routed to a modem pool and digital calls are routed to the default ISDN-GW (NETServer PRI) NAC. The Dual T1/PRI NAC

located in Chassis Slot 1 is configured to route both analog modem calls and digital (ISDN BRI or PRI) originated calls.

> **NOTE**: Dual T1/PRI NACs installed in a chassis slot other than Slot 1 only acknowledge and route digital originated calls.

Call Recognition

The D-channel Q.931 setup message contains setup information that identifies the call type. When the Dual T1/PRI NAC recognizes an incoming analog call, the call is routed to either a Quad Modem or an ISDN-GW (NETServer PRI) NAC. The Quad Modem is the default route setting for analog calls. When the Dual T1/PRI Q.931 setup message identifies a digital call, the call is routed to an ISDN-GW (NETServer PRI) NAC.

Analog or Digital Calls

Incoming analog calls that originate from a modem are typically either speech or 3.1 kHz audio. Incoming BRI/PRI digital calls are unrestricted digital, transmitted at either 56 Kbps or 64 Kbps.

Incoming digital originated calls are also transmitted as either speech or 3.1 kHz audio. In many cases, the originated digital call requests speech or 3.1 kHz audio in order to pass data at a lower tariff rate.

The Dual T1/PRI NAC handles these calls based on a dialed number (DNIS) table, which assigns specific dialed number calls to be treated as either an analog or a digital call. The DNIS table is searched for each incoming speech or 3.1 kHz audio call number. The NAC uses the call type from the table.

> **NOTE**: An example of a DNIS Configuration Table (Table 6-1) appears later in this chapter.

Routing Decisions

The flowcharts shown in Figure 6-2 summarize the call routing decision process of the Dual T1/PRI NAC.

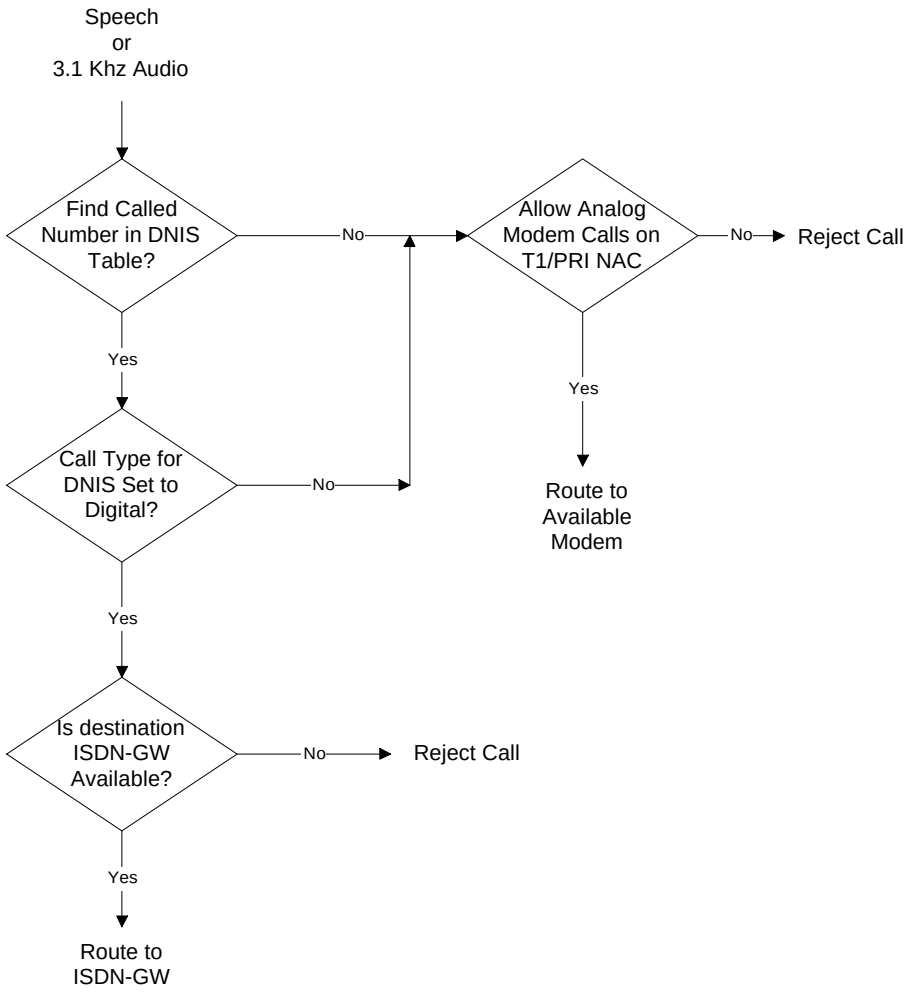

Figure 6-2. Call Routing Through the DNIS Table

Initially, the Dual T1/PRI NAC determines if the call is digital or analog. If the call is an analog call, the Dual T1/PRI NAC determines whether the call is speech or 3.1 kHz audio. The DNIS Table is then searched by the Dual T1/PRI NAC.

- When the Dual T1/PRI NAC does not locate the dialed number in the DNIS Table, analog calls are then routed to an available Quad Modem.
- As shown in Figure 6-3, when the number is located in the DNIS Table, the Dual T1/PRI NAC determines whether the call should be treated as analog or digital and routes the call appropriately. A digital call is routed to the first available ISDN-GW (NETServer PRI), while an analog call is routed to the first available Quad Modem. If none of the Quad Modem channels accept the call, it is dropped.

When the incoming digital call is either restricted or unrestricted 56 Kbps, or unrestricted 64 Kbps, the Dual T1/PRI routes the call to the first available ISDN-GW (NETServer PRI).

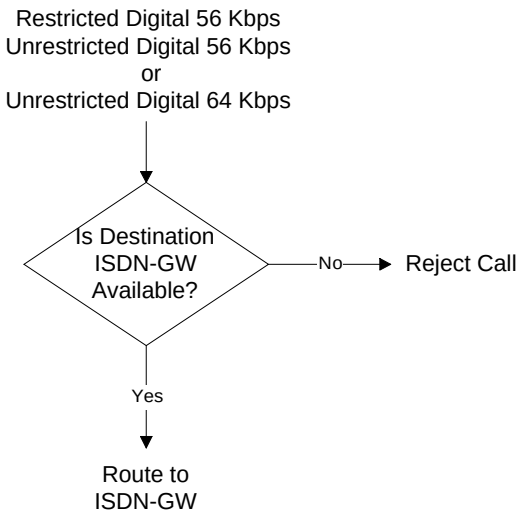

Figure 6-3. Digital Call Routing to ISDN-GW NAC

Chassis Configuration Options

The configuration options for installing and managing chassis devices affect the ability of the Dual T1/PRI NAC to receive, route, and tear down both analog and digital calls. Device configuration is typically managed by the NMC.

The Dual T1/PRI NAC supports several standard chassis configurations. Usage of these configurations allows the hub to be compatible with the following:

- Analog call handling
- Digital call handling
- Analog modems
- Robbed Bit Signaling (RBS) T1 lines

NOTE: See Chapter 4, *Installation*, for a description of each of the standard chassis configuration options.

Analog Modem Call Routing

The Dual T1/PRI NAC, located in Slot 1, routes analog calls to a configured pool of Quad Modem (QBCH-mdm) NACs. Incoming calls are distributed in a round robin fashion starting with the lowest idle modem slot/channel. In the following example, a T1/PRI is installed in Chassis Slot 1 and 12 modems are installed in Slots 2 through 13.

NOTE: When a modem rejects an incoming call, the T1/PRI NAC queries the remaining modems in the pool. When a modem does not respond, the call is dropped.

Table 6-1. First call routed to lowest slot/channel modem (2/1)

Current Route Index	Modem Slot Number	Modem Channel Number	Modem Status
->	2	1	Idle
	2	2	Busy
	2	3	Busy
	2	4	Idle
	3	1	Idle
	3	2	Idle
	3	3	Idle
	.	.	.
	13	4	Idle

Table 6-2. Second call routed to next lowest idle slot/channel modem (2/4)

Current Route Index	Modem Slot Number	Modem Channel Number	Modem Status
	2	1	Busy
	2	2	Busy
	2	3	Busy
->	2	4	Idle
	3	1	Idle
	3	2	Idle
	3	3	Idle
	.	.	.
	13	4	Idle

Table 6-3. Third call routed to next lowest idle slot/channel modem (3/1)

Current Route Index	Modem Slot Number	Modem Channel Number	Modem Status
	2	1	Idle
	2	2	Busy
	2	3	Busy
	2	4	Busy
->	3	1	Idle
	3	2	Idle
	3	3	Idle
	.	.	.
	13	4	Idle

Call Routing Tables

Several call routing configuration tables are used to manage available resources. For analog inbound calls, the Dial-In Phone Number (DNIS) table is searched. For digital inbound calls, a combination of configuration parameters and chassis slot device configuration status tables apply.

Dial-In Phone Number Configuration Table

The Dial-In Phone Number Configuration Table assigns specific phone numbers for either analog or digital treatment. The dialed phone numbers contain up to 18 characters, including 0 to 9, -, ( ), and *. The Dual T1/PRI only recognizes exact matches.

NOTE: Wild card phone numbers are not supported.

In Table 6-4, the letter A is used to indicate an analog call while the letter D is used to indicate a digital call.

Table 6-4. DNIS Configuration Table

Phone Number Inst#	Dial-In Phone Number	Call Type
0	(555)982-1000	D
1	(555)982-1001	A
2	(555)933-1002	D
. .		
23		
. .		
47		

Configuration Parameters

The configuration parameters specify the termination of analog incoming calls and digital incoming calls. The Dual T1/PRI routes the call according to specific parameters.

For example, the following configuration parameter specifies an ISDN-GW (NETServer PRI) NAC. The default value is None.

Default ISDN GW NAC Slot Number (1-16,255=none (default))
16

The following configuration parameter routes analog calls to the modem pool. Since only the Dual T1/PRI NAC located in chassis Slot 1 can accept both analog and digital calls, the following parameter applies only to this card. Each remaining Dual T1/PRI NAC will have this value set to No (N).

Modem Calls Allowed (Y (default) / N)
Y

Chassis Slot Device Configuration Table

The Chassis Slot Device Configuration Table contains a list of all the ISDN chassis devices, including ISDN-GWs, Quad Modems, and Dual T1/PRI NACs. When the Dual T1/PRI NAC searches the table, modem and ISDN-GW (NETServer PRI) card availability is determined. The Dual T1/PRI NAC tears down the call when devices are removed without sending any packet bus messages.

See Table 6-5 for an example of a Chassis Slot Device Configuration Table.

Table 6-5. Chassis Slot Device Configuration Table

Slot Instance Number	**Device Type*** 1 = DT1/PRI 2 = QBCH-mdm 3 = ISDN-GW 255 = none (default)
0	1 (DT1/PRI)
1	255 (none)
2	2 (QBCH-mdm)
. .	
6	2 (QBCH-mdm)
7	2 (QBCH-mdm)
8	2 (QBCH-mdm)
. .	
14	3 (ISDN-GW)
15	3 (ISDN-GW)

**Actual values for device types are taken from the NMC defined software.*

The Chassis Slot Device Configuration Table is managed and updated by the Network Management Card (NMC) and the Local RS-232 Console.

The NMC informs the Dual T1/PRI NAC of device installation, availability, and removal. The table is updated via the NMC as follows:

1. When the Dual T1/PRI NAC boots, the Chassis Slot Device Configuration Status Table is restored.
2. The NMC notifies the Dual T1/PRI NAC whenever a device is detected in the chassis and updates the Chassis Slot Device Configuration Table.
3. The NMC notifies the Dual T1/PRI NAC whenever a device is installed in the chassis or removed from the chassis and updates the Chassis Slot Device Configuration Table.

4. When the Dual T1/PRI NAC changes the table, the NMC is informed and sends the current chassis configuration. The Dual T1/PRI NAC changes the table either by restoring the configuration from the local RS-232 console or by changing the chassis slot configuration from the RS-232 Local Console.

When the system does not have a working NMC, an operator may physically update the Chassis Slot Device Configuration Table via the Local Console.

The NMC updates the status of the table to keep the status of the table current. The table is saved to NVRAM and will retain the last known chassis configuration at reboot.

NOTE: See Appendix A, *Dual T1/PRI NAC Operator Interface*, for additional information.

Appendix A
Dual T1/PRI NAC Operator Interface

Connecting a VT100 terminal, or a PC using a terminal emulation program, to the RS-232 Operator Interface port on the Dual T1 NIC allows for an operator to configure and manage the Dual T1/PRI NAC using menu-driven screens. Once the PC or terminal is connected, press the Return key to display the Operator Interface Main Menu.

NOTE: A remote operator configures the T1/PRI NAC by dialing into a modem connected to the RS-232 Operator Interface. Once the modems are connected, pressing the Return key displays the following Main Menu on the remote terminal screen.

```
U.S. Robotics, Inc. (c) 1996

Dual T1 PRI Application Card Revision 1.5.1
Boot Code Linked Date:      Mon Dec 04 17:41:48 1995
Operation Code Linked Date: Sun Mar 10 16:24:40 1996

Main Menu

1 Command
2 Status
3 Card Configuration
4 Inbound Call Routing Configuration
5 Span Line 1 Configuration
6 Span Line 2 Configuration
7 SW Fault Manager Event Logging

Enter menu selection and press Return.

Menu Selection (1-7):_
```

Figure A-1. Main Menu

To select an option from the Main Menu, type the number of the desired selection and press Return. At any point within the menu structure, press Esc to return to the previous menu.

Command

Select option 1 on the Main Menu to display the Command submenu. This submenu displays seven command options that are used to perform specific functions on the individual T1 span lines and B-channels.

```
Command

1 Reset to Highest Priority Timing Source
2 Reset PRI NAC
3 Force Receiver Reframe on Span Line 1
4 Disconnect Call on Span Line 1 B-CHANNEL(s)
5 Force Receiver Reframe on Span Line 2
6 Disconnect Call on Span Line 2 B-CHANNEL(s)
7 Force TDM-Bus Mastership on Card

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-7):_
```

Figure A-2. Command Menu

Reset to Highest Priority Timing Source. Select the first Command option to reset the Dual T1/PRI NAC's timing source to the next highest priority. Possible timing choices are Internal Clock, Span Line 1, Span Line 2, and TDM Bus.

```
Timing source has been set to: Span Line 1.

Press Esc to exit.
```

Figure A-3. Reset to Highest Priority Timing Source

Reset PRI NAC. Select Command option 2 to reset the T1/PRI NAC and restore the factory configuration. This action takes place immediately and does not prompt for confirmation.

```
Reset T1-PRI NAC
```

Figure A-4. Reset PRI NAC

Force Receiver Reframe on Span Line . Select Command option 3 for span line 1, or 5 for span line 2, to force the T1 framer to reframe. The reframing result, either successful or unsuccessful, displays on the screen.

```
Force Receiver Reframe on Span Line 1<2> Successful.
                                        <Unsuccessful.>

Press Esc to exit.
```

Figure A-5. Force Receiver Reframe on Span Line

Disconnect Call on Span LineB-channel(s). Select Command option 4 for span line 1, or 6 for span line 2, to disconnect an individual B-channel or a range of B-channels.

```
Disconnect Call on Span Line 1 <2> B-CHANNEL(s)

Enter B-CHANNEL(s)to be disconnected and press Return.

Separate all entries with a comma (,), where each entry can
either be an individual B-CHANNEL or a range of (1-24)
B-CHANNEL(s) separated by a dash (-).

>:_
```

Figure A-6. Disconnect Call on Span Line

Force TDM-Bus Mastership on Card. Select Command option 7 to manage the TDM Bus via the Dual T1/PRI NAC.

```
Force Bus Mastership on Card


Press Esc to exit.
```

Figure A-7. Force TDM-Bus Mastership on Card

Status

Select Status, option 2 on the Main Menu, to display the Status submenu.

```
Status

1 Power-up Self-test Status
2 Card Status
3 Chassis Slot Device Configuration Status
4 Quad B-channel/Modem Device Status
5 ISDN-gateway Device Status
6 Span Line 1 DS0 Status
7 Span Line 1 Alarm/Event Status
8 Span Line 2 DS0 Status
9 Span Line 2 Alarm/Event Status

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-9):_
```

Figure A-8. Status Menu

The Status submenu options report on the various Dual T1/PRI NAC and T1 span line status conditions, as well as any alarms or events. The displayed status is a snapshot of the events and/or conditions available at the time the operator requests the status report.

Power-up Self-test Status. Upon power-up, the T1/PRI software performs various tests to ensure proper operation of the T1/PRI hardware. Selecting option 1 from the Status menu displays the test results.

```
Power-up Self-test Status

RAM: Passed
Flash ROM: Passed
Non-maskable Interrupt: Passed
Watch Dog: Passed
Management UART: Passed
User Interface UART: Passed
Time/space Switch: Passed
Framer 1: Passed
Framer 2: Passed
Line Interface Unit 1: Passed
Line interface Unit 2: Passed
Flash ROM 12v Test: Passed
HDLC Channel 1: Passed
HDLC Channel 2: Passed
```

Figure A-9. Power-Up Self Test Status

Descriptions of the reportable Power-up Self-test Status conditions follow:

- **RAM**. This test fills the SRAM of the NAC with a pattern sequence, and then performs a comparison check. The failure level for this test is Critical.
- **Flash ROM**. This test performs a CRC check on the Flash ROM. The failure level for this test is Critical.
- **Non-maskable Interrupt**. This is a write-to-ROM test which results in a Non-Maskable Interrupt (NMI). Any attempt to write to ROM causes the NMI test code to run. The failure level for this test is Non-critical.
- **Watch Dog**. This test verifies the watch-dog circuitry on the Dual T1/PRI NAC. The failure level for this test is Non-critical.
- **Management UART**. This is a simple loopback test to verify the UART that communicates with the Management Bus. The failure level for this test is Non-critical.
- **User Interface UART**. This is a simple loopback test to verify the UART that communicates with the user interface port. The failure level for this test is Non-critical.
- **Time/space Switch**. The T1/PRI software runs two built-in self-tests of the Time Space Interchange (TSI), as well as a write/read test of the TSI registers. The failure level for this test is Non-critical.
- **Framer 1/2**. The T1/PRI software performs various diagnostic exercises to test the framer chips. The failure level for this test is Non-critical.
- **Line Interface Unit 1/2**. The power-up code verifies whether or not the Dual T1 NIC is present and then configures the CSU on the NIC to local loopback mode. The failure level for this test is Non-critical.
- **Flash ROM 12v Test**. This self-test checks and verifies the 12v circuitry to the Flash ROM. The failure level for this test is Pass or Fail.
- **HDLC Channel 1/2**. The code checks the HDLC controller Channels 1 and 2. The HDL controller is used for D channel signaling. The failure level for this test is Pass or Fail.

Card Status. Select the Status menu option 2, Card Status, to view the current timing source, the type of NIC installed with the T1 Card, the slot in which the Dual T1/PRI NAC is installed, and the size of the installed DRAM and Flash ROM. When the timing source is set to either Span Line 1 or 2, the T1/PRI provides master timing. When the timing source is set to TDM, the T1/PRI provides slave timing over the TDM bus.

```
Card Status

Current PRI Timing Source: Span Line 1
Current Pbus Timing Source: Slave.
NAC Type:                Dual T1
T1 NAC Chassis Slot Number   : 01
DRAM Installed:        4 M
FLASH ROM Installed:   1 M

Press Esc to exit.
```

Figure A-10. Card Status

Chassis Slot Device Configuration Status. Select Status menu option 3 to obtain current chassis slot device configuration information. The device type configurations are: None (no device installed); DT1PRI (Dual T1/PRI Card); QBCH-mdm (Quad Modem); and ISDN-GW (NETServer PRI Card).

```
Chassis Slot Device Configuration Status

      Device
Slot# Type

 1    DT1PRI
 2    QBCH-mdm
 3    QBCH-mdm
 4    QBCH-mdm
 5    QBCH-mdm
 6    QBCH-mdm
 7    QBCH-mdm
 8    QBCH-mdm
 9    QBCH-mdm
10    QBCH-mdm
11    QBCH-mdm
12    QBCH-mdm
13    QBCH-mdm
14    QBCH-mdm
15    ISDN-GW
16    ISDN-GW

Press Return to update status or press Esc to exit.
```

Figure A-11. Chassis Slot Device Configuration Status

Quad B-channel/Modem Device Status. Select Status menu option 4 to monitor the status of the installed Quad modems (QBCH-mdm). Each modem slot/channel indicates whether a modem is available (AVAIL), not available (Un-Avail), or currently active and not available (In-Use).

```
Quad B-channel Modem Device Status

ID Slot/Status   ID Slot/Status  ID Slot/Status ID Slot/Status
   Chan            Chan            Chan           Chan
 1 1/1 Un-Avail  17 5/1 In-Use   33  9/1 AVAIL  49 13/1 Un-Avail
 2 1/2 Un-Avail  18 5/2 In-Use   34  9/2 AVAIL  50 13/2 Un-Avail
 3 1/3 Un-Avail  19 5/3 AVAIL    35  9/3 AVAIL  51 13/3 Un-Avail
 4 1/4 Un-Avail  20 5/4 AVAIL    36  9/4 AVAIL  52 13/4 Un-Avail
 5 2/1 In-Use    21 6/1 AVAIL    37 10/1 AVAIL  53 14/1 Un-Avail
 6 2/2 In-Use    22 6/2 AVAIL    38 10/2 AVAIL  54 14/2 Un-Avail
 7 2/3 In-Use    23 6/3 AVAIL    39 10/3 AVAIL  55 14/3 Un-Avail
 8 2/4 In-Use    24 6/4 AVAIL    40 10/4 AVAIL  56 14/4 Un-Avail
 9 3/1 In-Use    25 7/1 AVAIL    41 11/1 AVAIL  57 15/1 Un-Avail
10 3/2 In-Use    26 7/2 AVAIL    42 11/2 AVAIL  58 15/2 Un-Avail
11 3/3 In-Use    27 7/3 AVAIL    43 11/3 AVAIL  59 15/3 Un-Avail
12 3/4 In-Use    28 7/4 AVAIL    44 11/4 AVAIL  60 15/4 Un-Avail
13 4/1 In-Use    29 8/1 AVAIL    45 12/1 AVAIL  61 16/1 Un-Avail
14 4/2 In-Use    30 8/2 AVAIL    46 12/2 AVAIL  62 16/2 Un-Avail
15 4/3 In-Use    31 8/3 AVAIL    47 12/3 AVAIL  63 16/3 Un-Avail
16 4/4 In-Use    32 8/4 AVAIL    48 12/4 AVAIL  64 16/4 Un-Avail

Press Return to update status or press Esc to exit.
```

Figure A-12. Quad B-Channel Modem Device Status

ISDN-gateway Device Status. Select Status menu option 5 to monitor the status of the installed ISDN-GW (NETServer PRI) devices. Each slot is designated as having an ISDN-GW installed and available (AVAIL); device not available (Un-Avail); or device currently active (In-Use). The number of calls for each device is also indicated.

```
ISDN-gateway  Device Status
ID  Status    Number
(Slot#)       of Calls

 1  Un-Avail     00
 2  Un-Avail     00
 3  Un-Avail     00
 4  Un-Avail     00
 5  Un-Avail     00
 6  Un-Avail     00
 7  Un-Avail     00
 8  Un-Avail     00
10  Un-Avail     00
11  Un-Avail     00
12  Un-Avail     00
13  Un-Avail     00
14  Un-Avail     00
15  AVAIL        00
16  AVAIL        00

Press Return to update status or press Esc to exit.
```

Figure A-13. ISDN-Gateway Device Status

Span Line DS0 Status. Select Status menu option 6 for span line 1, and option 8 for span line 2, to view a DS0 status snapshot.

```
Span Line DS0 Status

DS0   DS0          Device   Slot/  DS0 DS0          Device   Slot/
      Status       Type     Chan       Status       Type     Chan

1   CONNECTED-IN ISDN-GW  16/-   13  IDLE         NONE      -/-
2   IDLE         NONE      -/-   14  CONNECTED-IN QBCH-MDM  5/2
3   DIALING-IN   ISDN-GW  15/-   15  CONNECTED-IN QBCH-MDM   5/3
4   DIALING-IN   QBCH-MDM  7/1   16  CONNECTED-IN ISDN-GW  16/-
5   DIALING-IN   QBCH-MDM  -/-   17  CONNECTED-IN ISDN-GW  15/-
6   CONNECTED-IN QBCH-MDM  6/2   18  CONNECTED-IN ISDN-GW  16/-
7   DISCONN      QBCH-MDM  6/3   19  CONNECTED-IN QBCH-MDM  9/3
8   DIALING-IN   QBCH-MDM  -/-   20  CONNECTED-IN QBCH-MDM  9/4
9   DISCONN      QBCH-MDM  7/3   21  CONNECTED-IN QBCH-MDM  9/1
10  CONNECTED-IN QBCH-MDM  7/4   22  CONNECTED-IN QBCH-MDM  9/2
11  CONNECTED-IN QBCH-MDM  8/4   23  CONNECTED-IN ISDN-GW  15/-
12  CONNECTED-IN ISDN-GW   16/-  24  D-CHANNEL     NONE     -/-

Press Return to update status or press Esc to exit.
```

Figure A-14. Span Line DS0 Status

Descriptions of the reportable DS0 Status conditions follow.

- **Connected-In**. The DS0 (B-channel) line is active with a call originating from a remote device through the TELCO.
- **Disconn**. The B-channel call is disconnecting.
- **D-Channel**. The DS0 is carrying signaling data. A device is not associated with this activity.
- **Idle**. The DS0 line is available and awaiting a call.

Alarm/Event Status. Select Status menu option 7 for span line 1, and option 9 for span line 2, to view an Alarm / Event status snapshot.

```
Span Line Alarm/Event Status

Receiver Gain: 0.0 dB

Errored Seconds: xxxxx seconds
Severely Errored Seconds: xxxxx seconds
Failed Seconds: xxxxx seconds

Bipolar Violations: xxxxx
Framing Bit Errors: xxx
Change in Frame Alignment: xxx
Frame Slips: xxx

Bursty Errored Seconds (ESF Only) : xxxxx seconds
CRC Errors (ESF Only): xxxxx
Excessive CRC Error (ESF Only): xxx

Out of Frame: y/n        Out of Frame:  (Red Alarm): y/n
Loss of Signal: y/n     Loss of Signal: (Red Alarm): y/n
Remote Frame Alarm: y/n Remote Frame Alarm:(Yellow Alarm): y/n
Alarm Indication: y/n Alarm Indication Signal(Blue Alarm): y/n
Loop Back: None/Network
D-Channel Status: up/down

Press Return to update status, press Ctrl-R to reset counters or
press Esc to exit.
```

Figure A-15. Span Line Alarm/Event Status

Descriptions of the reportable status conditions follow.

- **Receiver Gain**. This is a function of the Line Interface Units that indicates T1 span line signal attenuation in 7.5 dB increments: 0 dB, 7.5 dB, 15 dB and 22.5 dB.
- **Errored Seconds**. This indicates OOF conditions, frame slip conditions, or error events for SF and ESF framing formats. For SF, it reports the number of seconds during which the frame was in either OOF or slip condition. For ESF, it reports error events in seconds.
- **Severely Errored Seconds**. This reports error events and frame slip conditions in seconds.
- **Failed Seconds**. This indicates the number of seconds in failed state operation. A failed state is defined as 10 consecutive seconds during which severely errored seconds occur.
- **Bipolar Violations**. This indicates bipolar violations (BPV) in the line format being used. For B8ZS line coding, invalid BPVs are indicated. The count of the BPVs detected from both span lines is reported.

- **Framing Bit Errors**. This indicates an error in the framing bit used to determine frame alignment. The count of framing bit errors is reported.
- **Change in Frame Alignment (CFA)**. This indicates that a receiver has reframed on a new framing pattern, and synchronized at a new frame alignment due to an Out of Frame (OOF) condition. The status report indicates whether or not a CFA has occurred. A counter records the number of times a CFA has occurred since the latest counter reset.
- **Frame Slips**. These can be caused either by frames repeated due to buffer overflow (BOF) or frames deleted due to buffer underflow (BUF). The status report indicates whether or not a BOF or BUF condition has occurred. A counter records the number of times a condition has occurred since the latest counter reset.
- **Bursty Errored Seconds**. This occurs in ESF format only. It reports CRC error conditions in seconds.
- **CRC Errors**. This occurs only in ESF format when a CRC bit is in error. The CRC error count is reported.
- **Excessive CRC Error Indication (ECRCEI)**. This is reported in ESF format when 32 of any 33 consecutive CRCs are in error. The status report indicates whether or not this event has occurred. A counter records the number of times an event has occurred since the latest counter reset.
- **Out of Frame (OOF)**. This indicates that a framing pattern for a T1 line has been lost and that data cannot be extracted properly. This is also referred to as a Red Alarm. In both SF and ESF formats, OOF occurs when any two of four consecutive frame synchronization bits are in error. The status indicates whether or not OOF conditions are present.
- **Loss of Signal (LOS)**. This occurs when 175 consecutive 0's are detected in the NIC. The signal is recovered when the 1's density reaches 12.5% or when four 1's are received within a 32-bit period. This is also referred to as a Red Alarm. The status report indicates the presence of an LOS condition.

- **Remote Frame Alarm (RFA)**. This indicates that an OOF condition has occurred at the remote end. This is also referred to as a Yellow Alarm. The status report indicates whether or not an RFA is present.
- **Alarm Indication Signal (AIS)**. This indicates to the remote end that a loss of the received signal has occurred. This is also referred to as a Blue Alarm. AIS occurs when a stream of 1's is received. The status report indicates the presence of an AIS condition.
- **Loop Back**. This indicates whether or not a remotely initiated loopback is in progress from the network.
- **D-Channel Status**. This indicates the state of the ISDN D-channel. Up indicates that the D-channel is active, and Down indicates that the D-channel is not active.

Card Configuration

The configuration options available from the Card Configuration menu pertain to the Dual T1/PRI NAC as a whole. When you select Card Configuration, option 3 from the Main Menu, the following menu appears.

```
Card Configuration                          Current Setting

1 Save Current Configuration to NVRAM
2 Restore NVRAM Configuration
3 Restore Default Configuration
4 Timing Source Priority Assignment         Span-1=1 Span-2=2
5 Chassis Slot Device Configuration


(NOTE: Changing configuration parameters may affect calls in
 progress.)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-5)
```

Figure A-16. Card Configuration Menu

Press Esc to return to the Card Configuration menu from any of the submenus.

Save Current Configuration to NVRAM. When changing the default configuration of the Dual T1/PRI NAC, select Card Configuration option 1 to retain these changes. This action saves the new configuration to NVRAM. The system then prompts the user to confirm the operation.

```
Saving Current Configuration Settings

1 Save Current Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

Figure A-17. Save Current Configuration to NVRAM

Restore NVRAM Configuration. When changing the NVRAM settings, select option 2 to reset the Dual T1/PRI NAC to its previous settings. The system then prompts the user to confirm the operation.

NOTE: Previous NVRAM configuration restoration is disabled when changes to the NVRAM settings are made and the *Save Current Configuration to NVRAM* option is selected.

```
Restore NVRAM Configuration

1 Restore NVRAM Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

Figure A-18. Restore NVRAM Configuration

Restore Default Configuration. Select option 3 on the Card Configuration menu to reload factory defaults. The system then prompts the user to confirm the operation.

```
Restore Default Configuration Settings

1 Restore Default Configuration

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

Figure A-19. Restore Default Configuration

Timing Source Priority Assignment. A number of either 1 for highest priority or 2 for lowest priority is assigned to the timing sources. The timing source with the highest priority clocks span line data. A timing source is disabled by assigning it a priority of 0. When not disabled, two or more timing sources cannot be assigned the same priority. Priority assignment of timing sources allows for switching to the next highest timing source when the current source fails.

```
Timing Source Priority Assignment

Span Line 1 (T1-1): 1
Span Line 2 (T1-2): 2


Enter the desired priority (0-2) beneath each timing source
and press Return or press Esc to exit.

0 = Disabled,  1 = Highest Priority, 2 = Lowest Priority


Timing Source Priority Assignment


Example: 2 1     changes T1-1=2 and T1-2=1

Timing Source Priority:_
```

Figure A-20. Timing Source Priority Assignment

The timing source does not switch unless a failure is detected on the current choice. For example, the primary timing source fails and the secondary timing source takes over. The secondary source remains active as long as it does not fail, even after the primary source returns.

From the Command Menu, select *Reset to Highest Priority Timing Source.* The primary timing source once again becomes active.

NOTE: Refer to the description of the *Reset to Highest Priority Timing Source* option contained earlier in this Appendix.

Table A-1 summarizes timing source priority options and defaults.

Table A-1. Timing Source Priority

Parameter	Options	Default
Span Line 1 Timing Source Priority	0 (Disabled) 1 (Highest priority) 2 (Lowest priority)	1
Span Line 2 Timing Source Priority	0 (Disabled) 1 (Highest priority) 2 (Lowest priority)	2

Chassis Slot Device Configuration. Select Card Configuration menu option 5 to allow the operator to assign device types to chassis slot numbers. Each chassis slot is assigned a number from 1 to 16. To assign a device type to a specific slot, use the letter q for the Quad modem (QBCH-mdm); g for the NETServer PRI NAC (ISDN-GW); and the letter n to indicate that there is not an ISDN device in the slot.

```
Chassis Slot Device Configuration Status

 Current Configuration Status

        Device                Device
 Slot#  Type          Slot #  Type

 1      DT1PRI          9     QBCH-mdm
 2      QBCH-mdm       10     QBCH-mdm
 3      QBCH-mdm       11     QBCH-mdm
 4      QBCH-mdm       12     QBCH-mdm
 5      QBCH-mdm       13     QBCH-mdm
 6      QBCH-mdm       14     QBCH-mdm
 7      QBCH-mdm       15     ISDN-GW
 8      QBCH-mdm       16     ISDN-GW

 Assign device types to chassis slot numbers given the format
 below:

      DEVICE_TYPE#:S#[,S#,S#-S#]

 Where,
  DEVICE_TYPE# -> q - QBCH-MDM, g - ISDN-GW, n - NONE (no ISDN
                                                 Device in slot)
                  S# -> Chassis Slot# (1-16)

 Example: q:4,5 assigns the QBCH-MDM NAC device type to slots
          4 and 5

 >:_
```

Figure A-21. Chassis Slot Device Configuration Status

NOTE: If the system returns a "Ring No Answer" error message, verify that the modem settings displayed on the screen reflect the modem's chassis location.

Inbound Call Routing Configuration

Select option 4, Inbound Call Routing Configuration, from the Main Menu to display the following menu.

```
 Inbound Call Routing Configuration

                                                    Current
1 Default ISDN-GW NAC:                              16
2 Allow Analog Modem Calls:                         Disabled
3 Inbound Phone Number Routing Configuration
4 Inbound Phone Number Routing Configuration Status(Entries 1-24)
5 Inbound Phone Number Routing Configuration Status(Entries 25-48)

 Enter menu selection and press Return or press Esc to exit.

 Menu Selection (1-5):_
```

Figure A-22. Inbound Call Routing Configuration Menu

Press Esc to return to the Inbound Call Routing Configuration menu from any of the submenus.

Default ISDN-GW NAC. Select Inbound Call Routing Configuration option 1 to assign the Dual T1/PRI NAC digital calls to a specific NETServer PRI (ISDN-GW). Type the chassis slot number for the ISDN-GW NAC, or type the letter **N** to activate the default setting. Save the setting to NVRAM the first time. The selection appears on the Inbound Call Routing Configuration screen.

```
Default ISDN-GW Slot

This ISDN-GW will handle this PRI NAC's Digital Calls.

Enter a slot number between 1-16 or N(default) for no ISDN-GW
and press Enter or press Esc to exit.

>:_
```

Figure A-23. Default ISDN-GW Slot

Allow Analog Modem Calls. Select this option to enable or disable analog modem call acceptance. The selection appears on the Inbound Call Routing Configuration screen.

```
Allow Analog Modem Calls

1) Enable
2) Disable

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

Figure A-24. Allow Analog Modem Calls

Inbound Phone Number Routing Configuration. Select this option to assign a call type to an individual called party phone number entry. Use the following when assigning a call type:

- Phone Number Index (PHIDX#)
- Remove phone number(s) from phone # index (rmv)
- Specify phone number (ph)
- Specify Call Type for phone number entry (ct)
- Treat call type as digital (D)
- Treat call type as analog (A)
- Up to 18 numeric character phone number including (), -, #, and * (PH#).

Press Return or Esc to escape back to the Inbound Call Routing Configuration menu.

```
Inbound Phone Number Routing Configuration

Assign a call type to a called party phone number entry using
the format below:

         PHIDX# [:rmv][:ph=PH# | rmv][,ct-A/D]

Where,
   PHIDX# -> Phone Number index (1-48)
   rmv -> Keyword for removing phone numbers from phone# index
   ph -> Keyword specifying phone number
   ct -> Keyword specifying call type for phone num. entry
   (A= Treat call as analog, D=treat call as digital)
   PH#=numeric character phone number up to 18 numeric
          characters including (), -, # and *.
   PHIDX#:rmv -> Remove ph# and set ct to D (default)
   PHIDX#:ph=rmv -> Remove this phone number entry from PHIDX#

Example: 1:ph=982-5010,ct=D adds the phone# 982-5010, and sets
call type to Digital

>: _
```

Figure A-25. Inbound Phone Number Routing Configuration

Inbound Phone Number Routing Configuration Status . Use this option to view the inbound phone number routing configuration status. The letter D specifies digital call type (CT) while the letter A specifies analog call type.

```
Inbound Phone Number Routing Configuration Status (Entries 1-24)


#  Phone Number     CT      #   Phone Number      CT

1  486-5200         D       13  x                 D
2  x                D       14  x                 D
.                           .
.                           .
12  x               D       24  x                 D


Press Esc to Exit.
```

Figure A-26. Inbound Phone Number Routing Configuration Status (Entries 1-24)

The following submenu displays the Inbound Phone Number Routing Configuration Status for channels 33-64.

```
Inbound Phone Number Routing Configuration Status (Entries 25-48)


#  Phone Number     CT      #   Phone Number      CT
25 486-5200         D       37  x                 D
26                  D       38  x                 D
.                           .
.                           .
36  x               D       39  x                 D


Press Esc to Exit.
```

Figure A-27. Inbound Phone Number Routing Configuration Status (Entries 25-48)

Span Line Configuration

Select Span Line Configuration option 5 for span line 1, option 6 for span line 2, from the Main Menu to display the following menu.

```
Span Line Configuration   Current Setting

1 Framing Mode                ESF
2 Line Coding                 B8ZS
3 Remotely Initiated Loopback Ignore
4 Jitter Attenuation          Transmitter
5 Transmit Line Build Out     0.0 dB
6 Switch Type (Boot time)     Config=5ESS(AT&T)Act=5ESS(AT&T)
7 Idle Byte Sent to TELCO     FE Hex

NOTE: Changing configuration parameters may affect calls in
progress

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-7):_
```

Figure A-28. Span Line Configuration

Press Esc to return to the Span Line Configuration menu from one of the submenus.

Table A-2 summarizes the configurable span line parameter options and defaults.

Table A-2. Parameters Configurable per T1 Span Line

Parameter	Options	Default
Framing Mode	Superframe (SF) Extended Superframe (ESF)	ESF
Line Coding	Binary 8 Zero Substitution (B8ZS)	B8ZS
Line Loopback	Ignore Respond	Ignore
Jitter Attenuation	Receiver Transmitter	Transmitter
Transmit Line Build Out	0.0 dB 7.5 dB 15.0 dB 22.5 dB	0.0 dB
Switch Type	5ESS, 4ESS, DMS-100, and DMS-250*	5ESS
Idle Byte	Hexadecimal value	FE

**Use DMS-100 or 5ESS switch settings when the only available switch type is DMS-250.*

Framing Mode. This option specifies the framing format, superframe (SF) or extended superframe (ESF), for Span line 1 or 2. ESF is recommended for use with T1/PRI service.

- The SF format consists of 12 DS1 frames containing 193 bit positions. The ESF format consists of 24 DS1 frames and the ESF alignment signal. A Cyclic Redundancy Check (CRC) and a data link share the frame overhead-bit position.
- In ESF mode, the Dual T1/PRI card reports Yellow Alarms on the Facilities Data Link.

NOTE: The Dual T1/PRI card is unable to provide performance monitoring or respond to diagnostic commands at this time.

```
Span Line Framing Mode

1) Extended Superframe (ESF)
2) Superframe (SF)

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2):_
```

Figure A-29. Span Line Framing Mode

Line Coding. Select option 2 from the Span Line Configuration menu to select a line coding scheme for Span Lines 1 and 2. A line coding scheme ensures a sufficient density of 1's in the bit stream as required by the T1 standard for clock synchronization. Binary 8 Zero Substitution (B8ZS) is the only line coding supported for T1 / PRI service.

```
Span Line Line Coding

1 Binary Eight Zero Substitution (B8ZS)

Note, for PRI B8ZS is the only line coding supported.

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1):_
```

Figure A-30. Span Line Line Coding

Remotely Initiated Loopback. Select this option to enable or disable the remotely initiated loopback mode for Span lines 1 and 2. This parameter allows the Dual T1 / PRI NAC to respond to a repeating pattern from the TELCO. When enabled, the T1 / PRI NAC enters the loopback mode upon receipt of the pattern *00001* for 5 seconds and exits the loopback mode upon receipt of the pattern *001* for 5 seconds.

While in loopback mode, the Dual T1 / PRI NAC loops back the received signal to the T1 line and the LPBK LED for the appropriate T1 line becomes green. As a result, the system side transfers to an idle condition.

```
Span Line Remotely Initiated Loopback

 1 Respond
 2 Ignore

 Enter menu selection and press Return or press Esc to exit.

 Menu Selection (1-2):_
```

Figure A-31. Span Line Remotely Initiated Loopback

Jitter Attenuation. The Dual T1 NIC hardware provides a 193-bit frame buffer to compensate for low frequency synchronization jitter to the T1 network. This buffer is placed in either the receive or transmit data path.

The default setting is transmitter.

```
 Span Line Jitter Attenuation

 1 Attenuate Jitter on Receiver
 2 Attenuate Jitter on Transmitter

 Enter menu selection and press Return or press Esc to exit.

 Menu Selection (1-2):_
```

Figure A-32. Span Line Jitter Attenuation

Transmit Line Build Out. Transmit Line Build Out is used to eliminate crosstalk when the transmitter energy causes errors on the low amplitude receive line. This is a function of the LIUs and is selected individually for each LIU at 0 dB, 7.5 dB, 15 dB or 22.5 dB.

```
 Span Line Transmit Line Build Out

 1)  0.0 dB
 2)  7.5 dB
 3) 15.0 dB
 4) 22.5 dB

 Enter menu selection and press Return or press Esc to exit.

 Menu Selection (1-4):_
```

Figure A-33. Span Line Transmit Line Build Out

Span Line Switch Type. The switch type is set to accommodate the various T1/PRI line providers. AT&T uses 5ESS and 4ESS. Northern Telecom uses DMS-100 and DMS-250. Switch type changes take effect during boot up.

NOTE: When using switch type DMS-250, select either DMS-100 or AT&T 5ESS. The Dual T1/PRI NAC supports the DMS-250 switch type for emulation mode only.

```
Span Line Switch Type

1 4ESS (AT&T)
2 5ESS (AT&T)
3 DMS-100 (Northern Telecom)

Note: Change takes affect at boot time.

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-3):_
```

Figure A-34. Span Line Switch Type

Idle Byte Pattern. T1 equipment requires a sufficient number of 1's in the bit stream for deriving clock synchronization. This parameter is set to send to the TELCO over idle B-channels. The parameter is configurable to satisfy the 1's density required by the TELCO.

NOTE: Use a byte in the hexadecimal ranges from 00 to FF, the default is FE (hex).

```
Span Line Configuration


Enter 2 Digit Idle byte


>:_
```

Figure A-35. Span Line Idle Byte Pattern

Software Fault Manager

Select option 7, SW Fault Manager Event Logging, from the Main Menu. The Software Fault Manager Event Logging provides a record of software fault events. The event logging feature is either enabled or disabled. In addition, either an online display or a historical record display are available for maintenance purposes.

NOTE Logging to the Software Fault Manager is not supported at this time.

```
Software Fault Manager                Current Setting

1 SW Fault Manager Event Logging      Enabled
2 SW Fault Online Display             Disabled
3 SW Fault History Display            Disabled

Enter menu selection and press Return or press Esc. to exit.

Menu Selection (1-3) : _
```

Figure A-36. Software Fault Manager Menu

SW Fault Manager Event Logging. Selecting the SW Fault Manager Event Logging option allows the operator to either enable or disable the software fault manager event logging program. The choices are 1 to enable, or 2 to disable, the event logging setting feature.

```
Software Fault Manager Event Setting

1 Enable
2 Disable

Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2): _
```

Figure A-37. Software Fault Manager Event Setting

SW Fault Online Display. Selecting this option allows the operator to either enable or disable the online display for software faults. The choices are 1 to enable, or 2 to disable, the online display feature.

```
 Software Fault Manager Online Setting

 1 Enable
 2 Disable

 Enter menu selection and press Return or press Esc to exit.

Menu Selection (1-2): _
```

Figure A-38. Software Fault Manager Online Setting

SW Fault History Setting. Selecting this option allows the operator to either enable or disable the software fault manager history setting. The choices are 1 to enable, or 2 to disable, the history setting feature.

```
 Software Fault Manager History Setting

 1 Enable
 2 Disable

 Enter menu selection and press Return or press Esc to exit.

 Menu Selection (1-2): _
```

Figure A-39. Software Fault Manager History Setting

Appendix B
Technical Specifications

Dual T1/PRI Interface

- Dual T1 / PRI Interface supports up to 48 DS0s
- ESF frame format
- B8ZS line coding
- Integral CSU
  - Line Rate: T1 (1.544 Mbps)
  - Input Signal: DS1 to -34dB typical per AT&T Publication 64211
  - Output Signal: DS1 with LBO 0, -7.5, -15, -22.5dB (selectable)
  - Configuration: Stored in NVRAM
- Loop timing source from either span line
- Automatic fallback to alternate timing sources
- Address signaling (DNIS / ANI)

Total Control Chassis Interfaces

- Supports QBCH Modem Cards (Quad Modem Cards with software upgrade)
- Dynamic modem configuration based on DNIS / ANI information

Management

- *Total Control Manager*, SNMP-based, Windows-compatible software for configuration management, status reporting, operator commands and software download
- TTY RS-232 Operator Interface for direct connection interface to perform the features of the Management Station
- Software upgradeable using on-board Flash memory

- Supports TELCO-initiated Line Loopbacks per AT&T Publication 54016

Monitoring

- Data Storage: Information accessible through user interface
- DS0/Modem Status: Alarm, Available, Idle, Test, Unavailable
- Alarm/Event Status: Alarm Indication Signal, Bipolar Violations, Bursty Errored Seconds, Current Timing Source, CRC Errors, Errored Seconds, Failed Seconds, Framing Bit Errors, Loss of Signal, Out of Frame, Receiver Gain, Remote Frame Alarm, Reset Counter, Severely Errored Seconds

LEDs

- Run/Fail
- Carrier (2, one for each span line)
- Loopback (2, one for each span line)
- Alarm (2, one for each span line)

Interfaces

- To terminate T1 span lines, 2 RJ48C connectors for T1 NIC
- For monitoring network signals, 2 Bantam Monitor jacks for T1 NIC
- RS-232 modular 8 connector for configuration and software download with a PC, terminal, or modem
- DIN connector to chassis midplane
- Menu-driven operator interface via the RS-232 port

Mechanicals

Dimensions

T1 / PRI NAC 12.45" x 6.4"

T1 / PRI NIC 4.85" x 6.4"

Power

7 watts

Heat

24 BTUs

Mean Time Between Failure

75,000 hours

Operating Environment

Temperature 0–40º C, 32–104º F

Relative humidity 0–95% non-condensing

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