Eiconcard™ Connections for Linux

User's Guide

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Dialogic CORPORATION.

9800 Cavendish Blvd., Montreal, Quebec, Canada H4M 2V9

This Agreement has been drafted in English at the express wish of the parties. Ce contrat a été rédigé en anglais à la demande expresse des parties.

Contents

CHAPTER 1

About this Guide

The Eiconcard Connections for Linux User's Guide provides information on how to configure and use Eiconcard Connections for Linux. It includes the following sections:

Important: This document does not contain information on how to install Eiconcard Connections for Linux. For installation information, consult the Release Notes (ReadmeFirst.txt) located in the Linux/SC_Series directory on the Universal Connections Suite CD.

1: About this Guide

Provides an overview of the Eiconcard Connections for Linux User's Guide and describes the typographic conventions used.

2: Introducing Eiconcard Connections for Linux

Introduces Eiconcard Connections for Linux and explains how it functions in different communications environments.

3: Configuring Eiconcard Connections for Linux

Describes how to install the Eiconcard Services and Eiconcard Connections for Linux drivers and how to configure their communications protocol software. For instructions on how to install Eiconcard Connections for Linux, see the *Eiconcard Connections for Linux Release Notes* (ReadmeFirst.txt) located in the Linux/SC_Series directory on the Universal Connections Suite CD.

4: Using the Eiconcard Host PAD and Eiconcard Terminal PAD

Explains how to configure the Eiconcard Host PAD and Eiconcard Terminal PAD.

5: Using Eiconcard Routing Services

Explains how to use the Eiconcard Routing Services package. It provides the procedure for testing sample X.25, PPP, Multilink PPP, and Frame Relay connections. This chapter also explains how to use the connection backup feature.

6: Advanced Eiconcard Services Configuration

Describes how to configure the Eiconcard Streams Device Driver.

7: Modem and Null-Modem Cables

Provides tips on modem and modemless (null-modem) cables and connections.

8: X.25 User-Facility Support and Code References

Describes the optional network services known as User Facilities and provides the DNIC, X.25 cause and diagnostic codes, and ASCII codes used to specify the facilities.

9: X.29 Call User Data Format

Provides the format for the X.29 Call User Data.

10: Key Packet Formats

Provides the formats for all the key packet types.

11: X.3 PAD Parameters

X.3 PAD parameters set the guidelines for how the PAD deals with different terminal emulations.

Typographic Conventions

This document uses the following typographic conventions:

Normal italic type is used for filenames, pathnames, and program names.

`Mono-spaced` type is used for commands and parameters.

Names of documents, sections, and chapters are enclosed in double quotes (“ ”).

This document uses the following syntax conventions for commands and parameters:

Convention	**Purpose**
`ectest`	Items set in `mono-spaced` type such as command names and parameters must be entered exactly as shown. Note that Linux is case sensitive.
`image`	User-supplied items are set in *`mono-spaced italic`* type.
Enter	Keys to be pressed appear in **boldface** type.
[-v]	Items enclosed in brackets [] are optional. When an optional item is included, it must be entered exactly as shown. Do not enter the square brackets.
1|2|3	The vertical bar | separates two or more choices in a multi-valued parameter. Choose only one value. Do not enter the vertical bar.
-t {A|B}	Braces { } enclosing a list of items separated by vertical bars (|) indicate that you must select one item from that list. Enter the item exactly as shown. Do not enter the braces or vertical bars.

CHAPTER 2

Introducing Eiconcard Connections for Linux

This chapter introduces Eiconcard Connections for Linux. It provides an overview of the Eiconcard Connections for Linux architecture and describes the communications options it offers. It also provides a brief description of Dialogic's hardware solution—the Eiconcard—and its supported communications protocols.

The Eiconcard Connections for Linux Solution

Eiconcard Connections for Linux allows you to:

- Connect a Linux server to local or remote systems over OSI-compliant connections such as X.25, and supports a wide range of OSI communications services. These services include management of communications links to local or remote systems, Packet Assembler/Disassembler (PAD) support (X.3, X.28, and X.29), protocol processing for X.25, HDLC (High-level Data Link Control), Frame Relay, SDLC (Synchronous Data Link Control) and PPP (Point-to-Point).
- Link Linux application servers, with their associated TCP/IP LANs, over a wide-area network. Eiconcard Connections for Linux integrates with the TCP/IP stack on your server, using the Eiconcard to route IP traffic over X.25, Frame Relay, PPP, or MultiLink PPP connections to remote TCP/IP hosts and networks.

  Eiconcard Connections for Linux performs the processing required to pass IP datagrams over WAN protocols, allowing a Linux server to connect with remote networks.

The Eiconcard Connections for Linux solution is composed of two components:

- The Eiconcard

  An intelligent communications adapter used in all of Dialogic's WAN connectivity solutions.
- The Eiconcard Connections for Linux software

  Provides the protocol software, the Eiconcard driver, and the management utilities required to set up your connections.

The Eiconcard

Dialogic's Eiconcard is the hardware component of the Eiconcard Connections for Linux solution. One or more Eiconcards can be installed in a Linux server. Each Eiconcard has its own onboard CPU and memory, allowing it to run one or more communications stacks, including X.25, Frame-Relay, SDLC (Synchronous Data Link Control), Point-to-Point (PPP) and MultiLink PPP. A range of Eiconcards is available for different communications needs, such as high-speed leased line connections, dial-up connections, or ISDN.

As the Eiconcard assumes all network-level protocol processing, the host Linux server's CPU can focus on application processing.

For a list of supported Eiconcards, consult the *Eiconcard Connections for Linux Release Notes*.

The Eiconcard Connections for Linux Software

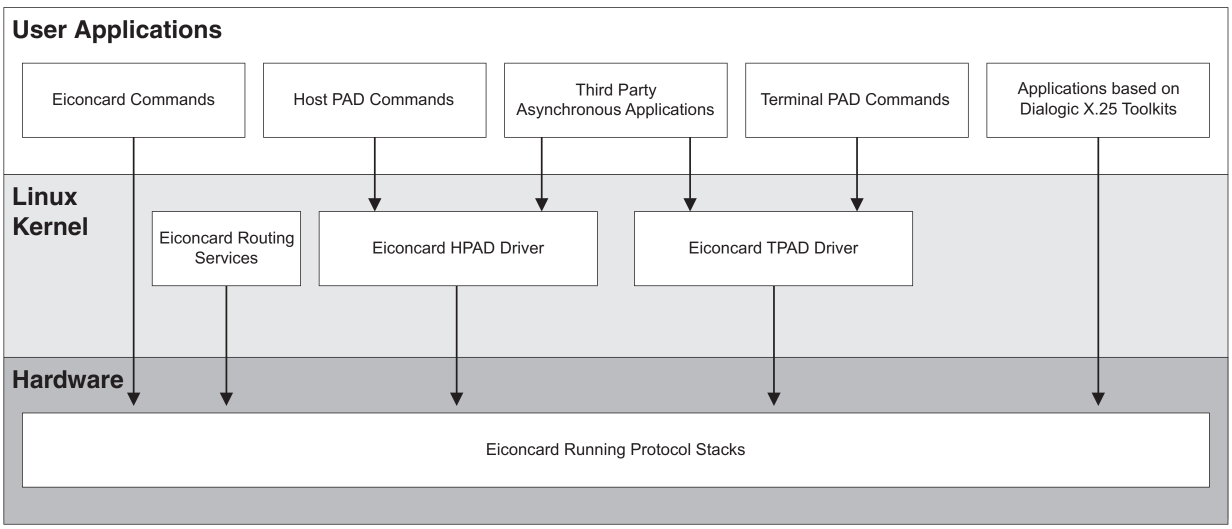
The Eiconcard Connections for Linux software includes four packages:

- Eiconcard Services
- Eiconcard Host PAD and Terminal PAD Services
- Eiconcard Routing Services
- Eiconcard SNMP Services

And one sub-package:

- Eiconcard X.25 Application Support

The following diagram shows how the Eiconcard Connections for Linux module integrates into the Linux system.



Eiconcard Services

Provides the protocol software (X.25, HDLC, Frame Relay), the Eiconcard driver, and management utilities for the Eiconcard. The Eiconcard Services package is a key component of Eiconcard Connections for Linux and must always be installed first.

The Eiconcard Host PAD and Terminal PAD Driver

The PAD Driver architecture consists of the Host PAD and Terminal PAD drivers running on top of the Eiconcard driver. These drivers fully emulate *tty* drivers, so any asynchronous application written to *tty* driver standards can function with the Linux PAD drivers.

Eiconcard Host PAD Driver

The Eiconcard Host PAD driver allows remote users to access your Linux server over X.25 connections. Host PAD provides this functionality by implementing the X.3, X.28, and X.29 PAD standards. It therefore allows remote login by users on systems conforming to these PAD standards over X.25. Host PAD provides the following capabilities:

- Each Eiconcard port can support multiple Host PAD sessions.
- The Eiconcard connects directly to the X.25 network, eliminating the need for asynchronous modems and an external PAD.
- Remote login capability over highly-reliable X.25 communications links.

The Eiconcard Host PAD driver is a pseudo-driver linked into the Linux kernel. It uses the services of the Eiconcard driver to access the X.25 protocol running on the Eiconcard. A Linux login daemon such as *getty* provides incoming connections from Host PAD with a login shell as if the connection were on a local terminal. The Eiconcard Host PAD driver also provides Host PAD device-configuration utilities and files, and includes a driver-configuration utility (Eiconcard Host PAD Driver Configuration option in `eiconcfg`).

Note: The Host PAD Driver only receives calls from remote PAD users, it does not initiate them. The Terminal PAD driver initiates calls to remote hosts over an X.25 network.

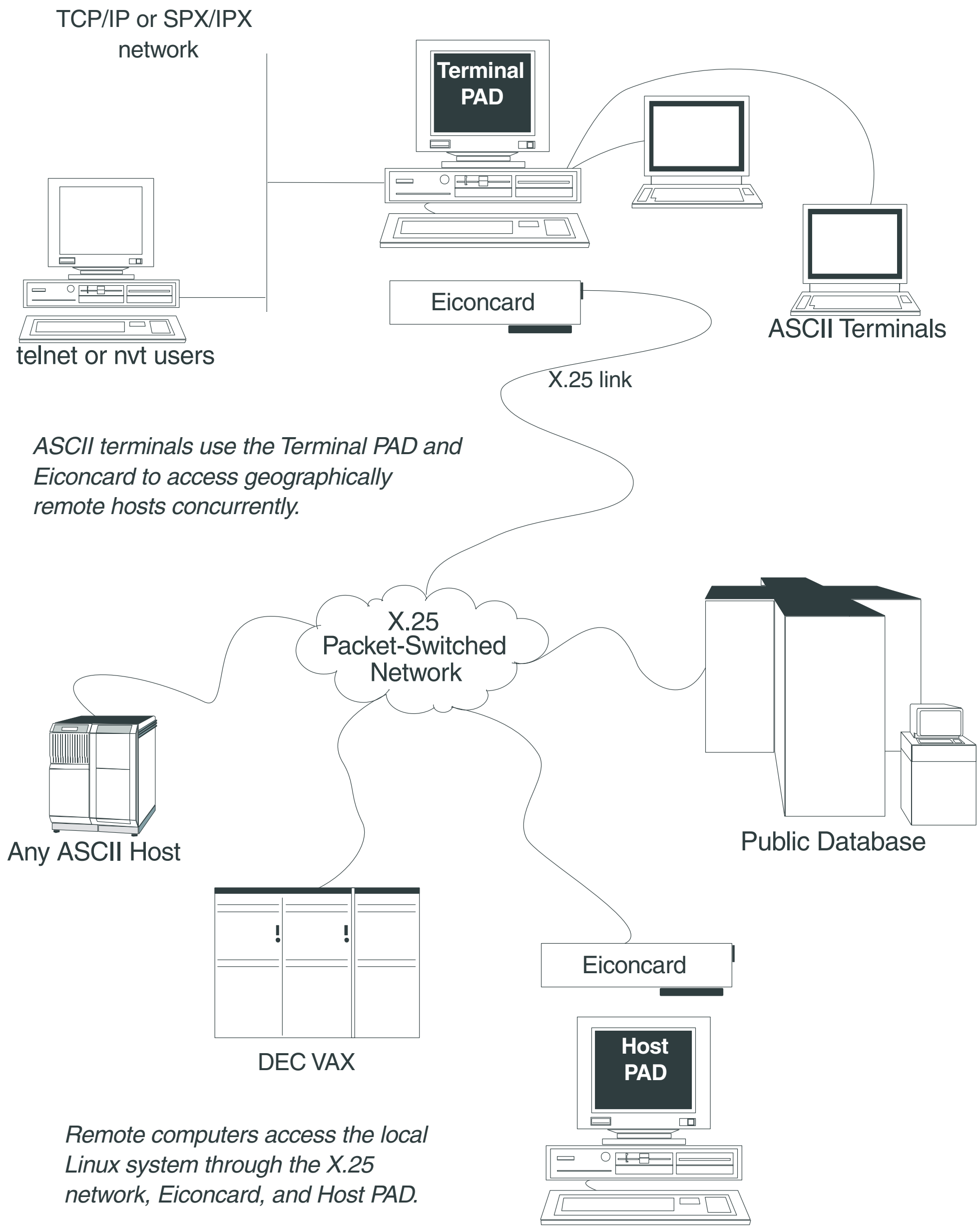
Eiconcard Terminal PAD Driver

The Eiconcard Terminal PAD driver enables Linux server users to login to remote systems over X.25. Each Eiconcard port supports multiple TPAD sessions. As with the Host PAD, the Terminal PAD provides this functionality by implementing the X.3, X.28, and X.29 PAD standards. It therefore allows local users to login to any remote systems that conform to these PAD standards over X.25.

The Eiconcard Terminal PAD driver is a pseudo-driver linked into the Linux kernel. It uses the services of the Eiconcard driver to access the X.25 protocol running on the Eiconcard. Linux utilities such as *cu* and *uucp* run over the Terminal PAD driver to provide the local user with terminal functionality. The Eiconcard Terminal PAD driver also provides Terminal PAD device-configuration utilities and files, and includes a driver-configuration utility (Eiconcard Terminal PAD Driver Configuration option in `eiconcfg`).

Note: The Terminal PAD driver only initiates calls from local session users, it does not receive them. Use the Host PAD driver to receive calls coming in over an X.25 network.

The diagram below illustrates how the Terminal PAD driver and Host PAD drivers are used in a typical installation.



Eiconcard Routing Services

Eiconcard Routing Services allows you to link Linux servers (Web, application, mail, etc.), with their associated TCP/IP LANs, over a wide-area network. Routing Services integrates with the TCP/IP stack on your Linux server, using the Eiconcard to route IP traffic over X.25, Frame-Relay, Point-to-Point (PPP), or MultiLink PPP connections to remote TCP/IP hosts and networks.

Routing Services performs the processing required to pass IP datagrams over WAN protocols, allowing a Linux server to connect with other networks over a wide area.

Eiconcard SNMP Services

This package provides the necessary support for network management. It allows the user to remotely control and monitor the Eiconcard Services components. As a remote manager you can perform real-time administrative tasks, gather statistics, and track the router's performance.

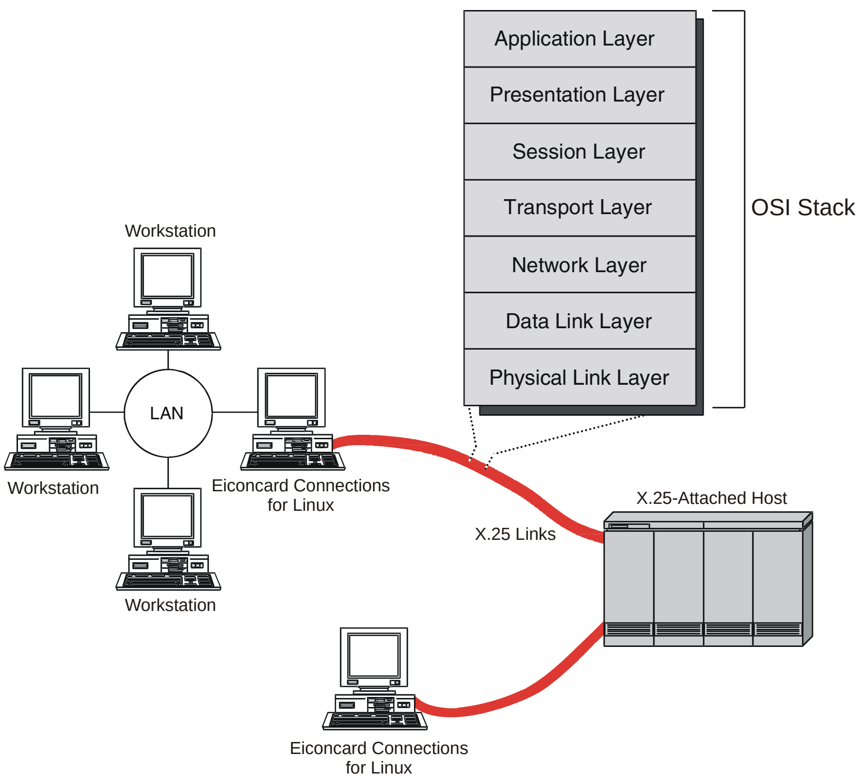
The package is composed of the Eiconcard SNMP Subagent, its configuration file, the supported MIBs, and few HTML help pages providing information on how to setup and test remote management of Eiconcard Services.

Eiconcard X.25 Application Support

The Eiconcard X.25 Application Support subpackage provides the functionality for running applications, developed using the Eiconcard X.25 Development Tools (available separatly from Dialogic® Corporation), over an X.25 network.

Integrating with OSI

OSI (Open Systems Interconnection) is a seven-layer hierarchical model for exchanging data. OSI was developed by the International Organization for Standardization (ISO), with the goal of defining, specifying, and relating communications protocols. OSI is a means of standardizing communications between different computer systems.

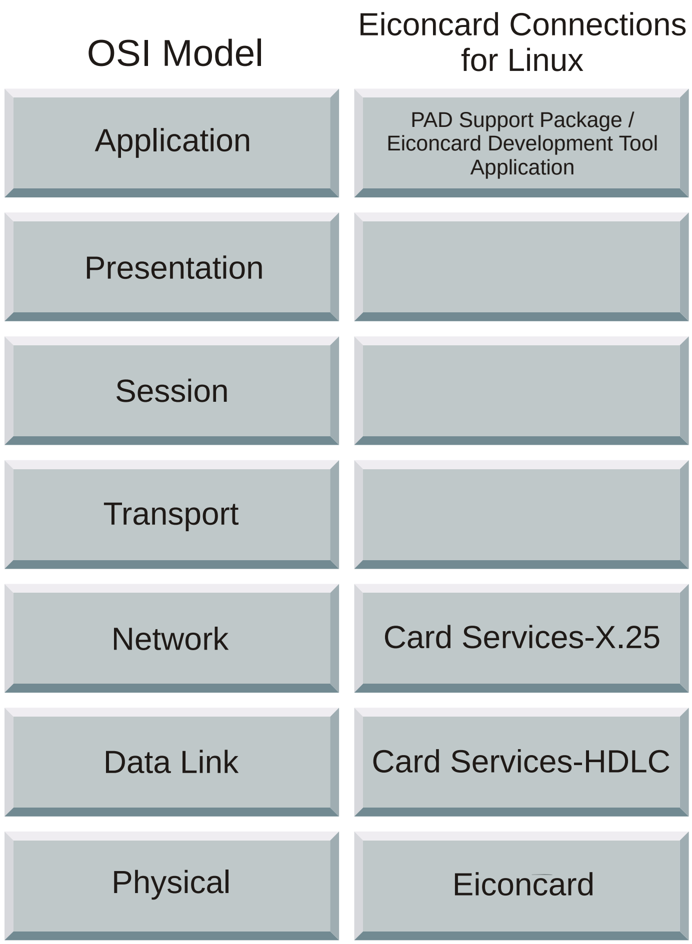


Eiconcard Connections for Linux supports X.25, HDLC, and Frame Relay protocols.

OSI Support

Eiconcard Connections for Linux is implemented according to the OSI model. The top layer—the Application Layer—is implemented by the PAD Support components or applications developed using the Eiconcard Development Tools. The Network Layer and Data Link Layer are implemented respectively by the X.25 and HDLC protocol support provided by the Eiconcard Services package. The bottom OSI layer—the Physical Layer—is implemented by a media connector on the Eiconcard.

The diagram below shows how Eiconcard Connections for Linux corresponds to the OSI network model.



For More Information

The *Eiconcard Connections for Linux Release Notes* provides step-by-step instructions for installing the Eiconcard Connections for Linux product.

The remainder of this user's guide provides information on configuring and operating Eiconcard Connections for Linux.

In addition to this user's guide, the Eiconcard Connections for Linux software includes HTML help pages that provide detailed information on the following:

- Eiconcard Services commands
- Eiconcard Host PAD commands
- Eiconcard Terminal PAD commands
- Eiconcard Routing Services commands
- Configuring the mpr.if file
- Configuring SNMPD agent
- Eiconcard Connections for Linux troubleshooting
- Glossary of terms and list of acronyms

The pages are located in the */docs* subdirectory of the installation directory and can be viewed using a Web browser.

CHAPTER 3

Configuring Eiconcard Connections for Linux

Installing / Removing Eiconcard Connections for Linux

This section describes how to install the Eiconcard Services and Eiconcard Connections for Linux software.

Introduction

The Eiconcard Connections for Linux software is installed using rpm. You must be logged in as ROOT in order to install and configure it.

Installing Eiconcard Services Software

It is recommended that the Eiconcard(s) be installed in your system before you install the Eiconcard Services software.

Install the Eiconcard Services package as follows:

```
# rpm -ivh Eiconcard_Services-VvRr_xxxx-xx-xxx.xxxx.rpm
```

(replace 'v', 'r' and 'x' with corresponding numbers that appear in the file name; see the description in "Section 3. Package Contents" in the file ReadmeFirst.txt)

This will create the /opt/dialogic/c4l directory that contains the Eiconcard Services software. You can now configure the Eiconcard drivers and the WAN Protocols by executing /opt/dialogic/c4l/eiconcfg.

Installing Eiconcard Routing Services

Install the Eicon Routing Services package as follows:

```
# rpm -ivh Eiconcard_Router-VvRr_xxxx-xx-xxx.xxxx.rpm
```

(replace 'v', 'r' and 'x' with corresponding numbers that appear in the file name; see the description in "Section 3. Package Contents" in the file ReadmeFirst.txt)

Once this package is installed, additional services (Routing Services & Compression Modules) will become available in the Eiconcard Services Protocol Configuration program.

To enable these additional services, run /opt/dialogic/c4l/eiconcfg, select option 2, then press **F4** to reach the Protocol Configuration panel.

Compression Modules must be enabled in order to use the PPP protocol; even if your connection will not use compression.

Note that routing options are not configurable via /opt/dialogic/c4l/eiconcfg. There are two methods that can be used to configure the routing services: ECCLI and Manual.

ECCLI Method

The Eiconcard Command Line Interface (ECCLI) application can be used to configure the routing services and automatically generate the routing services configuration file (mpr.if). Refer to the ECCLI documentation for details.

Manual Method

Optionally you can manually create and modify the mpr.if file in /opt/dialogic/c4l.

For details on the mpr.if file and how to configure a router for your Eiconcard(s), see the documentation and samples. The top level of the documentation is located in /opt/dialogic/c4l/docs/mprif.html.

Sample configurations are located in /opt/dialogic/c4l/mpr-if.

Note: If you edit the mpr.if file, it is recommended that you use the "vi" editor.

Installing Eiconcard PAD Services

Install the Eiconcard PAD Services package as follows:

```
# rpm -ivh Eiconcard_PAD_Services-VvRr_xxxx-xxx.xxxx.rpm
```

(replace 'v', 'r' and 'x' with corresponding numbers that appear in the file name; see the description in "Section 3. Package Contents" in the file ReadmeFirst.txt)

This will install HPAD and TPAD. To configure TPAD and HPAD:

```
# cd /opt/dialogic/c4l
# ./eiconcfg
```

Select option 6: Configure PAD

The program used by PAD Services to dial in is mgetty.

You should modify the mgetty configuration file (/etc/mgetty+sendfax/mgetty.config) to reflect your system's configuration.

For more information on configuring mgetty, consult your Red Hat/SuSE documentation.

Completing the Installation

You will need to reboot your PC to activate the new configuration.

Removing Eiconcard PAD Services

To remove Eiconcard PAD Services, do the following:

```
# rpm -e Eiconcard_PAD_Services
```

Removing Eiconcard Router

To remove the Eiconcard Router, do the following:

```
# rpm -e Eiconcard_Router
```

Removing Eiconcard Services

To remove the Eiconcard Services, do the following:

```
# rpm -e Eiconcard_Services
```

Manually removing /opt/dialogic/c4l (optional)

To completely remove all Eiconcard software and directories from your system after removing the packages with "rpm -e ...", manually delete the /opt/dialogic/c4l directory as follows:

```
# rm -rf /opt/dialogic/c4l
```

Configuring Eiconcard Connections for Linux

This section describes how to install the Eiconcard Services and Eiconcard Connections for Linux drivers in the kernel. It also describes as how to configure related communications protocol software.

Introduction

Since Eiconcard Connections for Linux can interact with a wide variety of equipment, switches, and networks, you should consult your network administrator for the correct configuration settings to use. To simplify the configuration process, default values have been set for each parameter, and in most cases it is not necessary to change them.

The eiconcfg program is used to install the Eiconcard Services and Eiconcard Connections for Linux drivers in the kernel, and to configure related communications protocol software. The eiconcfg program contains a number of different configuration screens that allow adjustment of parameters in the following areas:

- Install an Eiconcard
- Uninstall an Eiconcard
- Modify Eiconcard Auto Load Configuration
- Configure Eiconcard Protocol
- Configure Advanced Options
- Configure PAD

Install an Eiconcard

Once the Eiconcard Services driver is installed in the Linux kernel, all supported Eiconcards present in the system are automatically installed and configured by default to one port and X.25 over HDLC (LAPB). However you may uninstall and re-install any supported Eiconcards which are present in the system.

Follow these steps to reinstall a previously uninstalled Eiconcard:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 1, Add an Eiconcard.

3. Select the Eiconcard you wish to add from the displayed list of Eiconcards which are present in the system but not installed. The status of Eiconcards which are not installed is listed as UNINSTL.
4. Press **Enter**.
5. If you want to add another Eiconcard now, repeat steps 2-4. Otherwise, enter **b** to go back to the main Eiconcard Configuration screen

Uninstall an Eiconcard

To uninstall an Eiconcard run eiconcfg and follow these steps:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 2, Uninstall an Eiconcard.
3. Select the Eiconcard you wish to remove from the displayed list of Eiconcards which are currently installed.
4. Press **Enter**.
5. If you want to uninstall another Eiconcard now, repeat steps 2-4. Otherwise, enter **b** to go back to the main Eiconcard Configuration screen.
6. The status of uninstalled Eiconcards will be changed to UNINSTL.

Modify an Eiconcard's Auto Load Configuration

Follow these steps to modify an Eiconcard's Autoload configuration:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 3, Modify Eiconcard Auto Load Configuration.
3. Select the number of the Eiconcard you wish to configure.
4. Enter **Yes** or **No** as desired, or press **Enter** to accept the default value. Press h to display help information.
5. Press **Enter** to return to the card selection screen.
6. To modify another Eiconcard's Auto Load configuration now, repeat steps 3-5. Otherwise, enter **b** to go back to the main Eiconcard Configuration screen.

Configure Eiconcard Protocol

The Configure Eiconcard Protocol option is used to configure the communications protocol software. It contains configuration screens that allow adjustment of parameters in the following areas:

- High-Level Services
- Line Protocols
- Dialer Selection

The following sections provide guidelines for selecting options and adjusting parameters during configuration. For detailed configuration procedures, see Configuration Procedure on page 21.

High-Level Services

Eiconcard Connections for Linux High-Level Services consists of the following options:

- Transport ISO
- Routing Services
- Compression Modules.

Follow these steps to configure the Eiconcard High-Level Services:

1. Execute /opt/dialogic/c4l/eiconcfg
2. Select option 4, Configure Eiconcard Protocols.
3. Press **F4** to access the configuration screens.
4. Move the cursor to the desired High-Level Protocol and press the **Spacebar** to enable the feature.
5. Press **F4** to open the configuration screen for the selected High-Level Protocol.
6. Configure the displayed parameters as desired.
7. Press **F3** to return to the main Configure Eiconcard Protocols screen.
8. Press **F1** for on screen help at any time.
9. Press **F2** to save the configuration.
10. Press **F10** to exit the Configure Eiconcard Protocols screen.
11. Reload the Eiconcard(s) when prompted to activate the new configuration.

Line Protocols

Eiconcard Connections for Linux allows you to assign protocols on a per port basis. These protocols are called line protocols, and they handle the actual data transfer. Eiconcard Connections for Linux supports the following line protocols:

- X.25: An international standard for data communications and is supported in many countries worldwide. Eiconcard Connections for Linux supports CCITT Recommendation 1984 for X.25 operations, over HDLC connections.
- HDLC: A data-link layer protocol used by X.25 to transmit information over a network. Most applications interface at the X.25 level; however, HDLC is provided for custom applications that require it.
- SDLC: A data-link layer protocol used by SNA to transmit information over a network.
- Frame Relay
- Point-to-Point Protocol (PPP), with an option to configure Multilink PPP.

Dialer Selection

Like other Dialogic® products, Eiconcard Connections for Linux supports a number of dialer options:

- Direct (hardware dialer)
- Hayes AT (asynchronous dialer)
- V.25bis
- Bchannel

- SIG.+X.25

Choose one of these options based on the line type or modem being used.

Changing Protocol Parameters

Each protocol has a number of parameters associated with it. These parameters allow customization of the protocol software for your particular connection. Eiconcard protocols can be configured to suit almost any communications situation. This is done by assigning values to the parameters in the protocol configuration screens.

Note: It is always a good idea to make a backup copy of your Eiconcard configuration file ec.cfg before modifying any parameter values. If problems are encountered with the modified version, the backup copy can be restored. As an aid for detecting communication problems, log any changes you make to the original file.

Eiconcard Memory Requirements

The Eiconcard contains its own CPU, memory, and embedded operating system. The protocol software runs on the Eiconcard, not on the Linux server. Therefore, the software options you define for Eiconcard Connections for Linux are constrained by the amount of memory available on the Eiconcard. This applies to protocols you define with eiconcfg or ECCLI and to the number of Host PAD and Terminal PAD devices defined on the Linux system.

Using the Configuration Screens

The configuration screens all use specific function keys, which are listed at the bottom of the screen. To move between parameters, use the cursor keys () or the Tab key. To change a parameter, type the new value directly. For some parameters, you can press the **Spacebar** repeatedly to scroll through the permitted parameter values.

The following table describes the function keys displayed on the configuration screens:

Alternative Function Keys

Most terminals have the function keys defined in /usr/lib/terminfo/terminfo.src.

If this is not the case, you should be able to use an alternative function-key mapping. For example, the following function keys are normally available:

- Esc 1 Help
- Esc 2 Save
- Esc 3 Previous Screen
- Esc 4 Config
- Esc 5 Previous Card
- Esc 6 Next Card
- Esc 9 Print
- Esc 0 Quit

Note: If you are unable to use either set of function keys, consult the administrator's guide for your Linux operating system for information on keyboard mappings.

Function Key	Description
F1 Help	Provides information about the current screen and its parameters.
F2 Save	Saves the parameter values for all screens to the configuration file.
F3 Prev	Moves you to the previous configuration screen, if applicable.
F4 Config	Moves you to the next configuration screen, if applicable.
F5 PrvCrd	Moves you to the configuration screens for the previous card.
F6 NxtCrd	Moves you to the configuration screens for the next card.
F9 Print	Prints the configuration information to an ASCII file, using a .prt extension for the filename.
F10 Quit	Exits the Eiconcard Services Protocol Configuration or Help screen.

Online Help

You can press the F1 Help key anywhere in the protocol configuration program for screen-sensitive help. To see a description of parameters on a particular screen, move the cursor to that screen and press F1 Help.

Detailed information regarding the selected screen will appear. Press the Page Down key to see additional pages of information, or Page Up to see the previous page. Exit the Help page using F10.

Accessing ISDN switch-specific online help

To access this information, follow these steps:

1. Access the Hardware Configuration screen and select your switch type.

   For details on this and the other configurable parameters on the Hardware Configuration screen, press **F1**.
2. Press **F10** to quit the help screen.
3. Press **F4** to access the Protocol Configuration screen. For the first port, Direct is automatically selected as the Dialer Selection value. Move to this field and press the **Spacebar** until Bchannel is selected. Press **F4** to access the B-channel Configuration screen.
4. Specify the Local Directory Number assigned by the telephone company. You cannot access the online help until you have provided a value for this mandatory parameter.

   Note: For the NI-1 switch type, you must also specify the Service

   Profile Identifier (SPID) number before you can access the online help.
5. Press **F1** for information on the available port configurations for your configured switch type, as well as for information on the B-channel parameters specific to your switch type.
6. Press **F10** to quit the help screen.
7. Press **F3** to return to the Protocol Configuration screen and select B- channel, SIG.+X25, or an HSI dialer type for the remaining port(s) as needed.
8. With SIG.+X25 selected (if supported by your subscribed switch type), press **F4** to access the D-channel Configuration screen.

9. Specify a value for the Static TEI parameter and press **F1** for details on configuring the D-channel to transfer X.25 packet data.

   Note: For the NI-1 switch type, you must also specify the X.25 DTE address before you can access the online help.

Configuration Procedure

The eiconcfg program stores most parameter settings in the Eiconcard configuration file. The default name for this file is `/opt/dialogic/c4l/ec.cfg`.

The following steps outline the configuration process. References are made to several configuration screens. For information on using configuration screens, see Using the Configuration Screens on page 20.

1. Create a backup copy of the ec.cfg configuration file in case you need to restore the original version. Whenever you save the ec.cfg file, its previous version is saved to ec.bak. Subsequent saves will overwrite the backup file.
2. Select the Eiconcard Services Protocol Configuration option from the main eiconcfg menu.
3. Type the name of the Eiconcard configuration file that you want to modify and press **Enter**. To see a list of available configuration files, type *.cfg and press **Enter**. Use the cursor keys to highlight the file that you wish to configure and press **F4**.
4. If you want to save the *.cfg settings to an ASCII text file, select an Eiconcard configuration file in the Files box and press the **F9 Print** key. The ASCII text filename is *.prt, so if the configuration file was ec.cfg, then the ASCII text file will be saved to ec.prt in the current directory.
5. Press **F4** Config to display the Hardware Configuration screen.
6. Select appropriate values in the Number of ports and Auto activate ports fields for each Eiconcard in your system. Use the Spacebar to scroll through the available options in each box, and use the cursor keys (), Tab key, or Enter key to move between boxes. If you are configuring more than one Eiconcard, move to the appropriate column to change the values for each Eiconcard. If an entry you select is invalid, then that entry will flash until you change it (on X-terminals, the incorrect entry is simply highlighted).
7. Press **F4** Config to display the Protocol Configuration screen for the Eiconcard selected.

   Note: If there is an invalid entry anywhere on the current screen, you cannot continue to the next configuration screen. You can use F10 Quit or the Esc key to cancel the entire configuration operation.
8. Move the cursor to the Line Protocol Module box, and press the **Spacebar** until you see the option you want. Press **F4** Config to configure that option. When you are finished, press **F3 Prev** to return to the main Protocol Configuration screen.
9. To change the Dialer Selection, move the cursor to the Dialer Selection box, and press the **Spacebar** until you see the option you want. Press **F4** Config to configure that option.
10. If you have additional Eiconcards to configure, press **F6 NxtCrd**. The message "Card n" appears in the top right corner of the screen. Configure each Eiconcard as you did the first by modifying the necessary Line-protocol module and Dialer-selection parameters.
11. Press **F2** Save to save all parameter settings for all cards to the Eiconcard configuration file you selected on the Eiconcard Connections for Linux Protocol Configuration screen.
12. Press **F10 Quit** to exit the configuration program.
13. Reload the Eiconcard(s) when prompted.

14. Enter **q** to quit eiconcfg or, if you want to configure any of the Eiconcard Connections for Linux drivers, do not quit eiconcfg now. Instead, proceed to the relevant configuration section outlined in this chapter.

Configure Advanced Options

The default parameters for the Advanced Driver Options should be suitable for most user systems. However, you may want to increase these values if your system includes multiple applications written with the Eiconcard X.25 Development Kit.

To configure advanced Eiconcard options, run eiconcfg and follow these steps:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 5, Configure Advanced Options.
3. Select option 2 to keep the current configuration.
4. Select option 1 to modify the configuration.
5. Enter the driver parameters as prompted, or press **Enter** to accept the default value.
6. If you press **H**, help information will be displayed for each parameter.
7. After specifying a value for the last parameter, you will be returned to the Configure Advanced Options screen.
8. Enter **b** to go back to the main Eiconcard Configuration screen.

Configure the PAD

To configure the Eiconcard PAD driver, run eiconcfg and select option 6, Configure PAD. The displayed menu options are discussed in the following sections.

Configure Eiconcard Host PAD Driver

Follow these steps to configure the Eiconcard Host PAD driver:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 6, Configure PAD.
3. Select option 1, Eiconcard Host PAD Configuration.
4. Select option 1, Configure Eiconcard Host PAD Driver.
5. Enter the Eiconcard Host PAD Driver parameters as prompted, or press **Enter** to accept the default values. You can display online descriptions of the driver's parameters by pressing h at each parameter's prompt. After you specify a value for the last parameter, the new configuration values are displayed and you are returned to the Configure Eiconcard Host PAD Driver screen.
6. Enter **q** to return to the Eiconcard Host PAD Driver Configuration screen.
7. Enter **q** again to return to the main eiconcfg screen

Install/Remove Eiconcard Host PAD Driver

The Eiconcard Host PAD driver must be installed in the kernel before you can use the Eiconcard Host PAD.

To install or remove the Eiconcard Host PAD driver, follow these steps:

1. Execute `/opt/dialogic/c4l/eiconcfg`
2. Select option 6, Configure PAD.
3. Select option 1, Eiconcard Host PAD Driver Configuration.
4. Select option 2, Install/Remove the Eiconcard Host PAD Driver, as desired.
5. Select an option or press **Enter** to continue.
6. Enter **q** to return to the Eiconcard Host PAD Driver Configuration screen.
7. Enter **q** again to return to the main eiconcfg screen

Configure Eiconcard Terminal PAD Driver

Follow these steps to configure the Eiconcard Terminal PAD driver:

1. Execute /opt/dialogic/c4l/eiconcfg
2. Select option 6, Configure PAD.
3. Choose option 2, Eiconcard Terminal PAD Driver Configuration.
4. Select option 1, Configure Eiconcard Terminal PAD Driver.
5. Enter the Eiconcard Terminal PAD driver parameters as prompted, or press **Enter** to accept the default values. You can display online descriptions of the driver's parameters by pressing h at each parameter's prompt. After you specify a value for the last parameter, the new configuration values are displayed and you are returned to the Configure Eiconcard Terminal PAD Driver screen.
6. Enter **q** to return to the Eiconcard Terminal PAD Driver Configuration screen.
7. Enter **q** again to return to the main eiconcfg screen

Install/Remove Eiconcard Terminal PAD Driver

The Eiconcard Terminal PAD driver must be installed in the kernel before you can use the Eiconcard Terminal PAD.

To install or remove the Eiconcard Terminal PAD driver, follow these steps:

1. Execute /opt/dialogic/c4l/eiconcfg
2. Select option 6, Configure PAD.
3. Select option 2, Eiconcard Terminal PAD Driver Configuration.
4. Select option 2, Install/Remove the Eiconcard Terminal PAD Driver, as desired.
5. Select an option or press **Enter** to continue.
6. Enter **q** to return to the Eiconcard Terminal PAD Driver Configuration screen.
7. Enter **q** again to return to the main eiconcfg screen.

CHAPTER 4

Using the Eiconcard Host PAD and Eiconcard Terminal PAD

This section explains how to prepare and test the Eiconcard Host PAD devices and includes the available *stty* settings for the Eiconcard Host PAD *tty* devices and their equivalent X.3 PAD parameters. It also provides information on configuring the Eiconcard Terminal PAD using the *cu* and *uucp* commands.

For more information on X.3 PAD parameters, see X.3 PAD Parameters on page 81.

Quick Reference

The following list is a quick reference of Eiconcard Host PAD and Eiconcard Terminal PAD commands:

Displaying Status Information

```
hpad -h
hpad [-a][-v]
hpad [-v][devicename ...]

tpad -h
tpad [-v][devicename ...]
```

Loading Configuration Information

```
hpadcfg -h
hpadcfg [-v] [devicename ...]
hpadcfg [-p port][-a DTE][-f facility][-u userdata]
         [-C cfgfile] devicename ...

tpadcfg -h
tpadcfg [-p port][-l profile][-A tpaddir_entry] [-N][-L|-R]
         [-C cfgfile] devicename ...
```

Restoring Status

```
hpadload -h
hpadload [-t|-c] [-C cfgfile]

tpadload -h
tpadload [-c][-t {c,d,p}][-C cfgfile][-D dirfile][-P profile]
```

Maintaining Calling Directory

```
tpaddir -h
tpaddir [-a called_DTE][-l local_DTE][-f facilities]
         [-u userdata][-x parameters][-D dirfile][name...]
tpaddir -r [-D dirfile] name...
```

Maintaining X.3 Parameter Profiles

```
tpadprof -h
tpadprof [name...]
tpadprof [-x parameters][-s comment][-P profile][name...]
tpadprof -r [-P profile] name...
```

Information about all of these commands are available online. For information on how to access these commands, using an HTML browser, see For More Information on page 13.

Configuring Eiconcard Host PAD Devices

Once the Eiconcard Host PAD driver has been installed and configured, it may be necessary to change the setup of the various Eiconcard Host PAD *tty* devices. In most cases, the default setup for the Eiconcard Host PAD devices should suffice. The following steps describe how to change the default terminal type and parity settings:

1. Login as root.
2. When Eiconcard Host PAD was installed, a line was added to */etc/inittab* for each device. The */etc/inittab* file contains these lines:

   ```
   Et00:2345:off:/sbin/getty ttyEt00 hpad_8n
   Et01:2345:off:/sbin/getty ttyEt01 hpad_8n
   Et02:2345:off:/sbin/getty ttyEt02 hpad_8n
   Et03:2345:off:/sbin/getty ttyEt03 hpad_8n
   Et04:2345:off:/sbin/getty ttyEt04 hpad_8n
   Et05:2345:off:/sbin/getty ttyEt05 hpad_8n
   Et06:2345:off:/sbin/getty ttyEt06 hpad_8n
   Et07:2345:off:/sbin/getty ttyEt07 hpad_8n
   ```

   This example assumes that you are installing the eight default Host PAD devices.

   The Eiconcard Host PAD devices need to be enabled before you can use them. Set the action field from ‘off’ to ‘respawn’ or similar. See the inittab man page.
3. If you need more than one Eiconcard Host PAD device configuration, add entries to the */etc/gettydefs* file. When the Eiconcard Host PAD was installed, a default setup for its device was added to the */etc/gettydefs* file with the following line:

   ```
   hpad_8n# B9600 SANE HUPCL # B9600 CS8 SANE HUBCL TAB3 ECHOE IXANY \
   #login: #hpad_8n
   ```

   This line defines communications features such as baud rate and parity settings for the Eiconcard Host PAD. This default *gettydefs* or *ttydefs* definition sets the Eiconcard Host PAD to “8-bit none, no strip of parity,” which satisfies the needs of most installations.

   However, you may want to construct your own *gettydefs* definitions and assign them to unused codes. For details and instructions, see your Linux system administrator’s documentation or the *gettydefs* man page.
4. To complete the Eiconcard Host PAD device configuration, verify that settings in the mgetty configuration file (*/etc/mgetty+sendfax/megetty.config/megetty.config)* match the configuration of your system. The config file is grouped into port-specific sections, separated by port <tty-name> lines. Everything before the first port line specifies global defaults; everything between two port statements specifies configuration items valid only for this device.

Testing Eiconcard Host PAD Devices

Once the system has been rebooted and is running in multi-user mode, you should test an Eiconcard Host PAD connection as follows:

1. Load the Eiconcard manually if it is not already loaded:

   ```
   # eccard start
   ```

2. Issue the `eccard status` and `hpad` commands to verify that the port(s) assigned to your Eiconcard Host PAD *tty* devices are active. Use the `hpadcfg -p` command to reconfigure the devices if necessary.
3. Using a text editor, edit */etc/inittab* to enable the Eiconcard Host PAD *tty* devices. Enable the devices by changing the *off* parameter on the desired Eiconcard Host PAD device lines to *respawn*.
4. Use the `init` command to advise the system that */etc/inittab* has been changed:

   ```
   # init q
   ```

   The Eiconcard Host PAD *tty* devices are enabled for this session only. Steps 2 and 3 must be done each time you rebuild your kernel.

Note: Eiconcard Host PAD *tty* devices are disabled by editing */etc/inittab* and changing the Eiconcard Host PAD device *respawn* flags to *off*.

You can test both the Eiconcard Host PAD Driver and the Eiconcard Terminal PAD Driver by connecting the two together over an actual X.25 network.

Two Eiconcards, or one multi-port Eiconcard, may be connected back to back, so that X.25 communications is used without the need for connection to an X.25 network. A null-modem cable must be connected between the two ports. In addition, one port must be set up as DCE with internal clocking and line speed set, and the other as DTE with external clocking.

Once the Eiconcard Host PAD driver is properly installed and at least one device has been tested, the Eiconcard Host PAD *tty* devices are ready to be used. Several Eiconcard Host PAD commands are provided for configuring Eiconcard Host PAD devices and checking their status. For more information on these commands, see the online documentation. For information on accessing online documentation, see For More Information on page 13.

stty / X.3 PAD Parameters

The Linux `stty` command allows the Eiconcard Host PAD to change the setup of the remote Eiconcard Terminal PAD when the two are connected over an X.25 network.

Parity generation and checking is implemented in only the Eiconcard Host PAD driver. No X.29 packet is sent to the Eiconcard Terminal PAD to set parameter 21. If the terminal must use a 7-bit word size and even parity, set the Eiconcard Host PAD to use the `stty` settings `cs7 parenb -parodd`.

Using tpad with cu and uucp

This section provides information on the configuration of the Eiconcard Terminal PAD for use by the Linux commands `cu` and `uucp`. Several examples that demonstrate the use of `cu` and `uucp` for making calls to a remote system are also included.

The Eiconcard Terminal PAD driver is used to make outgoing `uucp` calls. The `uucp` configuration files must be set to your specific requirements before you make a call. For information on configuring these files, see The uucp Configuration Files on page 31.

To modify the outgoing call, use `tpaddir` with a `conn` command or use the `cu CALL` command.

X.28 is a CCITT recommendation that defines the messages that a terminal can send to a PAD. The X.28 PAD command signals may be entered in uppercase or lowercase. Before any PAD command interpretation is performed, all control characters, including DEL and spaces, are stripped from the editing buffer.

For `uucp`, the connection and login must be automated. When the PAD is started, the *PAD Identification* PAD service signal is sent, followed by a prompt. The standard prompt is the "*" (asterisk) character. The *Prompt* PAD service signal will be displayed if the initial PAD parameter 6 has value 4 set (that is, equals 4 or 5). Therefore, the first *Expect* string is "*". The *Send* string should be a call request string that contains no intervening spaces.

Note: You can include spaces in a call request string if you enter them in hexadecimal or octal format (e.g., a space is \040, the "C"-like escape sequence for octal 40).

The `cu` Commands

You can use the following `cu` commands with the configured Eiconcard Terminal PAD devices.

<empty line>

When a virtual call is established, a blank command line causes a return to the data transfer state. Otherwise, the blank line is ignored.

Selection PAD command signal

The *Selection PAD command signal* syntax consists of a facility request block or an address block, or both, optionally followed by a call-user data field.

This standard PAD command signal, defined in recommendation X.28-3.5.15, is not implemented in this version of the PAD.

Note: The commands listed below are not case-sensitive. For example, you can enter the `call` or `CALL` command.

call

The `call` PAD service signal provides the only outgoing call mechanism.

```
*call address [/facilities [/userdata]]
```

This establishes a call to the given X.25 address, with the specified facilities and call-user data. Valid X.25 addresses are strings of 1 to 15 digits. Facilities are numbers from 0 to 255, separated by commas. The facilities field may be empty, or contain up to 109 octets.

The call-user data is a set of numbers from 0 to 255, separated by commas and/or quoted strings. If the call-user data field starts with a minus symbol (-), the standard PAD protocol identifier 1,0,0,0 is suppressed in the call-user data. Up to 16 octets of call-user data are allowed (including the PAD protocol identifier), but this maximum is 128 octets when used with the fast select facility. If a virtual call is already established when this command is invoked, the error message *Already connected* is displayed. This PAD command signal is provided as an extension to the standard PAD functionality.

Examples

```
*call 324576
*call 092341 /1,1
*call 324543123 /1,0,2,1 /"login"
*call 234512343 // "uucp"
*call 34657332 /1,0 /-1,0,0,1,"bill"
```

clr

Clear virtual call. If no virtual call is established when this command is invoked, the error message *No connection* is displayed.

```
*clr
```

conn *name*

Connect to given name. The name is a PAD directory entry that describes the called DTE, its X.25 address, the facilities, the call-user data, and the X.3 parameters to be used (see the `tpaddir` command online). This PAD command signal is provided as an extension to the standard PAD recommendation.

```
*conn host1
```

Where `host1` is defined by tpaddir. For example:

```
# tpaddir -a 1234 host1
```

exit, logout, quit

Exit PAD. This command forces the *tty* software to simulate a loss of carrier detect signal and forces the Eiconcard Terminal PAD driver to read and write return zero (end of file). Ultimately, all processes currently using the Eiconcard Terminal PAD will close the Eiconcard Terminal PAD device file. This PAD command signal is provided as an extension to the standard PAD recommendation.

```
*exit
```

id

Display PAD identification PAD service signal. The format of the message is:

tpad *device* profile *profile* port *port*

where *device* is a 1, 2, or 3-decimal-digit number representing the decimal value of the minor device number; *profile* is the initial X.3 profile identifier for the device; *port* is the device's initial port number in decimal. This PAD command signal is provided as an extension to the standard PAD recommendation.

```
*id
tpad 0 profile 'uucp'
```

int

Send interrupt packet. An interrupt data packet with one byte of call-user data set to zero is sent over the X.25 virtual circuit. If no virtual call is established when this command is invoked, the error message *No connection* is displayed.

```
*int
```

port [*port*]

Set physical port. This command sets the physical port on which the communications will take place. Normally, ports 1-255 are used. If you do not specify a port, the current port number is displayed. To re-assign a port, include a decimal number with the *port* command. This PAD command signal is provided as an extension to the standard PAD recommendation.

```
*port
1
*port 2
*port
2
```

prof [*profile identifier*]

Set X.3 Profile. Set the X.3 PAD parameter profile to that of the specified profile identifier. If no profile identifier is specified, display the currently selected profile identifier. If the specified profile identifier is not known, the error message *Profile not found* is displayed.

Three standard profiles are provided: `uucp` (default), *90*, and *91*. The following lists the PAD parameter values for each of these profiles:

uucp:	1:1	2:1	3:126	4:0	5:0	6:5	7:4	8:0	9:0
	10:0	11:2	12:0	13:0	14:0	15:1	16:8	17:21	18:18
	19:2	20:0	21:0	22:0					
90:	1:1	2:1	3:126	4:0	5:1	6:1	7:2	8:0	9:0
	10:0	11:2	12:1	13:0	14:0	15:0	16:127	17:24	18:18
	19:1	20:0	21:0	22:0					
91:	1:0	2:0	3:0	4:20	5:0	6:0	7:2	8:0	9:0
	10:0	11:2	12:0	13:0	14:0	15:0	16:127	17:24	19:18
	19:1	20:0	21:0	22:0					

```
*prof
90
*prof uucp
*prof
uucp
```

par? [*par,par,...*]**, par** [*par,par,...*]

Display X.3 parameters. Display the current value of the specified X.3 PAD parameters. If no parameter is specified, all parameters are displayed. If a specified parameter reference is invalid, it is displayed with its value specified as *inv*. The two commands are treated identically. The PAD command signal *par* is provided as an extension to the standard PAD recommendation.

```
*par? 1,2,43,7
par 1:1, 2:1, 43:inv, 7:21
```

reset

Reset virtual circuit. If no virtual call is established when this command is invoked, the error message *No connection* is displayed.

```
*reset
```

set [*par:val,par:val...*]

Set the specified X.3 PAD parameters (*par*) to the specified values (*val*). If no *par:val* is specified, the PAD parameters are set to the value of the current profile identifier. If a specified parameter reference and/or value is invalid, it is displayed with its value specified as *inv*.

```
*set 1:0,2:1
*set 1:1,2:3
par 2:inv
*set 2:0
```

set? [*par:val,par:val...*]

Set and display the specified X.3 PAD parameters (*par*) and values (*val*). If no *par:val* is specified, the PAD parameters are set to the value of the current profile identifier. If a specified parameter reference and/or value is invalid, it is displayed with its value specified as *inv*.

```
*set? 1:0,2:1
par 1:0, 2:1
*set? 1:1,2:3
par 1:1, 2:inv
*set? 2:0
par 2:0
```

stat

Display the status of the virtual call, which may be either *engaged* or *free*.

X.3 PAD Parameters

The *uucp Standard* profile (similar to the X.3 *Standard* profile) should be used when `uucp` transfers are to be made with the Eiconcard Terminal PAD. In particular, the X.3 PAD parameter 12 must be zero (no *flow control of the PAD by the start-stop mode DTE*), otherwise the *X-ON* and *X-OFF* characters will be interpreted by the PAD, making binary data transfer impossible.

You may need to modify some of the PAD parameter values. With the exception of *timer expiration* (4:1), the PAD parameters should be set so that no data interpretation is done. The *Recall* character should be zero (1:0), *Echoing* off (2:0), no *data forwarding character* (3:0), no *special character insertion* (10:0, 13:0), no *editing* (15:0), no *page wait* (22:0). Hosts to which the Eiconcard Terminal PAD connects should send the appropriate X.29 *set* or *set and read PAD messages* when the *tty* mode is changed from *canonical* mode to *raw* mode. See your Linux documentation for a description of the `stty` command.

The `uucp` Configuration Files

You must set up the configuration for your Eiconcard Terminal PAD devices before you can use them. To do this, you add or edit appropriate entries in the `uucp` configuration files. This must be done before calls are made with the Eiconcard Terminal PAD.

Examples are used to help clarify how these `uucp` configuration files are used. Names and other user-supplied items are chosen arbitrarily. To run these examples on your system, choose user-supplied names and items that are defined for your system.

The `uucp` configuration files are usually located in the */etc/uucp* directory. Check your Linux documentation on `uucp` for the correct path on your system. There are several `uucp` configuration files including *call*, *dial*, *dialcode*, *passwd*, *port*, and *sys*. The example below uses the *sys* and *port* files.

Sys

In the *sys* file, add entries to define your connections. In the example below, the entry defines a `uucp` connection via the PAD. The connection is named ‘pad’ and can be called at “any’ time using a device type of ‘tpad’ at speed ‘38400’. This entry may be used with `cu` or an interactive terminal-emulation program when direct user interaction is desired with the PAD.

```
system pad
time any
port tpad
speed 38400
```

Port

In the *port* file, add entries for each terminal *tty* line device.

```
port tpad
type direct
device /dev/tpadEt00
speed 38400
```

Using uucp and cu

`uucp` implementations are very flexible. They can be customized to suit the various types of line connections and modems you use for `uucp` communications. Before running this example on your system, the `uucp` configuration files must be set up according to specific requirements.

In the following examples, “#” is the system prompt, “*” is the Eiconcard Terminal PAD prompt, and “$” is the remote system prompt.

Note: Verify that you have correctly configured the Eiconcard Terminal PAD device(s) before attempting to establish a connection. For example, you may need to assign ports using the `tpadcfg -p` command.

Example 1

Use the `cu` utility to login to a remote system. The *pad* entry of the *Systems* file connects you to the Eiconcard Terminal PAD. You may then call a remote system over an X.25 network:

# cu pad	// Connect to Terminal from system prompt
Connected	
tpadEt 0 profile uucp port 1	
*	// Now in Terminal PAD

*call 1302056300026
or use
*conn host1
	// Call remote system
	
	//host1 must be have been previously defined using the tpadddir command

*	
Connected	// Connected to remote system
Welcome to ...	
login: xxxxx	// Login to remote system
password: *****	
$	// Now in remote system
$...	
$...	// Perform desired work
$...	
$ logout	// Log out
CLR CONF	
*	// Now back in Terminal PAD
*exit	// Return to system
*	
Lost Carrier	
Disconnected	
#	// Now back at system prompt

CHAPTER 5

Using Eiconcard Routing Services

This section describes the steps necessary for establishing routes in Eiconcard Routing Services. It describes the key protocol configuration parameters for Eiconcards, and tests a sample X.25, Frame Relay, PPP, and Multilink PPP link. This chapter also explains how to use the connection backup feature.

Overview

To operate Eiconcard Routing Services, you must perform the following tasks:

- Configure the mpr.if file
- Start your Eiconcard
- Load the mpr.if file and start your circuits

Note: You must have run the `eiconcfg` program and configured the Eiconcard Services driver, the Eiconcard Services protocols, and the Eiconcard Routing Services driver before configuring the *mpr.if* file.

Configure the *mpr.if* file

The *mpr.if* file is an ASCII file, located in */opt/dialogic/c4l*, in which the circuit entries for each Routing Services interface and the packet filtering rules are defined.

Note: The *mpr.if* file is the default file for Eiconcard Routing Services, but you can create and name your own **.if* file, if required.

Sample files are provided with Eiconcard Routing Services which are configured for both simple and advanced connections as follows:

Connection Type	Sample File
X.25 Connection	*sys1x25.if* and *sys2x25.if*
Frame Relay Connection	*sys1fr.if* and *sys2fr.if*
PPP Connection	*sys1ppp.if* and *sys2ppp.if*
PPP Connection with PAP and CHAP	*sys1pap.if* and *sys2pap.if*
Multilink PPP Connection	*sys1mlp.if* and *sys2mlp.if*

Creating Circuit Entries

A circuit entry is the definition of a virtual circuit that will be used to establish a subnetwork connection. To establish a circuit entry, you create the circuit entry, name it, and define the IP address of its first-hop destination.

A circuit entry defines the parameters necessary for the subnetwork connection, such as the destination address and the port to use. For example, you can specify a remote DTE, facilities, and user data for an X.25 circuit, whereas you specify a DLCI for a Frame Relay circuit.

The circuit entries you define for Routing Services are bound to the Routing Services call-directory entries, depending on availability. Only when the circuit entry is associated with a call-directory entry can you attempt to establish a connection. Routing Services then allocates an open subnetwork circuit to the call-directory entry as needed during the connection. It is recommended that you match both the maximum number of call-directory entries and the maximum number of subnetwork circuits to the number of connections that you plan to have. For more information on configuring call-directory entries and subnetwork circuits, refer to Configuring Eiconcard Connections for Linux on page 15.

For more information about creating circuit entries, refer to Testing Your Installation on page 40. For more information on the options used for creating circuits, consult */opt/dialogic/c4l/docs/mprif.html*.

Creating Backup Circuit Entries

You can create primary and backup circuits, so that if the primary circuit fails, the backup circuit will ensure that the connection is not lost. The backup connection remains inactive until the primary connection fails.

You must meet the following criteria to use primary and backup circuits:

- You must define a primary connection before defining a backup connection.
- Only one backup connection may be assigned per primary connection.
- The primary and backup connection must both use the same subnetwork protocol—X.25, for example.
- A primary connection and its backup can use the same Eiconcard port, or two different ports. If they use two different ports, both ports must be part of the same Eiconcard. Only the logical connection is being backed up when the primary and backup circuits use the same port.
- Backing up a PPP (point-to-point) connection or a permanent X.25 connection requires the use of separate ports for the primary and the backup circuit. It is the physical link that is backed up in these cases.

The connection backup feature works when it is used on both sides of the connection. You cannot back up only half of a connection. If you back up system A's connection (the circuit it uses to connect to system B), system B's connection to system A (the circuit configured on system B) must also be backed up. To properly back up a connection between two systems, you must configure a total of four circuits: a primary, and a backup on both systems.

For more information about backing up circuit entries, refer to Testing Your Installation on page 40. For more information on the options used for creating circuits, consult */opt/dialogic/c4l/docs/mprif.html*.

Configuring Multiple Interfaces

Routing Services provides up to five WAN interfaces. These interfaces enable the establishment of routes to multiple subnetworks simultaneously, offering a complete internetworking solution. The five interfaces are configured in the *mpr.if* file. Each interface requires an interface name, an IP address, and a network mask address. The interface names *eic0* to *eic4* identify the five Routing Services interfaces used by Dialogic.

A symbolic name can also be configured for each interface in the *mpr.if* file, which is stored in the */etc/hosts* file and can be used when specifying entries for the IP-routing table, though this is optional. For more information on the IP-routing table, see IP Routing Tables on page 38

Configuring Packet Filtering Rules

When Routing Services receives an IP datagram over an interface, it checks the configured packet filtering rules, and transparently forwards or drops the datagram based on these rules.

It is important to note that adding packet filtering will affect the performance of Eiconcard Routing Services. As each IP datagram has to be tested against all of the defined packet filtering rules, the datagrams will be delayed. It is therefore recommended to keep the number of defined rules to a minimum and to make the rules as simple as possible.

Note: If no packet filtering rules are defined, all packets are forwarded by default.

Creating Packet Filtering Rules

Packet filtering allows you to determine what type of IP traffic can pass through your WAN connections. You can control access to and from specific services, hosts, or networks. The syntax for configuring packet filtering rules is given below with a detailed explanation of the available options:

Syntax filter [-saddr *source_addr addr_mask*]
[-daddr *dest_addr addr_mask*][-prot *IP_protocol*]
[-sport [*source_port*]][-dport [*dest_port*]]
in|out|both drop|forward

Parameters	Description
-saddr *source_addr* *addr_mask*	Specifies the source address and address mask for which you are specifying a packet filtering rule. All packets with a source address that match an address specified in the packet filtering rules will be either forwarded or dropped.
-daddr *dest_addr* *addr_mask*	Specifies the destination address and address mask for which you are specifying a packet filtering rule. All packets with a destination address that match an address specified in the packet filtering rules will be either forwarded or dropped.
-prot *IP_protocol*	Identifies the Transport Layer Protocol for which a packet filtering rule is being specified. The protocol field of the IP datagram specifies the Transport Layer Protocol encapsulated in the IP datagram. All packets with a Transport Layer Protocol that match a protocol specified in the packet filtering rules will be either forwarded or dropped. TCP and UDP are currently the only Transport Layer Protocols that support source and destination port checks (see */etc/protocols*).
-sport [*source_port*]	Specifies the source port for which you are specifying a packet filtering rule. All TCP/IP protocols use addresses, known as ports, that are used to uniquely define services (access points to the Transport layer) at the Transport layer (see */etc/services*). For example, all *ftp* connections to a host are directed to port number 21; this way the receiving host knows to send the request to the *ftp* service and not to the *telnet* service. All packets with a source port that match a port specified in the packet filtering rules are either forwarded or dropped. A source port is specified to prevent access to certain services or applications on a local system by remote hosts. This option must be enclosed within the brackets and port ranges must be specified numerically.

Parameters	Description
-dport [*dest_port*]	Specifies the destination port for which you are specifying a packet filtering rule. All packets with a destination port that matches a port specified in the packet filtering rules are either forwarded or dropped. A destination port is specified to prevent access to certain services or applications on a remote system by local hosts. This option must be enclosed within the brackets.
in|out|both	Specifies whether a rule should be executed on receipt of a packet from an Eiconcard, prior to being sent out over the Eiconcard, or both. All rules should be executed on receipt of a packet, guaranteeing that a packet is validated prior to being received by IP. However, as packets cannot be validated on being received over non-Eiconcard interfaces (i.e. LAN card), the facility will be available to validate these packets prior to being sent out over Eiconcard controlled interfaces.
drop|forward	Specifies whether a packet should be dropped or forwarded based on the configured packet filtering rules.

For more information on the options available for configuring packet filtering rules, consult */opt/dialogic/c4l/docs/mprif.html*.

Load the mpr.if file

Once the *mpr.if* file is configured, it must be loaded down to the Eiconcard Routing Services driver. Before doing this, you must ensure your Eiconcards are started using the `eccard start` command.

Once your Eiconcards are started, run `mprload` at the command line to load the *mpr.if* file, and `mprstart` to start your configured circuits.

The following commands are available with Eiconcard Routing Services:

- `mprload`: Loads the default mpr.if file down to the Eiconcard Routing Services driver.
- `mprstart`: Starts the circuits created with Eiconcard Routing Services
- `mprstop`: Stops the circuits created with Eiconcard Routing Services
- `mprstat`: Displays the status of the configured circuits or packet filtering rules
- `mprauto`: A script file that can be used to load and start your circuits automatically when the system is started.

For more information on these commands, refer to the appropriate HTML page located in the */opt/dialogic/c4l/docs* directory.

IP Routing Tables

You can add IP-routing entries by using the Linux `route` command or the TCP/IP routing daemon, `routed`. Entries you add with `route` are static. The `routed` daemon uses TCP/IP's Routing Information Protocol (RIP) to exchange information and update the routing table entries.

When you use the `route` command, entries are added directly to a host's IP-routing table, but will be lost when the system shuts down. If you are setting up a complex network, it is recommended that you use the TCP/IP routing daemon, which is initialized with the entries stored in the host's */etc/gateways* file. The `routed` daemon manages both static and dynamic routes, updating all hosts and gateways in the network automatically.

Note: Although using TCP/IP routing is necessary in the case of LAN-to-LAN connections, it is not required when data is being transmitted only between Eiconcard Routing Services workstations.

Each Linux host on a broadcast network sends out its accessible routes (using a routing protocol, such as RIP) and keeps track of what other hosts it can access. Each host has an IP-routing table, and the `routed` daemon handles all exchanges of routing information.

Adding Routing Table Entries to the /etc/gateways File

The `routed` daemon references the */etc/gateways* file to identify a system's routes. Route entries listed in this file are installed in the system's IP-routing table in the kernel at startup. The syntax for Eiconcard entries in */etc/gateways* is as follows:

Syntax [net|host] *addr1* gateway *addr2* metric *n* [passive|active]

Parameters	Description
[net|host]*addr1*	If the IP route destination is a network, use *net* as the first parameter, followed by the network's address, *addr1*. If the IP route is for a connection to a stand-alone host, use *host addr1*. The network address must always be specified in full; */etc/gateways* does not accept abbreviated addresses. For example, the 192.1.100 network address must be specified as 192.1.100.0.
gateway *addr2*	Specifies the address of the first hop leading to the destination network.
metric *n*	Identifies the total number of gateways through which data must pass to reach the final destination.
[passive|active]	If you want `routed` to include the destination network or host in its information broadcasts for the routing tables, specify *active*. TCP/IP's Routing Information Protocol (RIP) dictates that hosts exchange information every 30 seconds and have a 3-minute cache. This means that if a host has not heard from another host for 3 minutes, it marks that host's routing table entry for deletion. After another 60 seconds, the table entry is deleted. With X.25-switched subnetworks, this information exchange can be costly in terms of tariffs and the amount of bandwidth used. If you want to include a circuit's route in the Linux systems but do not want its entry being constantly updated or marked for deletion, specify *passive*. A connection can then be made using the route, even though hosts in the system are not notified of any changes in connection hosts' status (for example, if either the local host or the connection's destination host goes down).

For example, if Sys-2 (IP address 192.1.100.2) is connected to a network (IP address 192.218.20.0), the */etc/gateways* file for Sys-1 could include the following entry to identify a connection to that LAN:

```
net 192.218.20.0 gateway 192.1.100.2 metric 1 active
```

In this case, Sys-2 functions as a gateway to the 192.218.20 network.

Make sure each routing table entry you add to a host's */etc/gateways* file is correct before adding another entry. You may want to test the route connection, as `routed` will not inform you of any errors in */etc/gateways*, such as an incorrectly specified IP address.

Note: If changes are made to the */etc/gateways* file, the routed daemon must be restarted with the `-s` option.

Displaying IP-routing Entries

You can use the `netstat` command to display information related to the IP routing tables. The `-i` option displays information concerning the interfaces for entries in your system's IP-routing table, and the `-r` option presents the static and currently active routing entries.

You can also use the `-n` option to specify the use of dot notation. Addresses displayed by `netstat` are then numeric values, rather than the symbolic names assigned by the */etc/hosts* file. (If an address does not have an assigned name in */etc/hosts*, the `netstat` command displays the numeric value.)

For example, the following commands show the entries you would see after adding the sample entry to Sys-1's */etc/gateways* file, assuming the `routed` daemon had been reinitialized and the route connection had been used to send and transmit data:

```
netstat -r -n
```

Routing tables

Destination	**Gateway**	**Flags**	**Refcnt**	**Use**	**Interface**
127.0.0.1	127.0.0.1	UH	1	0	lo0
192.1.100	192.1.100.2	U	2	392	eic0
192.218.20	192.1.100.2	UG	2	392	eic0

```
netstat -i
```

Name	Mtu	Network	Address	Ipkts	Ierrs	Opkts	Oerrs	Collis	
lo0	2048	loopback	localhost	24	0	24	0	0	
eic0	1500	192.1.100	192.1.100.2	4	0	410	0	0	

The interface name *eic0* identifies the Eiconcard Routing Services interface used by Dialogic. The interface name *lo0* is the default IP interface that enables the host to send or transmit data to itself.

Note: Refer to the Linux system administrator documentation for more information on IP routing if necessary.

Testing Your Installation

If you have at least two Linux systems that have an Eiconcard and Eiconcard Routing Services installed, consider setting up a simple test system as suggested here. This will help you over some of the initial hurdles inherent in dealing with internetworks and routers. Only two Linux systems are used in this test system. You may add additional systems to test more complex configurations.

You may assign your own IP addresses for this test, but it is recommended that you use the IP addresses suggested in Resources for the Test System below.

The Test System

The test system described here links two Linux systems together back to back through their Eiconcards. This procedure also tests the connection backup feature. Although this setup cannot be considered an internetwork, it tests the Eiconcards' transmission and reception of IP datagrams over an X.25, Frame Relay, PPP, or Multilink PPP link.

To simplify the discussion below, the names Sys-1 and Sys-2 are used to identify the two test systems.

Resources for the Test System

If you performed the installation as described in the Eiconcard Connections for Linux Release Notes (Readmefirst.txt), you now have a Linux system (Sys-1) made up of the following:

- Hardware
  - i386-based or higher Linux system
  - An Eiconcard
- Software
  - Linux
  - Eiconcard Services package
  - Eiconcard Routing Services package

A null-modem RS-232 cable or V.35 cable is also required.

To perform the tests, you will need to set up a second system (Sys-2) that is equivalent to the first. Each system must be uniquely addressed.

Before continuing, make sure that the complete installation procedure has been performed for Sys-1 and Sys-2.

When both the installations are complete and the systems rebooted, messages referring to the Eiconcard, the Eiconcard Streams Device Driver (Eiconcard Services package), TCP/IP, and Eiconcard Routing Services appear in the Linux boot messages.

The Addressing Scheme

Before continuing with the test, you should take a look at the proposed addressing scheme. Both IP addresses and X.25 DTE addresses (for the X.25 connection) must be considered when coming up with an addressing scheme for an IP internetwork that uses Eiconcard Routing Services.

In this simple test the scheme uses an arbitrary assignment of four addresses—two X.25 DTE addresses (for the X.25 connection), and the two IP addresses. The addresses used in this test are:

Address	**Sys-1**	**Sys-2**
X.25 DTE address	3020001	3020123
IP address	192.1.100.1	192.1.100.2

To test the back-to-back connection, including the connection backup feature, you need to configure the two Eiconcards, define an Eiconcard Routing Services circuit on each system, define the destination IP addresses for the circuits on each system, and define the backup circuits on each system before you can transmit data using the connection.

Configuring the Eiconcards

The Eiconcards installed in Sys-1 and Sys-2 must have several configuration parameters changed so that back-to-back X.25 communications may be established.

To configure the Sys-1 and Sys-2 Eiconcards, select the Eiconcard Services Protocol Configuration option in `eiconcfg`. For a description of `eiconcfg`, refer to Configuring Eiconcard Connections for Linux on page 17.

When you select the Eiconcard Services Protocol Configuration option in `eiconcfg` for the first time, or if the Eiconcard configuration file *ec.cfg* has been removed, you are notified that a new *ec.cfg* file is being created. The default parameters for all screens related to the protocols selected on the Protocol Configuration screen are saved in the newly created *ec.cfg* file.

Start with a default configuration. (You can keep a backup copy of your current configuration by moving or renaming */opt/dialogic/c4l/ec.cfg*.) Select the Eiconcard Services Protocol Configuration option in `eiconcfg` on both Sys-1 and Sys-2 and set the parameters as indicated in the following steps:

1. Move to the Protocol Configuration screen. Select *Routing Services*. The default values for the Line protocol module and Dialer selection, *X.25* and *Direct*, are the values required for both systems.
2. Move to the Routing Services Configuration screen and set the *Maximum number of connection manager sessions* to 2, one for the primary circuit and one for the backup circuit (one per Eiconcard port).
3. Verify that the *Maximum number of call-directory entries* and *Maximum number of open subnetwork circuits* parameters are both set to at least 2, one for the primary circuit and one for the backup circuit (the default is 4 in both cases).
4. Move to the X.25 Configuration screen. For Sys-2 select *DCE* as the Node type and specify *3020123* as the Node address. Leave Sys-1 configured as *DTE* and specify *3020001* as the Node address.

   The HDLC Configuration screen for Sys-2 is automatically updated to reflect the change from DTE to DCE.
5. Access the Sync Driver Configuration screen (via Dialer selection) and set Clocking to *Internal* for Sys-2. Sys-1 keeps the Clocking default, *External*.

   Note: If you choose to name your ports on the Sync Driver Configuration screen, the names, rather than the port numbers, will be displayed when you use the `mprstat` command.
6. On the same screen, you can set Line speed (bps) up to *64000* for Sys-2, provided you are using a maximum length of 8 feet for the RS-232 cable that will connect the two Eiconcards back to back.
7. Once the parameters are set, press **F2 Save** and **F10** to exit. The two *ec.cfg* files are now configured for Sys-1 and Sys-2's back-to-back connection.
8. If the Eiconcard is already loaded and running (using `eccard start`), run `eccard stop` to stop it.
9. Connect the Eiconcard in Sys-1 to the Eiconcard in Sys-2 with an RS-232 null-modem cable.

10. Run `eccard start` on both systems. The Eiconcards on each system are loaded and configured according to the parameters found in their *ec.cfg* file.

Once `eccard start` has run successfully (no errors reported), you can use `ecstatus` to check the integrity of the connection between Sys-1 and Sys-2.

Note: If you start the DTE first, it will report an error even though the connection will be properly set up once you start the DCE. To avoid this temporary error condition, start the system configured as DCE (Sys-2) first.

Creating an X.25 Test Circuit

After Sys-1 and Sys-2 are properly connected, an X.25 circuit must be created on each system. Two sample files, *sys1x25.if* and *sys2x25.if*, are provided with Routing Services which are configured for the purpose of running this test.

Note: Circuit names need only be unique within one Linux system; you can specify the same name for the test circuits used on Sys-1 and Sys-2.

Once the circuits are created on both systems, ensure the Eiconcards are already started, and run `mprload -f sys1x25.if` on Sys-1 and `mprload -f sys2x25.if` on Sys-2. This loads the specified interface file down to the Eiconcard Routing Services driver. If the `-f` option is not specified, the default file *mpr.if* is loaded down to the driver.

Run `mprstart` to start the circuits. If you stop an Eiconcard after creating a circuit entry, use `mprstart` to restart the circuit once you have restarted the card.

Checking the Status of the X.25 Circuit

To check the status of your X.25 circuit, follow these steps:

1. Run `ecstatus hdlc` on both systems to confirm that the link between Sys-1 and Sys-2 is operational. The *Line State* and *Protocol State* items appearing in the `ecstatus` display should be listed as "Opened" on both systems.
2. Run `ecstatus x25` on both systems to confirm that the link between Sys-1 and Sys-2 is operational. The *Link activated at* item in the `ecstatus` display should list the time at which the Eiconcards were started on each system.

   Check that the circuit is correctly defined on both systems and that they are bound by using the `mprstat -c` command. The systems display the following:

   [Sys-1]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
x25test1	X.25	T B	1	Off	RDTE:3020123	192.1.100.2	eic0

   [Sys-2]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
x25test2	X.25	T B	1	Off	RDTE:3020001	192.1.100.1	eic0

   If there is an "E" in the *Flags* column, the binding or mapping of the circuit may be incorrect. Determine what the error is and correct it. You can use the `mprstart` command to restart the circuit or the `mprstat -cv` command to display detailed status information for the circuits if necessary.

For more information on the `ecstatus` command, see *ecstatus.html* in the */opt/dialogic/c4l/docs* directory.

3. If all the circuit states are set properly, go ahead to Testing Sys-1/Sys-2 Communications on page 51.

Troubleshooting

If any of the values displayed using the `ecstatus` command vary from their expected values, check the following:

- Confirm that a null-modem cable has been used to connect the two systems, and that both ends are firmly connected to their respective Eiconcards.
- Ensure the procedure described in the “Configuring the Eiconcards” section has been followed exactly. Only one of the two systems can be the DCE and have internal clocking. Any changes to the configuration requires that you restart the Eiconcard(s) and restart the circuit(s).
- Confirm that you defined the circuit’s parameters correctly on both systems. If you have another circuit on one of the systems that uses the same IP address as the system’s test circuit, delete it to avoid any conflict of duplicate mappings.

If problems persist, contact your Dialogic representative.

Setting Up a Frame Relay Connection

If you want to test a Frame Relay connection using Sys-1 and Sys-2, follow a procedure similar to that presented in the previous sections for X.25.

1. Select the Eiconcard Services Protocol Configuration option in `eiconcfg` on each system to modify its Eiconcard configuration.
2. Move to the Protocol Configuration screen. Select *Routing Services.* Configure the Line protocol module as *FRELAY* and leave the default value for Dialer selection, *Direct*, for both systems.
3. Move to the Routing Services Configuration screen and set the *Maximum number of connection manager sessions* to two, one for the primary circuit and one for the backup circuit (one per Eiconcard port).
4. Verify that the *Maximum number of call-directory entries* and *Maximum number of open subnetwork circuits* parameters are both set to at least 2, one for the primary circuit and one for the backup circuit (the default is 4 in both cases).

   The default values on the Frame Relay Configuration and the Data Link Connection Configuration screens do not need to be modified for a back-to-back connection.
5. Access the Sync Driver Configuration screen (via Dialer selection) and set Clocking to *Internal* for Sys-2. Sys-1 keeps the Clocking default, *External*.

   If you choose to name your ports on the Sync Driver Configuration screen, the names, rather than the port numbers, will be displayed when you use the `mprstat` command.
6. On the same screen, you can set Line speed (bps) up to *64000* for Sys-2, provided you are using a maximum length of 8 feet for the RS-232 cable that will connect the two Eiconcards back to back.

7. Once the parameters are set, press **F2 Save** and **F10** to exit. The two *ec.cfg* files are now configured for Sys-1 and Sys-2's back-to-back connection.

8. If the Eiconcard is already loaded and running (using `eccard start`), run `eccard stop` to stop it.

9. Connect the Eiconcard in Sys-1 to the Eiconcard in Sys-2 with an RS-232 null-modem cable.

10. Run `eccard start` on both systems. The Eiconcards on each system are loaded and configured according to the parameters found in the system's *ec.cfg* file.

11. Once `eccard start` has run successfully (no errors reported), you can use `ecstatus` on both systems to check the integrity of the connection between Sys-1 and Sys-2.

12. Create a test circuit on both systems. Two sample files, *sys1fr.if* and *sys2fr.if*, are provided with Routing Services which are configured for the purpose of running this test.

    Circuit names need only be unique within one Linux system; you can specify the same name for the test circuits used on Sys-1 and Sys-2.

13. Ensure the Eiconcards are already started, and run `mprload -f sys1fr.if` on Sys-1 and `mprload -f sys2fr.if` on Sys-2. This loads the specified interface file down to the Eiconcard Routing Services driver. If the `-f` option is not specified, the default file *mpr.if* is loaded down to the driver.

14. Run `mprstart` on both systems to start the circuits. If you stop an Eiconcard after creating a circuit entry, use `mprstart` to restart the circuit once you have restarted the card.

15. Run `ecstatus frelay` to confirm that the link between Sys-1 and Sys-2 is operational. The *Line State* item appearing in the left column of the `ecstatus` display should be listed as "Opened" on both systems, and the *Number of active DLCI* should be listed as "1."

    Check that the circuit is correctly defined on both systems and that the two circuits are bound by using the `mprstat -c` command. The systems display the following:

[Sys-1]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_fr1	FRBS	OPB	1	Off	DLCI:16	192.1.10 0.2	eic0

[Sys-2]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_fr2	FRBS	OPB	1	Off	DLCI:16	192.1.10 0.1	eic0

    If there is an "E" in the *Flags* column, the binding or mapping of the circuit may be incorrect. Determine what the error is and correct it. You can use the `mprstart` command to restart the circuit or the `mprstat -cv` command to display detailed status information for the circuits if necessary.

    For more information on the `ecstatus` command, see *ecstatus.html* in the */opt/dialogic/c4l/docs* directory.

16. If the circuit states are set properly, continue with Testing Sys-1/Sys-2 Communications on page 51.

Setting Up a PPP Connection

You can set up a Point-to-Point connection using Sys-1 and Sys-2 by following this procedure.

1. Select the Eiconcard Services Protocol Configuration option in `eiconcfg` on each system to modify its Eiconcard configuration.
2. At the Hardware Configuration screen, set auto activate ports to *No* for the PPP ports.
3. Move to the Protocol Configuration screen. Select *Routing Services*. Configure the Line protocol module as *PPP* and leave the default value for Dialer selection, *Direct*, for both systems.
4. Move to the Routing Services Configuration screen and set the *Maximum number of connection manager sessions* to 2, one for the primary circuit and one for the backup circuit (one per Eiconcard port).
5. Verify that the *Maximum number of call-directory entries* and *Maximum number of open subnetwork circuits* parameters are both set to at least 2, one for the primary circuit and one for the backup circuit (the default is 4 in both cases).

   The default values on the Point-to-Point Configuration screen do not need to be modified for a back-to-back connection.
6. Access the Sync Driver Configuration screen (via Dialer selection) and set Clocking to *Internal* for Sys-2. Sys-1 keeps the Clocking default, *External*.
7. On the same screen, you can set Line speed (bps) up to *64000* for Sys-2, provided you are using a maximum length of 8 feet for the RS-232 cable that will connect the two Eiconcards back to back.
8. Once the parameters are set, press **F2 Save** and **F10** to exit. The two *ec.cfg* files are now configured for Sys-1 and Sys-2's back-to-back connection.
9. If the Eiconcard is already loaded and running (using `eccard start`), run `eccard stop` to stop it.
10. Connect the Eiconcard in Sys-1 to the Eiconcard in Sys-2 with an RS-232 null-modem cable.
11. Run `eccard start` on both systems to start the Eiconcards. The Eiconcards on each system are loaded and configured according to the parameters found in the system's *ec.cfg* file.
12. Once `eccard start` has run successfully (no errors reported), you can use `ecstatus` on both systems to check the integrity of the connection between Sys-1 and Sys-2.
13. Create a test circuit on both systems. Two sample files, *sys1ppp.if* and *sys2ppp.if*, are provided with Routing Services and are configured for the purpose of running this test.

    Circuit names need only be unique within one Linux system; you can specify the same name for the test circuits used on Sys-1 and Sys-2.
14. Ensure the Eiconcards are already started, and run `mprload -f sys1ppp.if` on Sys-1 and `mprload -f sys2ppp.if` on Sys-2. This loads the specified interface file down to the Eiconcard Routing Services driver. If the `-f` option is not specified, the default file *mpr.if* is loaded down to the driver.
15. Run `mprstart` on both systems to start the circuits. If you stop an Eiconcard after creating a circuit entry, use `mprstart` to restart the circuit once you have restarted the card.

16. Run `ecstatus ppp` to confirm that the link between Sys-1 and Sys-2 is operational. The *Protocol State* item appearing in the left column of the `ecstatus` display should be listed as "Opening" on both systems.

    Check that the circuit is correctly defined on both systems and that the two circuits are bound by using the `mprstat -c` command. The systems display the following:

[Sys-1]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_ppp1	PPP	OPB	1	Off		192.1.100.2	eic0

[Sys-2]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_ppp2	PPP	OPB	1	Off		192.1.100.1	eic0

If there is an "E" in the *Flags* column, the binding of the circuit may be incorrect. Determine what the error is and correct it. You can use the `mprstart` command to restart the circuit or the `mprstat -cv` command to display detailed status information for the circuits if necessary.

For more information on the `ecstatus` command, see *ecstatus.html* in the */opt/dialogic/c4l/docs* directory.

17. If the circuit states are set properly, go to the Testing Sys-1/Sys-2 Communications on page 51.

Setting up a PPP Connection using PAP and CHAP

You can set up a Point-to-Point connection using PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) on Sys-1 and Sys-2 by following this procedure.

1. Select the Eiconcard Services Protocol Configuration option in `eiconcfg` on each system to modify its Eiconcard configuration.
2. At the Hardware Configuration screen, set auto activate ports to *No* for the PPP ports.
3. Move to the Protocol Configuration screen. Select *Routing Services*.
4. Configure the Line protocol module as *PPP* on both systems.

   The default values on the Point-to-Point Configuration screen do not need to be modified for a back-to-back connection.
5. Press **F4** twice to access the Password Authentication Configuration screen.
6. On Sys-1, set the password authentication parameters as follows:

```
Local PAP User Name       System1
Local PAP Password        Pass1
Remote PAP User Name      System2
Remote PAP Password       Pass2

Local CHAP User Name      Sys1
Local CHAP Secret         Password
Remote CHAP User Name     Sys2
```

7. On Sys-2, set the password authentication parameters as follows:

```
Local PAP User Name       System2
Local PAP Password        Pass2
Remote PAP User Name      System1
Remote PAP Password       Pass1

Local CHAP User Name      Sys2
Local CHAP Secret         Password
Remote CHAP User Name     Sys1
```

Important: If these parameters are not configured correctly on both sides of the connection, the circuits will not start.

8. Press **F3** twice to return to the Protocol Configuration screen. Leave the default value for Dialer selection, *Direct*, for both systems.
9. Access the Sync Driver Configuration screen (via Dialer selection) and set Clocking to *Internal* for Sys-2. Sys-1 keeps the Clocking default, *External*.
10. On the same screen, you can set Line speed (bps) up to *64000* for Sys-2, provided you are using a maximum length of 8 feet for the RS-232 cable that will connect the two Eiconcards back to back.
11. Once the parameters are set, press **F2 Save** and **F10** to exit. The two *ec.cfg* files are now configured for Sys-1 and Sys-2's back-to-back connection.
12. If the Eiconcard is already loaded and running (using `eccard start`), run `eccard stop` to stop it.
13. Connect the Eiconcard in Sys-1 to the Eiconcard in Sys-2 with an RS-232 null-modem cable.
14. Run `eccard start` on both systems to start the Eiconcards. The Eiconcards on each system are loaded and configured according to the parameters found in the system's *ec.cfg* file.
15. Once `eccard start` has run successfully (no errors reported), you can use `ecstatus` on both systems to check the integrity of the connection between Sys-1 and Sys-2.
16. Create a test circuit on both systems. Two sample files, *sys1pap.if* and *sys2pap.if*, are provided with Routing Services which are configured for the purpose of running this test. Sys-1 is configured as the authenticator and Sys-2 as the system to be authenticated, as shown in the sample circuit definitions.

    Note: When using PAP and CHAP to configure Eiconcard Routing Services, one side of the connection must be configured as the authenticator for incoming connections, and the other as the system to be authenticated, that is, the system making the call.

    Note: Circuit names need only be unique within one Linux system; you can specify the same name for the test circuits used on Sys-1 and Sys-2.
17. Ensure the Eiconcards are already started, and run `mprload -f sys1pap.if` on Sys-1 and `mprload -f sys2pap.if` on Sys-2. This loads the specified interface file down to the Eiconcard Routing Services driver. If the `-f` option is not specified, the default file *mpr.if* is loaded down to the driver.
18. Run `mprstart` on both systems to start the circuits. If you stop an Eiconcard after creating a circuit entry, use `mprstart` to restart the circuit once you have restarted the card.

19. Run `ecstatus ppp` to confirm that the link between Sys-1 and Sys-2 is operational. The *Protocol State* item appearing in the left column of the `ecstatus` display should be listed as "Opening" on both systems.

    Check that the circuit is correctly defined on both systems and that the two circuits are bound by using the `mprstat -c` command. The systems display the following:

    [Sys-1]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_pp p1	PPP	OPB	1	Off		192.1.100. 2	eic0

    [Sys-2]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_pp p2	PPP	OPB	1	Off		192.1.100. 1	eic0

    If there is an "E" in the *Flags* column, the binding of the circuit may be incorrect. Determine what the error is and correct it. You can use the `mprstart` command to restart the circuit or the `mprstat -cv` command to display detailed status information for the circuits if necessary.

    For more information on the `ecstatus` command, see *ecstatus.html* in the */opt/dialogic/c4l/docs* directory.

20. If the circuit states are set properly, go to the Testing Sys-1/Sys-2 Communications on page 51.

Setting up a Multilink PPP Connection

Multilink PPP allows you to run a Point-to-Point connection over two 64K ISDN B-Channels, providing you with a single 128K data pipe. You can set up a Multilink PPP connection using Sys-1 and Sys-2 by following this procedure. The two systems must be connected over ISDN lines. For this test, the EuroISDN switch type is configured.

1. Select the Eiconcard Services Protocol Configuration option in `eiconcfg` on each system to modify its Eiconcard configuration.
2. At the Hardware Configuration screen, set the ISDN option to *Yes* and select *EuroISDN* as your switch type.
3. Set auto activate ports to *No* for the PPP ports and set the number of ports to 2.
4. Move to the Protocol Configuration screen. Select *Routing Services*. Configure the Line protocol module as *PPP*.
5. Press **F4** to access the Point-to-Point Configuration screen and set the Multilink PPP option to *Yes* on both systems. Ensure the Link Speed is the same on both systems.
6. Press **F3** to return to the Protocol Configuration screen. Set the Dialer selection option to *B-Channel* for the two ports on each system.
7. Press **F4** to access the B-Channel Configuration screen on both systems.
8. On Sys-1, set the local directory number to 384000 and the remote directory number to 384020 on both port 1 and port 2.

   Note: These numbers are used only for the purpose of this example, and should be replaced by your ISDN number.

9. On Sys-2, set the local directory number to 384020 and the remote directory number to 384000 on both port 1 and port 2.

   Note: These numbers are used only for the purpose of this example, and should be replaced by your ISDN number.

10. Once the parameters are set, press **F2 Save** and **F10** to exit. The two *ec.cfg* files are now configured for Sys-1 and Sys-2's connection.
11. If the Eiconcard is already loaded and running (using `eccard start`), run `eccard stop` to stop it.
12. Connect the Eiconcard in Sys-1 to the Eiconcard in Sys-2 over an ISDN line.
13. Run `eccard start` on both systems to start the Eiconcards. The Eiconcards on each system are loaded and configured according to the parameters found in the system's *ec.cfg* file.
14. Once `eccard start` has run successfully (no errors reported), you can use `ecstatus` on both systems to check the integrity of the connection between Sys-1 and Sys-2.
15. Create a test circuit on both systems. Two sample files, *sys1mlp.if* and *sys2mlp.if*, are provided with Routing Services and are configured for the purpose of running this test.

    Circuit names need only be unique within one Linux system; you can specify the same name for the test circuits used on Sys-1 and Sys-2.

16. Ensure the Eiconcards are already started, and run `mprload -f sys1mlp.if` on Sys-1 and `mprload -f sys2mlp.if` on Sys-2. This loads the specified interface file down to the Eiconcard Routing Services driver. If the `-f` option is not specified, the default file *mpr.if* is loaded down to the driver.
17. Run `mprstart` on both systems to start the circuits. If you stop an Eiconcard after creating a circuit entry, use `mprstart` to restart the circuit once you have restarted the card.
18. Run `ecstatus ppp` to confirm that the link between Sys-1 and Sys-2 is operational. The *Protocol State* item appearing in the left column of the `ecstatus` display should be listed as "Opening" on both systems.

    Check that the circuit is correctly defined on both systems and that the two circuits are bound by using the `mprstat -c` command. The systems display the following:

[Sys-1]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_ppp1	PPP	OPB	1	Off		192.1.100.2	eic0

[Sys-2]# mprstat -c

cctname	Subnet	Flags	Port	Comp	Parameters	First Hop	I/F
test_ppp2	PPP	OPB	1	Off		192.1.100.1	eic0

    If there is an "E" in the *Flags* column, the binding of the circuit may be incorrect. Determine what the error is and correct it. You can use the `mprstart` command to restart the circuit or the `mprstat -cv` command to display detailed status information for the circuits if necessary.

    For more information on the `ecstatus` command, see *ecstatus.html* in the */opt/dialogic/c4l/docs* directory.

19. If the circuit states are set properly, go to Testing Sys-1/Sys-2 Communications below.

Testing Sys-1/Sys-2 Communications

The two systems are now ready to exchange IP datagrams over the X.25, Frame Relay, or PPP link that connects them together. The TCP/IP *ping* utility provides a convenient way of doing this.

The *ping* utility provides real network traffic by means of ICMP Echo Requests. It transmits datagrams from one system to another system identified by the specified IP address. Reply datagrams contain items such as a sequence number, the number of datagrams sent so far, and the round-trip time for each datagram. The sequence number indicates the datagram to which a reply corresponds.

The reply from the other system fits on a single line, and a new reply line is displayed once every few seconds. You can use the interrupt key (**Ctrl-Break** or **Delete**) to terminate *ping* at any time, or you can specify the number of datagrams to be sent on the *ping* command line. When *ping* terminates, several summary statistic lines are displayed.

Run *ping* on Sys-1 as shown below. A sample of the statistical information displayed by *ping* is also included. The IP address of Sys-2 is included on the *ping* command line, indicating the system with which the communications are to occur.

```
[Sys-1]# ping 192.1.100.2

PING 192.1.100.2: 56 data bytes
64 bytes from 192.1.100.2: icmp_seq=0.  time=125. ms
64 bytes from 192.1.100.2: icmp_seq=1.  time=105. ms
64 bytes from 192.1.100.2: icmp_seq=2.  time=110. ms
64 bytes from 192.1.100.2: icmp_seq=3.  time=105. ms
64 bytes from 192.1.100.2: icmp_seq=4.  time=105. ms
64 bytes from 192.1.100.2: icmp_seq=5.  time=115. ms
64 bytes from 192.1.100.2: icmp_seq=6.  time=110. ms
64 bytes from 192.1.100.2: icmp_seq=7.  time=110. ms
64 bytes from 192.1.100.2: icmp_seq=8.  time=105. ms
64 bytes from 192.1.100.2: icmp_seq=9.  time=110. ms
64 bytes from 192.1.100.2: icmp_seq=10. time=115. ms
64 bytes from 192.1.100.2: icmp_seq=11. time=115. ms
64 bytes from 192.1.100.2: icmp_seq=12. time=110. ms
64 bytes from 192.1.100.2: icmp_seq=13. time=110. ms

----192.1.100.2 PING Statistics----
14 packets transmitted, 14 packets received, 0% packet loss
round-trip (ms) min/avg/max = 103/114/125
```

In this example, the interrupt key (e.g., **Ctrl-Break** or **Delete**) was pressed after 14 datagrams were sent. The *ping* utility then displayed the summary statistics and halted. The term "packet" used on the summary lines at the end of the sample *ping* display is equivalent to the term "datagram" as in "IP datagram."

You can also run *ping* on Sys-2 to show a more realistic traffic pattern, with the two systems simultaneously communicating with each other. You can continue adding Eiconcard Routing Services systems and running *ping* as desired.

CHAPTER 6

Advanced Eiconcard Services Configuration

This section describes the advanced Eiconcard Services Configuration.

Eiconcard Device Driver Parameters

Total Request Buffers Allocated

The Total Request Buffers Allocated parameter defines the number of request buffers to be allocated for the Eiconcard Streams Device Driver. Request buffers are used to transfer commands between the Eiconcard Driver and the Eiconcard.

By default, the Eiconcard Streams Device Driver has a total of 1024 request buffers enabled. Each request buffer requires 20 bytes. Once allocated, the memory configured for the Eiconcard Streams Device Driver is never returned to the system. Approximately 2560 bytes of memory is reserved for 128 request buffers. The value you should configure for this parameter depends on:

- The number of simultaneous sessions on the Eiconcard.
- System memory available.
- The volume of traffic on the Eiconcard.
- How many Eiconcards are installed in the system.

In high-stress environments (for example, when you also have Eiconcard Routing Services running on your system), it may be appropriate to configure additional request buffers per Eiconcard, provided you have sufficient memory in your system.

For Eiconcard Connections for Linux, the number of request buffers configured for the Eiconcard Streams Device Driver is automatically increased during the configuration of the Host PAD and Terminal PAD drivers.

Total Data Buffers Allocated

By default, 1024 data buffers are reserved for the Eiconcard Character-Compatibility Driver. If you modify this value, make sure that the value you specify is greater than or equal to the number of request buffers. The Eiconcard Character-Compatibility Driver reserves 256 bytes per buffer at initialization.

Given that the data buffers are reserved for the Eiconcard Character-Compatibility Driver, you may want to specify a lower value if, for example, you are not using the Development Tools and are using less than 32 Host PAD devices. The Eiconcard Host PAD driver may also add buffers to the value specified for the Eiconcard Character-Compatibility Driver. Therefore, the total number of reserved data buffers may be larger than the value previously configured for this driver.

Note: Data buffers are also used by X.25 Development Tools requests. For example, with an X.25 application, an `x25send( )` or `x25recv( )` that uses a 4K buffer to send or receive data requires 16 data buffers; 4096 bytes (16 x 256) are used in this case.

Load/Self-test Timeout Period

The Load/Self-test Timeout Period parameter is the maximum time in seconds that the load/self-test procedure is permitted to take before assuming that a system hardware or software failure has occurred.

Watchdog Wake Up Period

This parameter serves to monitor the Eiconcard Character-Compatibility Driver's usage of resources. A watchdog task is activated periodically to clean up requests that belong to defunct processes and release their resources. By default, this occurs every 30 seconds.

X.25 socket driver

This option enables/disables the boot time loading of the X.25 socket driver. Turn this option on if you are running a third-party application that uses the Eiconcard X.25 sockets interface. By default this option is off.

Consult the Eiconcard Development Suite documentation for more information on developing software using the Eiconcard X.25 sockets interface.

Eiconcard Advanced Driver Options Configuration

To configure the Eiconcard Advanced Driver Options, run `eiconcfg`, and follow these steps:

1. Select the Eiconcard Services Driver Configuration option.
2. Select option 1 to modify the configuration, or select option 2 to keep this configuration.
3. Enter the parameters as prompted or press **Enter** to accept the default values. If you enter **h**, help information will be displayed for the related parameter.
4. After you specify a value for the last parameter, enter **q** to quit or **b** to go back to the previous screen if you are configuring other options within `eiconcfg`.

CHAPTER 7

Modem and Null-Modem Cables

This section describes the modem and null-modem cables available from Dialogic and how to use them. It also includes diagrams showing the pin-out wiring and signals for each cable, as well as instructions for making null-modem connections between two systems.

Connecting Two Workstations

This section describes how to connect two Linux servers, each with an Eiconcard, back-to-back using a null-modem cable. Depending on the types of Eiconcards you are linking, cable requirements vary. Match the correct cable to the Eiconcards you want to link.

Which Cables to Use?

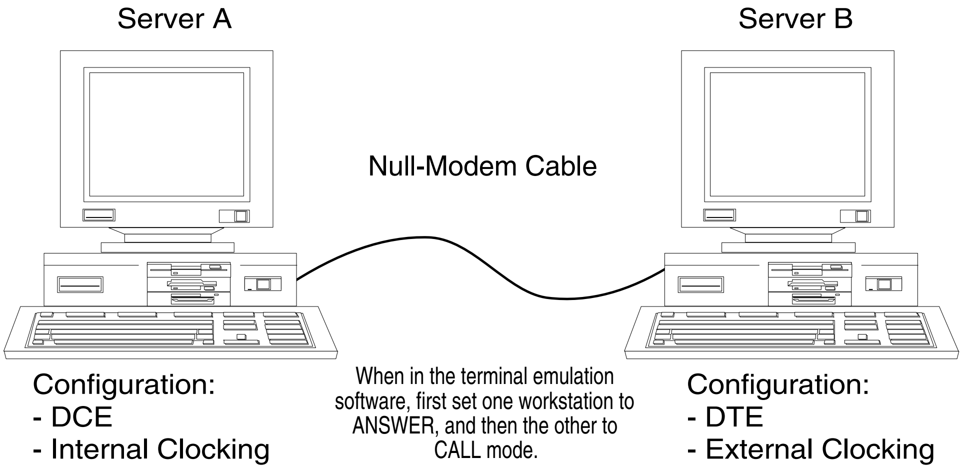
The table below shows which null-modem cables to use to connect specific kinds of interfaces.

Eiconcard	Interface	Target Eiconcard	Cable
C-Class	V.24 (RS-232-C)	C-Class	V.24 Null-Modem Cable
S-Class	V.24 or V.35	S-Class	V.24/V.35 HSI/HSI Null-Modem Cable
S-Class	X.21	S-Class	X.21 HSI Null-Modem Cable
C-Class	V.24	S-Class	V.24 HSI Modem Cable, with the HSI Null-Modem Conversion Cable

For further information on cable diagrams and part numbers, see the respective sections on Modem and Null-Modem Cables in this section. Remember that not all cables are symmetrical: both ends of a cable are not necessarily identical.

Establishing Contact

The diagram below summarizes the proper configuration of hardware and software for a null-modem connection.



To make a back-to-back X.25/HDLC connection using a null-modem cable, follow these steps:

1. Connect Server A to Server B using a null-modem cable. It does not matter which computer you select as A or B.

   Note: Make sure that the packet size, window size, and the number of VCs match on both ends. This can be verified by running `eiconcfg` and selecting the Eiconcard Services Protocol Configuration on Servers A and B. Match the X.25 and HDLC configuration values on the two gateways.

2. On Server A, run `eiconcfg` and select Eiconcard Services Protocol Configuration.
3. Go to the Sync Driver Configuration Screen and set Clocking to *Internal*.

   Note: When using an X.21 HSI Null-Modem Cable (300-032) to connect two Eiconcards, be sure to set both ends to NRZI encoding, Internal+DPLL, and the line speed to 19.2 kbps or less.

4. Go to the HDLC Configuration Screen and set DTE/DCE Addressing to *DCE*.
5. Save the changes you have made and exit `eiconcfg`.

   Note: You must reload the Eiconcard for any changes you have made in `eiconcfg` to take effect.

6. On Server B, run `eiconcfg` and select Eiconcard Services Protocol Configuration.
7. Go to the Sync Driver Configuration Screen and set Clocking to *External*.
8. Go to the HDLC Configuration Screen and set DTE/DCE Addressing to *DTE*.
9. Save the changes you have made and exit `eiconcfg`.

   Note: You must reload the Eiconcard for any changes you have made in `eiconcfg` to take effect.

   Note: If you receive the error message “Modem Not Ready,” then you may have the two ends of the null-modem cable reversed. Unplug the cable and reverse the ends. This error may also be caused by a damaged cable.

Modem Cables

This section contains information, including pin-out diagrams, on all Dialogic modem cables.

All current modem cables for Eiconcards are shown in the table below. These cables may be ordered from your Dialogic distributor.

Cable Name	Part Number
V.24 Modem Cable	300-007
V.35 HSI Modem Cable	300-024
X.21 HSI Modem Cable	300-025
V.24 HSI Modem Cable	300-026
HSI/V.24 Converter	300-046

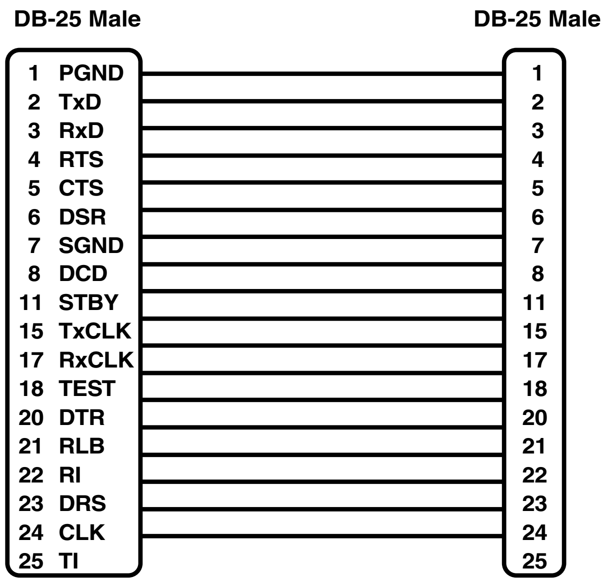
Note: Not all cables are symmetrical: both ends of a cable are not necessarily identical.

These modem cables can be used to perform the following functions:

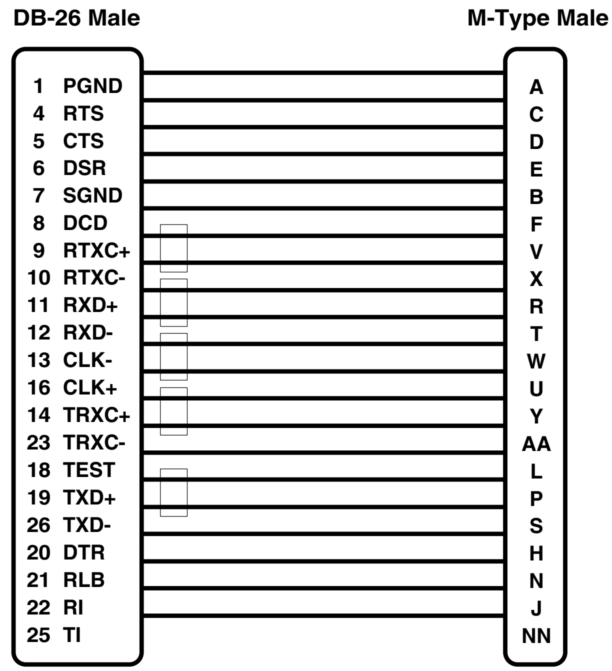
- The V.24 Modem Cable connects an Eiconcard with a V.24 (RS-232-C) interface to a modem.
- The V.35 HSI Modem Cable connects an Eiconcard with a high speed interface to a V.35 modem.
- The X.21 HSI Modem Cable connects an Eiconcard with a high speed interface to an X.21 modem.
- The V.24 HSI Modem Cable connects an Eiconcard with a high speed interface to a V.24 modem.
- The HSI/V.24 Converter makes an HSI port look like a regular V.24 port.

All connectors specified in the following diagrams must have a shielded ground. Small boxes around the wires denote a twisted pair. For complete wiring diagrams, contact your Dialogic representative.

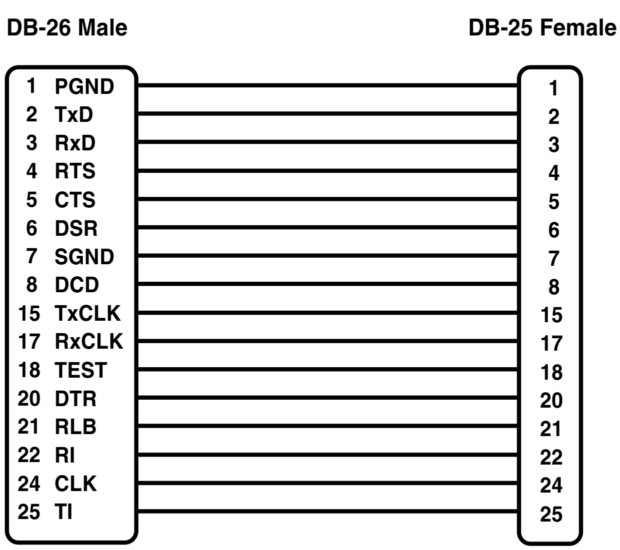
Note: The V.24 Modem Cable, the V.24 HSI Modem Cable, and the HSI/V.24 Converter are fully symmetrical.



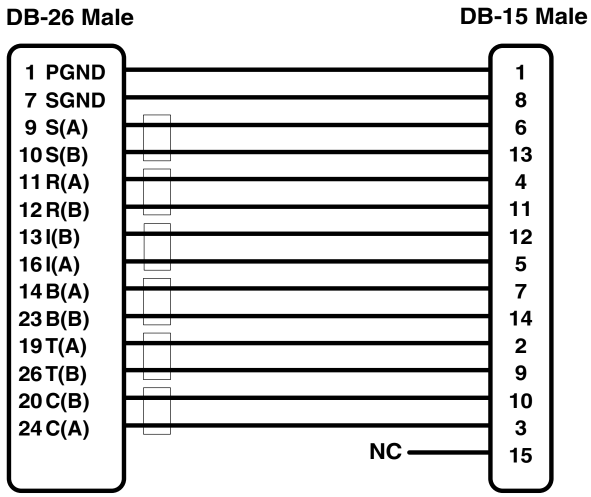
RS-232-C Modem Cable
300-007



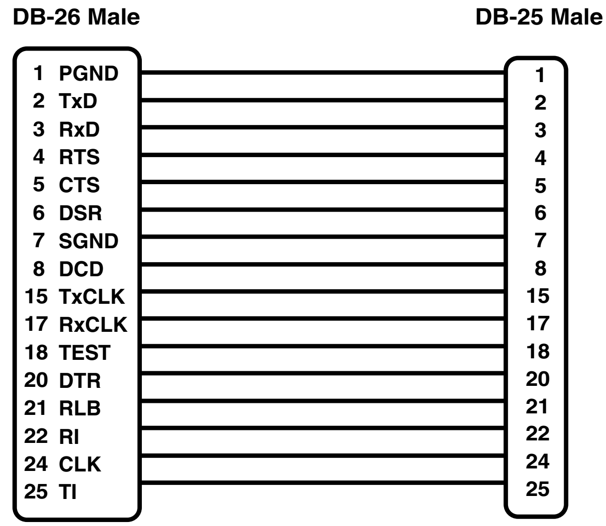
V.35 HSI Modem Cable
300-024



HSI/V.24 Converter
300-046



X.21 HSI Modem Cable
300-025



V.24 HSI Modem Cable
300-026

Null-Modem Cables

This section contains information, including pin-out diagrams, on various Dialogic null-modem cables, .

All current null-modem cables for Eiconcards are shown in the table below. These cables may be ordered from your Dialogic distributor.

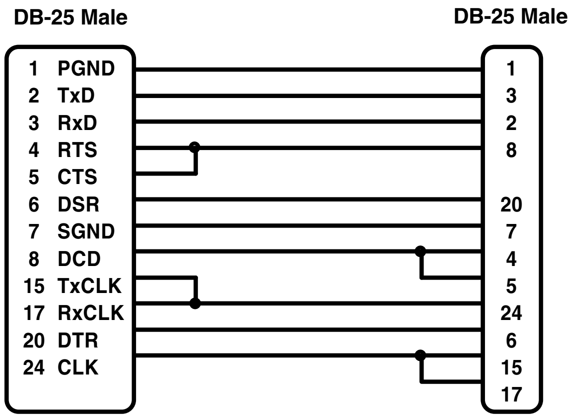
Cable Name	Part Number
V.24 Null-Modem Cable	300-022
V.24/V.35 HSI/HSI Null-Modem Cable	300-031
X.21 HSI Null-Modem Cable	300-032
HSI Null-Modem Conversion Cable	300-033

Note: Not all cables are symmetrical: both ends of a cable are not necessarily identical.

These null-modem cables can be used to perform the following functions:

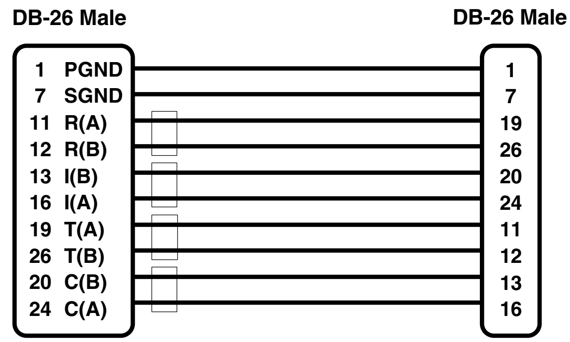
- The V.24 Null-Modem Cable connects an Eiconcard to another Eiconcard, using an V.24 interface.
- The V.24/V.35 HSI/HSI Null-Modem Cable connects an Eiconcard HSI to another Eiconcard HSI, using a V.24 or V.35 interface.
- The X.21 HSI Null-Modem Cable connects an Eiconcard HSI to another Eiconcard HSI, using an X.21 interface. When using this cable to connect two Eiconcards, be sure to set both ends to NRZI encoding, Internal Clocking, and the line speed to 19.2 kbps or less.
- The HSI Null-Modem Conversion Cable connects an Eiconcard HSI to a HSI Modem Cable connector.

All connectors specified in the following diagram must have shielded ground. Small boxes around the wires denote a twisted pair. For complete wiring diagrams, contact your Dialogic representative.



RS-232-C Null-Modem Cable

300-022



X.21 HSI Null-Modem Cable

300-032

APPENDIX A

X.25 User-Facility Support and Code References

This section describes X.25 user-facility support features and includes details on DNICs, X.25 diagnostic and cause codes, and ASCII control codes specific to the X.25 protocol.

User-Facility Support

User facilities are optional network services that let you perform tasks such as reversing charges on your calls, accessing a Closed User Group, or specifying a Network User Identification (NUI).

Two of Dialogic's additions to the X.28 Command set—*call* and *conn*— support full CCITT Facility request capability.

Facilities are encoded into the facility field of the call request packet without any interpretation on the part of the X.PAD program. The facility field contains both facility codes and their associated parameters. Code format varies, since facilities may have one or more parameters. You can enter the contents of the user-facilities field in three different formats:

- Hexadecimal numbers separated by commas
- ASCII characters within either single or double quotation marks
- Combination of hexadecimal numbers and ASCII characters

The table below summarizes the facility codes for these facilities, including the applicable packet types. The facility code is given in hexadecimal.

Facility Codes

Facility	**Applicable Packet types**				**Code**
	Call Request	Incoming Call	Call Accepted	Call Connecte d	(hex)
Flow Control Parameter Negotiation (Packet Size)	X	X	X	X	0x42
Flow Control Parameter Negotiation (Window Size)	X	X	X	X	0x43
Throughput Class Negotiation	X	X	X	X	0x02
Closed User Group (CUG) Selection	X	X			0x03
CUG with Outgoing Access Selection	X	X			0x09
Bilateral CUG Selection	X	X			0x41
Reverse Charging	X	X			0x01*
Fast Select	X	X			0x01*
Network User Identification (NUI)	X		X		0xC6

* The Fast Select facility code is present in the incoming call packet if reverse charging and/or fast select is indicated.

Facility Types

Facilities fall into two groups: those specified at subscription time, and those specified on a per-call basis.

Subscription Facilities

The first group includes CCITT facilities such as nonstandard default window and packet sizes, Closed User Group definitions, barring of incoming or outgoing calls, and reverse charging.

Per-Call Facilities

The second group of facilities are agreed upon at the time of subscription but can be used on a per-call basis. These facilities include: reverse charging, indexing of a Closed User Group (CUG), or specification of a Network User Identification (NUI).

Facility Syntax

Facility codes are entered as a string of numbers and/or ASCII characters. The first parameter of a facility code identifies the facility. The subsequent parameters supply information about the facility.

A request for CCITT facilities must always precede all requests for non-CCITT facilities. The National Facility Marker (0,0) need only be included when at least one request for a non-CCITT facility is present.

The syntax for Network User Identification and Flow Control Negotiation is explained below.

Network User Identification (NUI): C6,*NUIlength*,NUI

The first parameter after the facility code specifies the length, in bytes, of the NUI. This is followed by the NUI itself, in a format determined by the network administration. The following shows how to encode the seven-character NUI *pass.id*.

```
C6,07,"pass.id"
```

Flow Control Negotiation (packet size):42,*insize*,*outsize*

Insize and *outsize* specify, respectively, the maximum length of incoming and outgoing packets. They are coded as the logarithm base 2 of the packet size, and may be offered by networks in the range of 4 through 12, that is, packet sizes from 16 to 4096 bytes. All networks must offer packet size 7 (128 bytes).

Examples of User Facilities

The following table provides examples of user facilities and their corresponding codes:

User Facility	Code
National Facility Marker	0,0
Reverse Charging	1,1
Throughput Class Negotiation	2,*table*

User Facility	Code
Closed User Group (CUG) Selection	3,*CUG index*
Flow Control Negotiation (packet size)	42,*insize*,*outsize*
Flow Control Negotiation (window size)	43,*insize*,*outsize*
Network User Identification (NUI)	C6,*NUIlength*,NUI

Packet size

The packet size for transmissions from the remote DTE is shown in the low nibble of the first octet in the parameter field. The packet size for transmissions from the local DTE is indicated in the low nibble of the second octet. The high nibble of each octet must be zero.

Flow Control (Packet Size)								
Code	0	1	0	0	0	0	1	0
Octet 1	0	0	0	0	Size Code (Remote)			
Octet 2	0	0	0	0	Size Code (Local)			
Bit	7	6	5	4	3	2	1	0

The four bits indicating packet size are binary-coded as follows:

Packet Size Codes	
Code	Octets
0100	16
0101	32
0110	64
0111	128

Packet Size Codes	
Code	Octets
1000	256
1001	512
1010	1024
1011	2048
1100	4096

Note: Some networks may offer a subset of these values. Default packet size is 128 bytes.

Window Size

The window size for transmissions from the remote DTE is represented in bits 6 to 0 of the first octet in the parameter field. The window size for transmissions from the local DTE is represented in bits 6 to 0 of the second octet. Bit 7 of each octet must be 0.

Flow Control (Window Size)								
Code	0	1	0	0	0	0	1	1
Octet 1	0	Window Size (Remote)						
Octet 2	0	Window Size (Local)						
Bit	7	6	5	4	3	2	1	0

The bits referring to window size are binary coded and directly indicate the size of the window.

Window sizes of 1 to 7 are standard. Window sizes of 8 to 127 are valid only if extended sequence numbering is used. The default window size is 2. A value of 0 is not allowed.

Fast Select

The fast select facility is controlled by bits 6 and 7 of the octet in the parameter field. If fast select is not requested then bits 6 and 7 are set to 0. If fast select is requested with no restriction on response then bit 6 is set to 0 and bit 7 is set to 1. Otherwise, if fast select is requested with a restriction on response then bits 6, 7 are set to 1.

Fast Select								
Code	0	0	0	0	0	0	0	1
Octet 1	Fast Select							*
Bit	7	6	5	4	3	2	1	0

*See Reverse Charging on page 66.

Bits 1, 2, 3, 4, 5 may be used for other facilities or set to 0

Fast Select Values

Bit 7	Bit 6	Meaning
0	0	Fast Select not requested
1	0	Fast Select requested with no restriction on response
1	1	Fast Select requested with restriction on response

Note: The reverse charging and Fast Select facilities share the same facility code and may be used concurrently.

Throughput Class Negotiation

The throughput class for transmissions from the remote DTE is represented in the high nibble of the octet in the parameter field. The throughput class for transmissions from the local DTE is indicated in the low nibble.

Throughput Class								
Code	0	0	0	0	0	0	1	0
Octet 1	Remote DTE				Local DTE			
Bit	7	6	5	4	3	2	1	0

The two groups of four bits referring to throughput class are binary coded and indicate the throughput classes as follows:

Throughput Class Values								
Remote DTE				Local DTE				Throughput (bits/s)
0	0	0	0	0	0	0	0	Reserved
0	0	0	1	0	0	0	1	Reserved
0	0	1	0	0	0	1	0	Reserved
0	0	1	1	0	0	1	1	75
0	1	0	0	0	1	0	0	150
0	1	0	1	0	1	0	1	300
0	1	1	0	0	1	1	0	600
0	1	1	1	0	1	1	1	1200
1	0	0	0	1	0	0	0	2400
1	0	0	1	1	0	0	1	4800
1	0	1	0	1	0	1	0	9600
1	0	1	1	1	0	1	1	19200
1	1	0	0	1	1	0	0	48000
1	1	0	1	1	1	0	1	Reserved
1	1	1	0	1	1	1	0	Reserved
1	1	1	1	1	1	1	1	Reserved
7	6	5	4	3	2	1	0	**Bit**

Closed User Group (CUG) Selection

The index number to the closed user group selected for the virtual call is in the form of two decimal digits. Each digit is coded in BCD, in a nibble of the parameter field. The high nibble represents the first digit and the low nibble represents the second digit.

CUG Selection								
Code	0	0	0	0	0	0	1	1
Octet 1	Index (1st digit)				Index (2nd digit)			
Bit	7	6	5	4	3	2	1	0

Note: Indices to the same Closed User Group at different DTE/DCE interfaces may be different.

CUG with Outgoing Access Selection

The index number to the closed user group selected for the virtual call is in the form of two decimal digits. Each digit is coded in BCD, in a nibble of the parameter field. The high nibble represents the first digit and the low nibble represents the second digit.

CUG Selection (Outgoing)								
Code	0	0	0	0	0	0	1	1
Octet1	Index (1st digit)				Index (2nd digit)			
Bit	7	6	5	4	3	2	1	0

Note: Indices to the same Closed User Group at different DTE/DCE interfaces may be different.

Bilateral CUG Selection

The index number to the bilateral closed user group selected for the virtual call is in the form of four decimal digits. Each digit is coded in a semi-octet, in BCD. The high and low nibbles of the first octet of the parameter field represent the first and second digits. The high and low nibbles of the second octet represent the third and fourth digits, respectively.

Bilateral CUG Selection								
Code	0	0	0	0	0	0	1	1
Octet1	Index (1st digit)				Index (2nd digit)			
Octet2	Index (3rd digit)				Index (4th digit)			
Bit	7	6	5	4	3	2	1	0

Note: Indices to the same Bilateral Closed User group at different DTE/DCE interfaces may be different.

Reverse Charging

The reverse charging facility is controlled by bit 0 of the octet in the parameter field. If reverse charging is not requested then bit 0 is set to 0. Otherwise if reverse charging is requested then bit 0 is set to 1.

Reverse Charging								
Code	0	0	0	0	0	0	0	1
Octet1	*	*	0	0	0	0	0	RC
Bit	7	6	5	4	3	2	1	0

*See Fast Select on page 64.

Reverse Charging Values	
Bit 0	**Meaning**
0	Reverse Charging not requested
1	Reverse Charging requested

Bits 1, 2, 3, 4, 5 may be used for other facilities or set to 0

Note: The reverse charging and Fast Select facilities share the same facility code and may be used concurrently.

Network User Identification (NUI)

The octet following the facility code field indicates the length, in octets, of the Password and NUI fields. The following octets contain the user password and network user identification.

Network User ID								
Code	1	1	0	0	0	1	1	0
Length	0	0	0	0	Length			
Password $_1$	0	1st Password Character						
...		...						
Password $_6$	0	6th Password Character						
NUI $_1$	0	1st NUI Character						
...		...						
NUI $_8$	0	8th NUI Character						
Bit	7	6	5	4	3	2	1	0

The Length field is set to the combined number of octets in the password and the NUI fields.

Each octet in the Password and NUI fields contain a single ASCII character. The maximum Password length is 6 characters. The maximum NUI length is 8 characters.

If both the NUI Charging facility and the reverse charging facility are specified then the reverse charging facility will apply to the call.

Example of a Non-CCITT Facility

The Datapac Traffic Class Facility is an example of a non-CCITT facility. One of its significant aspects is that it is compulsory when making an international call. Its coding is 1,1 and it must be preceded by the National Facility Marker (0,0). For example:

Priority Traffic:	0,0,1,1
Reverse Charging and Priority Traffic:	1,1,0,0,1,1

Other networks also define their own facilities. If you receive repeated "Invalid Facility Request" messages or if you wish to find out more about the facilities applicable to you, contact your network representative.

Further Information on User Facilities

The previous sections are not intended as an exhaustive description of the user facilities supported either by the CCITT or by the network you may be using. For information on CCITT user facilities, consult the CCITT Recommendation *International User Services and Facilities in Public Data Networks*, Vol. VIII, Fascicle VIII.2, Rec. X.2.

Networks and DNICs

CCITT Recommendation X.121 defines a general address format containing 12, 13, or 14 digits. The first four digits of a general address format constitute the Data Network Identification Code (DNIC). The first three digits of the DNIC generally identify the country—much like telephone area codes—with the exception of large countries such as the United States. The fourth digit identifies a particular network within the country.

The following table shows the DNICs of various public data networks around the world and information/test numbers, as applicable. You can call these numbers for further information about a given network, or to test your X.3 PAD parameter settings. The numbers in this table are in effect at the time of publication.

Country	Network	DNIC	Information/Test Number
Argentina	ARPAC	7220	
Austria	Radio Austria	2320	
Austria	RADAUS	2329	
Austria	Datex-P	2322	
Bahamas	Batelco	3640	
Barbados	IDAS	3420	
Belgium	DCS	2062	
Bermuda	IPSD	3500	
Brazil	Interdata	7240	
Canada (Telecom)	Datapac	3020	76000002 Include “ECHO” in Call User Data field of call request or connect command.
Canada (CN/CP)	Infoswitch	3029	
Chile	ENTEL	7302	
Colombia	DAPAQ	3107	
Denmark	Datapak	2382	
Dominican Republic	UDTS	3700	
Egypt	Arento	6020	
Finland	Finnpak	2442	
France	Transpac	2080	0030100
France	NTI	2081	
Germany	Datex-P	2624	5690049002 Include “ECHO” in Call User Data field of call request or connect command.
Greece	Helpak	2022	
Guatemala	Guatel	7040	
Hong Kong	IDAS	4542	
Iceland	Icepak	2740	
Indonesia	SKDP	5101	
Ireland	EIRPAC	2724	

Country	Network	DNIC	Information / Test Number
Israel	Isranet	4251	
Italy	ITAPAC	2227	
Jamaica	Jamatel	3380	
Japan (NTT)	DDX-P	4401	
Japan (KDD)	Venus-P	4408	
Luxembourg	Luxpac	2704	
Malaysia	Maypac	5021	
Mexico	Telepac	3340	
Netherlands	Datanet 1	2044	
Norway	Datapak	2422	
Panama	Intelpaq	7141	
Portugal	SABD	2682	
Puerto Rico	UDTS-PDIA	3301	
Singapore	Telepac	5252	
South Korea	DNS	4501	
Spain	Iberpac	2145	
Sweden	Telepak	2402	
Switzerland	Telepac	2284	
Thailand	IDAR	5250	
United Kingdom	IPSS	2341	
United Kingdom	PSS	2342	1920100513
United States	Accunet	3134	
United States	Autonet	3126	
United States	ITT	3103	
United States	RCA	3113	
United States	SprintNet	3110	
United States	Tymnet	3106	
United States	WUI	3104	
Virgin Islands	UDTS-PDIA	3300	

X.25 Diagnostic Codes

The following table describes X.25 diagnostic codes. These codes can help you in tracing the source of problems with an X.25 connection

Description	Diagnostic	Hex Code
NO ADDITIONAL INFORMATION	EX25NOINFO	*0x*00
Invalid P(S)	EX25INVPS	*0x*01
Invalid P(R)	EX25INVPR	*0x*02

Description	Diagnostic	Hex Code
PACKET TYPE INVALID	EX25PKTINV	*0x*10
For state r1	EX25PKTIR1	*0x*11
For state r2	EX25PKTIR2	*0x*12
For state r3	EX25PKTIR3	*0x*13
For state p1	EX25PKTIP1	*0x*14
For state p2	EX25PKTIP2	*0x*15
For state p3	EX25PKTIP3	*0x*16
For state p4	EX25PKTIP4	*0x*17
For state p5	EX25PKTIP5	*0x*18
For state p6	EX25PKTIP6	*0x*19
For state p7	EX25PKTIP7	*0x*1A
For state d1	EX25PKTID1	*0x*1B
For state d2	EX25PKTID2	*0x*1C
For state d3	EX25PKTID3	*0x*1D
PACKET NOT ALLOWED	EX25PKTNA	*0x*20
Unidentifiable packet	EX25UPKT	*0x*21
Call on one-way logical channel	EX25COWLC	*0x*22
Invalid packet type on a PVC	EX25IPKT	*0x*23
Packet on unassigned LCN	EX25PKTULC	*0x*24
Reject not subscribed to	EX25REJNST	*0x*25
Packet too short	EX25PKT2S	*0x*26
Packet too long	EX25PKT2L	*0x*27
Invalid GFI (General Format Identifier)	EX25IGFI	*0x*28
Restart with non-zero GFI	EX25RN0GFI	*0x*29
Packet type not compatible with facility	EX25PKTNCF	*0x*2A
Unauthorized interrupt confirmation	EX25UINTRC	*0x*2B
Unauthorized interrupt	EX25UINTR	*0x*2C
Unauthorized reject	EX25UREJ	*0x*2D
TIMER EXPIRED	EX25TIMEXP	*0x*30
For incoming call	EX25TEIC	*0x*31
For clear indication	EX25TECI	*0x*32
For reset indication	EX25TERI	*0x*33
For restart indication	EX25TERAI	*0x*34
CALL SET-UP, CALL CLEARING, OR REGISTRATION PROBLEM	EX25CSUP	*0x*40
Facility/registration code not allowed	EX25FCNA	*0x*41
Facility parameter not allowed	EX25FPNA	*0x*42

Description	Diagnostic	Hex Code
Invalid called address	EX25ICDA	0x43
Invalid calling address	EX25ICGA	0x44
Invalid facility/registration length	EX25IFRLEN	0x45
Incoming call barred	EX25ICBARRED	0x46
No logical channel available	EX25NLCAVAIL	0x47
Call collision	EX25CALLCOLL	0x48
Duplicate facility requested	EX25DUPFACREQ	0x49
Non-zero address length	EX25N0ADDRLEN	0x4A
Non-zero facility length	EX25N0FACLEN	0x4B
Facility not provided when expected	EX25FNOTPROV	0x4C
Invalid CCITT-specified DTE facility	EX25ICCITTF	0x4D
MISCELLANEOUS		0x50
Improper cause code from DTE	EX25IMPCCODE	0x51
Non-aligned byte (octet)	EX25NOTALIGN	0x52
Inconsistent Q-bit setting	EX25IQBITSET	0x53
INTERNATIONAL PROBLEM	EX25INTLPROB	0x70
Remote network problem	EX25RNETPROB	0x71
International protocol problem	EX25INTLPPROB	0x72
International link out of order	EX25INTLLOOR	0x73
International link busy	EX25INTLBUSY	0x74
Transit network facility problem	EX25TNETFPROB	0x75
Remote network facility problem	EX25RNETFPROB	0x76
International routing problem	EX25INTLRPROB	0x77
Temporary routing problem	EX25TEMPRPROB	0x78
Unknown called DNIC	EX25UCDNIC	0x79
Maintenance action	EX25MAINTACT	0x7A

X.25 Cause Codes

The table below describes X.25 generated cause codes. This includes all clearing, resetting, and restarting causes. These codes can help you to trace the source of problems with an X.25 connection.

Description	Causes	Hex Code
CLEARING CAUSES		
DTE originated call	EX25DTEORG	0x00
Number busy	EX25NUMBUSY	0x01
Invalid facility request	EX25IFREQ	0x03
Network congestion	EX25NETCONG	0x05
Out-of-order	EX25OUTORDER	0x09

Description		Causes	Hex Code
	Access barred	EX25ABARRED	*0x*0B
	Not obtainable	EX25NOTOBT	*0x*0D
	Remote procedure error	EX25REMPROC	*0x*11
	Local procedure error	EX25LOCPROC	*0x*13
	RPOA out of order	EX25RPOAOOR	*0x*15
	Reverse charging not subscribed to	EX25REVCHRGNS	*0x*19
	Incompatible destination	EX25INCDEST	*0x*21
	Fast Select acceptance not subscribed to	EX25FASTSELNS	*0x*29
	Ship absent (for mobile maritime service)	EX25SHIPABS	*0x*39
RESETTING CAUSES			
	DTE originated call	EX25RDTEORG	*0x*00
	Out of order (PVC only)	EX25ROUTORDER	*0x*01
	Remote procedure error	EX25RREMPROC	*0x*03
	Local procedure error	EX25RLOCPROC	*0x*05
	Network congestion	EX25RNETCONG	*0x*07
	Remote DTE operational (PVC only)	EX25RREMDTEOP	*0x*09
	Network operational (PVC only)	EX25RNETOP	*0x*0F
	Incompatible destination	EX25RINCDEST	*0x*11

ASCII Control Codes

The following table lists ASCII control codes.

Decimal value	Mnemonic	Keyboard entry
0	NUL	Ctrl-2
1	SOH	Ctrl-A
2	STX	Ctrl-B
3	ETX	Ctrl-C
4	EOT	Ctrl-D
5	ENQ	Ctrl-E
6	ACK	Ctrl-F
7	BEL	Ctrl-G
8	BS	Ctrl-H-left arrow
9	HT	Ctrl-I-tab
10	LF	Ctrl-J
11	VT	Ctrl-K
12	FF	Ctrl-L

13	CR	Ctrl-M or Enter
14	SO	Ctrl-N
15	SI	Ctrl-O
16	DLE	Ctrl-P
17	DC1	Ctrl-Q
18	DC2	Ctrl-R
19	DC3	Ctrl-S
20	DC4	Ctrl-T
21	NAK	Ctrl-U
22	SYN	Ctrl-V
23	ETB	Ctrl-W
24	CAN	Ctrl-X
25	EM	Ctrl-Y
26	SUB	Ctrl-Z
27	ESC	Esc or Ctrl-[
28	FS	Ctrl-\
29	GS	Ctrl-]
30	RS	Ctrl-6
31	US	Ctrl- -
127	DEL	Del

APPENDIX B

X.29 Call User Data Format

An overview of the Call User Data formats used in X.25 calls is provided in this section. It shows how to format user data for X.25 call clearing.

The format for Call User Data consists of four protocol identifier octets followed by a maximum of 12 octets of the call user data. Octets consist of bits numbered 7 to 0, where bit 0 is the low order bit and is transmitted first. Octets are consecutively numbered starting from 1 and are transmitted in this order.

Call User Data								
Octet $_1$ Protocol ID	See "Protocol ID (octet 1) Detail" below							
Octet $_2$ Protocol ID	0	0	0	0	0	0	0	0
Octet $_3$ Protocol ID	0	0	0	0	0	0	0	0
Octet $_4$ Protocol ID	0	0	0	0	0	0	0	0
Octet $_5$ User Data	User Data							
...	...							
Octet $_{16}$ User Data	User Data							
Bit	7	6	5	4	3	2	1	0

See below for information on how bit 0 relates to bits 6 &7 of octet 1

Protocol Identifier octet 1 details are shown below:

	Protocol ID (octet 1) Detail								
	Bit Values								**Description**
	0	0	0	0	0	0	0	1	for CCITT use re: PADs
	0	1	Future Use						for national use
	1	0							reserved for international user bodies
	1	1							for DTE-DTE use
Bit	7	6	5	4	3	2	1	0	

When bits 7 and 6 are 00, bits 5 to 0 are 000001 to indicate PAD messages relating to the PAD facility for the start-stop mode DTE. Other coding of bits 5 to 0 is reserved for future standardization by the CCITT, subject to the rules of Recommendation X.244.

All bits of octets 2, 3, and 4 are set to 0. These octets are reserved for future use to provide the called PAD or packet mode DTE with additional information pertinent to the calling party.

Octets of the call data field will contain the user characters received by the PAD from the start-stop mode DTE during the call establishment phase. The coding of these octets is similar to that of user sequences. The call data field is limited to 12 octets.

APPENDIX C

Key Packet Formats

Details of the Packet Format for the X.25 Packets used in call establishment and call clearing are provided in this section. It describes the fields that must be filled by the application.

Call Request Packet Format

The format for a Call Request Packet is shown below. Octets consist of bits numbered 7 to 0 where bit 0 is the low order bit and is transmitted first. Octets are consecutively numbered starting from 1 and are transmitted in this order. See the CCITT X.25 Recommendation for details.

Call Request Packet Format

Bit 7	6	5	4	3	2	1	0
General Format ID				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	0	1	1
Calling DTE Address Length				Called DTE Address Length			
Called DTE digit-1				...			
Callled DTE digit-*n*				Calling DTE digit-1			
Calling DTE digit-2				...			
Calling DTE digit-*n*				0*	0	0	0
Facility Length							
Facilities							
...							
Call User Data							
...							

*Semi-octet of zeroes is present only if combined total digits in DTE address block is odd

The first three octets (up to and including Packet Type Identifier) are handled by the Eiconcard X.25 Development Kit. The rest of the octets are built from information supplied by the application program.

Call Accepted Packet Format

The format for a Call Accepted Packet is shown below. Octets consist of bits numbered 7 to 0 where bit 0 is the low order bit and is transmitted first. Octets are consecutively numbered starting from 1 and are transmitted in this order. The General Format Identifier can be coded 0x01 for modulo 8 or to 0x10 for modulo 128. See the CCITT X.25 Recommendation for details.

Call Accepted Packet Format

General Format ID	Logical Channel Group
Logical Channel Number	
Packet Type Identifier 0 0 0 0	1 1 1 1
Calling DTE Address Length	Called DTE Address Length
Called DTE digit-1	...
Callled DTE digit-*n*	Calling DTE digit-1
Calling DTE digit-2	...
Calling DTE digit-*n*	0* 0 0 0
Facility Length	
Facilities	
...	
Call User Data	
...	
Bit 7 6 5 4	3 2 1 0

*Semi-octet of zeroes is present only if combined total digits in DTE address block is odd

The first three octets (up to and including Packet Type Identifier) are handled by the Eiconcard X.25 Development Kit. The rest of the octets are built from information supplied by the application program.

Clear Request Packet Format

The format for a Clear Request Packet is shown below. Octets consist of bits numbered 7 to 0 where bit 0 is the low order bit and is transmitted first. Octets are consecutively numbered starting from 1 and are transmitted in this order. The General Format Identifier can be coded 0001 for modulo 8 or to 0010 for modulo 128. See the CCITT X.25 Recommendation for details.

Clear Request Packet Format

General Format ID	Logical Channel Group
Logical Channel Number	
Clearing Cause	
Diagnostic Code	
Packet Type Identifier 0 0 0 1 0 0 1 1	
Calling DTE Address Length	Called DTE Address Length
Called DTE digit-1	...
Callled DTE digit-*n*	Calling DTE digit-1
Calling DTE digit-2	...
Calling DTE digit-*n*	0* 0 0 0
Facility Length	
Facilities	
...	
Call User Data	
...	

Bit 7 6 5 4 3 2 1 0

*Semi-octet of zeroes is present only if combined total digits in DTE address block is odd

The first three octets (up to and including Packet Type Identifier) are handled by the Eiconcard X.25 Development Kit. The rest of the octets are built from information supplied by the application program.

Clear Confirmation Packet Format

The format for a Clear Confirmation Packet is shown below. Octets consist of bits numbered 7 to 0 where bit 0 is the low order bit and is transmitted first. Octets are consecutively numbered starting from 1 and are transmitted in this order. The General Format Identifier can be coded 0001 for modulo 8 or to 0010 for modulo 128. See the CCITT X.25 Recommendation for details.

Clear Confirmation Packet Format

General Format ID	Logical Channel Group
Logical Channel Number	

Packet Type Identifier							
0	0	0	1	0	1	1	1

Calling DTE Address Length	Called DTE Address Length
Called DTE digit-1	...
Callled DTE digit-*n*	Calling DTE digit-1
Calling DTE digit-2	...
Calling DTE digit-*n*	0* 0 0 0

Facility Length
Facilities
...

Bit	7	6	5	4	3	2	1	0

*Semi-octet of zeroes is present only if combined total digits in DTE address block is odd

APPENDIX D

X.3 PAD Parameters

X.3 PAD parameters set the guidelines for how the PAD deals with different terminal emulations. You use X.3 PAD parameters to control such features as local echo and line feed insertions after carriage returns, to enable local editing, and to determine what service signals are forwarded to the user.

X.3 PAD Parameter Support

There are 22 standard X.3 PAD parameters that are recognized internationally. These parameters and the functions they control are described later in this section. There also exist national X.3 PAD parameters numbered higher than 22, but their definition varies from country to country. The Eiconcard Host PAD and Eiconcard Terminal PAD do not support these national parameters.

You should be aware that each of the 22 international X.3 PAD parameters has both mandatory and optional values. The Eiconcard Host PAD and Eiconcard Terminal PAD support all mandatory values (as defined in CCITT Recommendation X.3, 1984); they also support many of the optional parameter values. Network support, however, will vary. Consult your network manager for specifics.

How to Set X.3 PAD Parameters

There are several ways to set X.3 PAD parameters. You can set them using `tpadcfg` or `tpadprof` with the Eiconcard Terminal PAD, or using the Linux `stty` command with the Eiconcard Host PAD.

The initial values for the Eiconcard Terminal PAD are setup using either `tpadcfg` or `tpadprof`. The Eiconcard Host PAD initial values are set in the device configuration entry in the */etc/gettydefs* file.

X.3 PAD Parameters

The table below shows the CCITT PAD Parameters.

Number	Description
1	PAD recall using a character
2	Echo
3	Selection of data forwarding character
4	Selection of idle timer delay
5	Ancillary device control
6	Control of PAD service signals
7	Operation on receipt of break signal
8	Discard output
9	Padding after carriage return

Number	Description
10	Line folding
11	Binary speed of start-stop mode DTE
12	Flow control of the PAD
13	Linefeed insertion after carriage return
14	Padding after linefeed
15	Editing
16	Character delete
17	Line delete
18	Line display
19	Editing PAD service signals
20	Echo mask
21	Parity treatment
22	Page wait

X.3 PAD Parameters

This section describes all 22 international X.3 PAD parameters in numerical order, together with the functions they control. All parameters and their possible values are decimal numbers.

ASCII control characters (ASCII characters 0 through 31) are entered as key sequences, such as **Ctrl-P**. A table of ASCII control characters, their keyboard entry sequences, and their common mnemonic references appear in X.25 User-Facility Support and Code References on page 61.

Certain X.3 PAD parameters can be coded as the sum of their listed values. This allows you to specify several values simultaneously. Parameter 7, for example, which deals with response to a break signal, has a default value of 21. This is the sum of three of the previous values: 1 (send an interrupt packet), 4 (send an indication of a break), and 16 (discard data). The X.3 PAD parameters that can be coded this way are parameters 3, 6, 7, 13, and 20.

1:*n* Escape from data transfer

When you send or receive data, this parameter allows you to escape from Data Transfer mode (Terminal mode) and enter Command mode. Flow of data from the network is temporarily suspended.

Value	Description
0	No escape allowed
32-126	Escape is possible by typing the ASCII character represented by the number *n*
1	Escape from data transfer using **Ctrl-P**

2:*n* Echo

This parameter provides for all characters to be echoed on your screen in data and command mode as well as to be forwarded to the remote device.

Value	Description
0	No echo
1	Echo

3:*n* Selection of data forwarding signal

This parameter defines sets of characters that act as data forwarding signals.

Value	Description
0	No data forwarding character
1	Alphanumeric characters (A - Z, a - z, 0 - 9)
2	Character CR
4	Character ESC, BEL, ENQ, ACK
8	Character DEL, CAN, DC2
16	Character ETX, EOT
32	Character HT, LF, VT, FF
64	All other characters: ASCII 0 to 31

Coding of parameter 3 can be a single value or the sum of any combination of values listed above. A useful combination would be value 126, which is the sum of the values 2 through 64 (2+4+8+16+32+64 = 126). This would allow you to use any control character as the data forwarding signal.

Note: These characters are included in the forwarded data packet.

4:*n* Selection of idle timer delay

This parameter specifies the value of an idle timer used for data forwarding.

Value	Description
0	No data forwarding on time-out
1-255	Units of 1/20 second, maximum 255

5:*n* Auxiliary Device Control

This parameter was originally designed to give control of the data flow to the PAD when it was dealing with high-speed input devices which could overflow its processing capacity. This is no longer necessary, since PADs provide buffering services automatically.

Value	Description
0	No use of DC1 (X-ON) and DC3 (X-OFF) for auxiliary devices or intelligent terminals

6:*n* Control of service signals

This parameter determines whether or not PAD service signals are to be transmitted by the PAD to the DTE (terminal). It also governs the use of Extended Service Signals, as well as the language in which service signals are displayed.

Note: For Extended Service Signals to be available, you must specify the languages you want to use.

Value	Description
0	No service signals transmitted to the terminal.
1	All Standard Service Signals other than the prompt are transmitted to the terminal.
4	Only the prompt signal is transmitted to the terminal.
5	All Standard Service Signals are transmitted to the data terminal, plus the prompt signal (4 + 1).
16	Extended Service Signal support for English. No service signals displayed (Base value).
17	Extended Service Signals in English with all service signals other than the prompt (16 + 1).
21	Extended Service Signals in English with all service signals, plus the prompt (16 + 4 + 1).
32	Extended Service Signal support for French. No service signals displayed (Base value).
33	Extended Service Signals in French with all service signals other than the prompt (32 + 1).
37	Extended Service Signals in French with all service signals, plus the prompt (32 + 4 + 1).

7:*n* Procedure on receipt of break signal

This parameter specifies the operation upon entry of a break character.

Value	Description
0	Nothing
1	Send an interrupt packet
2	Send a reset packet
4	Send an indication of break
8	Escape from data transfer state
16	Discard output
21	Send an interrupt packet, send an indication of break, and discard output (16 + 4 + 1)

Coding of parameter 7 can be a single value or the sum of any combination of values listed above. The default value (21) is the sum of 16 + 4 +1.

8:*n* Discard data

Value	Description
0	Normal data delivery to terminal
1	Discard pending data

This parameter allows the PAD to discard data. It is permanently set to 0 (normal delivery to terminal) and cannot be directly modified, even in Command mode. You can, however, arrange for data to be discarded after a break signal if you set X.3 parameter 7 to 16.

9:*n* Carriage return padding

This parameter provides for the automatic insertion of a time delay referred to as a padding character into the character string after a carriage return. This allows for a printing mechanism to perform the carriage return function properly.

Value	Description
0-31	A value from 0 to 31 indicating the number of padding characters to be inserted after a carriage return
2	Insert 2 padding characters after a carriage return

10:*n* Line folding

This parameter determines the maximum number of characters that can be printed or displayed on each line on your terminal. If more characters are entered, a new line will be started automatically.

Value	Description
0	No line folding
1-255	Line folding after n characters

11:*n* Communication speed

This parameter originally specified the speed of data transmission. You can set it to one of the values below if you are dealing with a host computer that needs to check this parameter when you first connect. However, this is a formality and will not affect the speed of your X.25 link.

Value	Description
0	110 bits/second
1	134.5 bits/second
2	300 bits/second
3	1200 bits/second
4	600 bits/second
5	75 bits/second
6	150 bits/second
7	1800 bits/second
8	200 bits/second
9	100 bits/second

Value	Description
10	50 bits/second
11	75/1200 bits/second
12	2400 bits/second
13	4800 bits/second
14	9600 bits/second
15	19200 bits/second
16	48000 bits/second
17	56000 bits/second
18	64000 bits/second

12:*n* Flow control of the PAD by the workstation

This parameter allows for flow control of received data using X-ON and X-OFF characters. The X-ON character is DC1 (**Ctrl-Q**) and the X-OFF character is DC3 (**Ctrl-S**).

Value	Description
0	No use of X-ON and X-OFF
1	Use of X-ON and X-OFF

13:*n* Line Feed insertion after Carriage Return

This parameter instructs the workstation to routinely insert a Line Feed (LF) into the data stream after each appearance of a Carriage Return (CR) character.

Value	Description
0	No LF insertion
1	Insert a LF after each CR in the received data stream
2	Insert a LF after each CR in the transmitted data stream
4	Insert a LF after each CR in the echo to the screen

Coding of parameter 13 can be a single value or the sum of any combination of values listed above.

14:n Linefeed padding

This parameter provides for the automatic insertion of padding characters, by the PAD, to allow for a time duration delay after each linefeed character. This allows a printing mechanism to correctly perform a line feed.

Value	Description
0-15	Any number from 0 to 15, which indicates the number of padding characters to be inserted after a linefeed
0	No padding characters inserted

15:*n* Editing

This parameter allows you to perform local editing after a connection is made with the host. If you enable local editing (set parameter 15 to 1), you can correct any data buffered locally, rather than sending it across the network to the host for later correction. When local editing is allowed, the workstation monitors for characters which have been assigned per 16 (Character delete), 17 (Line delete), and 18 (Line redisplay).

Local editing cannot be enabled unless the idle timer (parameter 4) is set to 0.

Value	Description
0	No editing in the data transfer state
1	Editing in the data transfer state

16:*n* Character delete

This parameter lets you specify which ASCII character will delete the previously typed character from the buffer (provided local editing has been enabled).

Value	Description
0	No character delete
1-127	Character-delete character
127	Character delete with DEL

17:*n* Line delete

This parameter lets you specify which ASCII character will delete the previously typed line from the buffer (provided local editing has been enabled).

Value	Description
0	No line delete
1-127	Line-delete character
24	CAN (**Ctrl-X**) serves as line-delete character

18:*n* Line redisplay

This parameter lets you specify which ASCII character will redisplay the previously typed line (provided local editing has been enabled).

Value	Description
0	No line redisplay
1-127	Line-redisplay character
18	DC2 (**Ctrl-R**) is line-redisplay character

19:n Editing service signals

This parameter specifies what service signal to send to the terminal once the editing functions described by Character Delete, Line Delete, and Line Display characters (parameters 16, 17, and 18).

Value	Description
0	No service signal
1	Display "\" for each deleted character; display "XXX" for each deleted line
2	Display <BS><SP><BS> for each deleted character and for each subsequent character on the same line that is deleted
8	Backspace character will be the editing service signal
32-126	The character specified will be the editing service signal

20:*n* Echo mask

This parameter specifies the characters from the workstation for which the PAD is to echo back to the DTE (terminal). The echo mask applies only when parameter 2 (echo) is set to 1.

Value	Description
0	No Echo mask (all characters echoed)
1	No echo of character CR
2	No echo of character LF
4	No echo of characters VT, HT, FF
8	No echo of characters BEL, BS
16	No echo of characters ESC, ENQ
32	No echo of characters ACK, NAK, STX, SOH, EOT, ETB, ETX
64	No echo of editing characters as designated by parameters 16, 17, and 18
128	No echo of all other ASCII control characters (0-31) not mentioned above, and the character DEL (ASCII character 127)

Coding of parameter 20 can be a single value or the sum of any combination of values listed above. If parameter 5, 12 or 22 is set to a non-zero value, then X-ON (DC1) and X-OFF (DC3) are not echoed.

21:*n* Parity treatment

Value	Description
0	No parity checking or generation

Not necessary for a software PAD, since an asynchronous signal is not being generated. Parameter 21 is permanently set to 0 and does not influence parity.

If your application generates parity signals, however, then the PAD will also generate them and will incorporate them into the packets it transmits. In this case the PAD will also remove parity signals from incoming packets before sending the data to your application.

22:*n* Page wait

The workstation will be able to suspend the transmission of additional characters after a specified number of linefeeds have been received. No further data will be transmitted until the page wait condition is canceled.

Value	Description
0	Page wait disabled
1-255	Page wait condition after *n* linefeed characters are received by the workstation

The workstation will cancel the page wait condition and resume normal transmission on receipt of an X-ON character (**Ctrl-Q**).

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