Solstice X.25 9.2 Administration Guide

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Preface

This guide covers the configuration, use, and troubleshooting of Solstice™ X.25 9.2. It also provides reference material. This guide does not cover the installation and licensing of Solstice X.25 9.2. For this, refer to the *Solstice X.25 9.2 Installation Guide and Release Notes*. It also does not cover the use of the Packet Assembler/Disassembler delivered as part of the product. For this, refer to the *Solstice X.25 9.2 PAD User's Guide*.

How This Book Is Organized

Chapter 1, provides an overview of the Solstice X.25 9.2 product.

Chapter 2, provides background information on the X.25 Recommendations.

Chapter 3, covers points to consider when planning your configuration.

Chapter 4, introduces the `x25tool` and provides a step-by-step example of a basic configuration.

Chapter 5, introduces the configuration files and provides a step-by-step example of editing the files to create a basic configuration.

Chapter 6, covers the configuration of the IP and PAD applications.

Chapter 7, provides reference information on all available parameters.

Chapter 8, contains descriptions of some common configurations.

Chapter 9, lists the available command line utilities.

Chapter 10, is a description of how to configure `uucp` and `tip` to run over X.25.

Chapter 11, contains information to help you deal with common problems.

Appendix A, describes the cables you will need.

Appendix B, lists the available keywords and parameters for the configuration files.

Appendix C, lists and explains error messages.

Appendix D, provides the information you need to manage Solstice X.25 using Domain Manager (formerly known as SunNet Manager).

Appendix E, provides the information you need to manage Solstice X.25 using SNMP agent.

Appendix F, provides the special information you will need if you require Solstice X.25 9.2 to co-exist on a network with SunNet X.25 7.0. (Solstice X.25 9.2 is already fully compatible with SunLink X.25 8.x and 9.0 and Solstice X.25 9.1.)

Glossary is a list of words and phrases found in this book and their definitions.

What Typographic Changes Mean

The following table describes the typographic changes used in this book.

TABLE P–1 Typographic Conventions

Typeface or Symbol	Meaning	Example
`AaBbCc123`	The names of commands, files, and directories; on-screen computer output	Edit your `.login` file. Use `ls -a` to list all files. `machine_name% You have mail.`
`AaBbCc123`	What you type, contrasted with on-screen computer output	`machine_name%` **`su`** `Password:`
AaBbCc123	Command-line placeholder: replace with a real name or value	To delete a file, type `rm` *filename*
AaBbCc123	Book titles, new words or terms, or words to be emphasized	Read Chapter 6 in *User's Guide*. These are called *class* options. You *must* be root to do this

CHAPTER 1

About Solstice X.25

The information in this section is specific to the Solstice X.25 9.2 product. For general X.25 information, refer to Chapter 2.

Overview

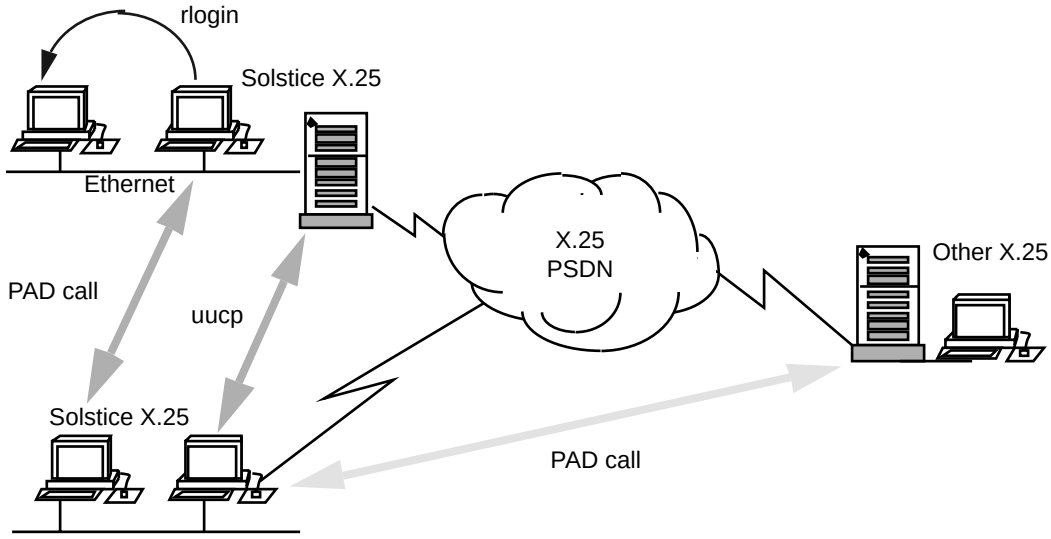

Figure 1–1 Solstice X.25 Overview

Solstice X.25 9.2 is an implementation of the ITU-T's (formerly CCITT) X.25 Recommendations, together with some other, related software. Using Solstice X.25 9.2,

you can make connections to a Packet Switched Data Network (PSDN), and connect to remote devices that are running any standard-compliant implementation of X.25.

Figure 1–1 shows some of the ways you can use Solstice X.25 to make connections with remote devices:

- PAD calls from Sun workstations running Solstice X.25 to Sun workstations and servers running Solstice X.25, and to remote systems running other implementations of X.25.
- PAD calls from one X.25 device to another, from where the user can `rlogin` to a non-X.25 IP host.
- `uucp` connections with remote X.25 devices.
- IP routed between TCP/IP networks.

Note - All of the connections shown in the diagram are made across the X.25 PSDN.

Solstice X.25 9.2 Features

This section summarizes the features provided by Solstice X.25 9.2.

New in this Release

Solstice X.25 9.2 offers the following new features:

- Updated software which now runs in either 64bit or 32bit mode.
- New LLC2 module which handles LAN plumbing and PPA assignment for applications which run directly over LLC2.
- The ability to specify the name of a a file containing PAD commands when using the `pad` command.

Feature Summary

In addition to the new features added to the current release, Solstice X.25 offers the following features:

- A user-friendly GUI based on Motif.
- HTML-based on-line help that provides `x25tool` specific information.
- A PAD Printer which makes it possible to print locally while logged in to a remote terminal.

- A Call Filtering module filters incoming calls based on specific criteria which are then stored in a configuration file. The criteria you can specify include X.121 address, time of day, call user data.
- The software allows for a total up to 32,763 virtual circuits distributed over any number of links (with a maximum of 4096 virtual circuits on any one line). Machine resources and the configuration of your X.25 network may constrain you to a smaller number.
- Maximum data rates of:
  - 2.048 Mbits per second on one HSI port
  - 1.544 Mbits per second on two HSI ports
  - 19.2 Kbits per second on SPARCstation CPU ports
- X.29 packet-mode host (PAD daemon) and X.3/X.28 virtual terminal (PAD) support.
- Encapsulation of IP packets in X.25 packets, as defined in RFC 1356.
- Address Extension Facility (AEF) for running OSI over X.25.
- Standard configuration file templates for major PSDNs.
- Domain Manager agent (formerly known as SunNet Manager agent).
- Security mechanism (through full or partial address specification) for incoming calls to PAD daemon.
- APIs: STREAMS-based Network Layer Interface and sockets module for backward compatibility with SunNet X.25 7.0.
- The X.25 Packet Layer includes:
  - Extended packet sequence numbering.
  - Large flow control windows (up to 127 packets) and large packet sizes: up to 1024 bytes over 1980-compliant X.25 networks, and up to 4096 bytes over 1984 and 1988 X.25 networks.
- Basic and extended frame sequence numbering for LAPB (1984 and 1988).
- ISO 8208 for DTE-to-DTE operation.
- LLC2 for running X.25 over a LAN (802.x or FDDI)
- Reverse charging, RPOA selection, flow control parameter negotiation, CUG selection, throughput class negotiation, and fast select on a per-call basis.
- Multiple physical links per system. You can have as many connections as serial ports and other resources allow.
- MultiLink Procedure enables more than one physical interface to be used to connect a DTE and a DCE. This allows load sharing and link failure recovery.
- The Data Link Provider Interface (DLPI) is a standard way of writing application programs directly above the datalink layer.

- A client-only implementation of X.32, which provides authentication and is most useful for dial-up calls.
- V.25*bis* allows Solstice X.25 to be used in dial-up configurations.
- Routing (automatic link selection) among multiple links.
- Configuration files. You can also configure Solstice X.25 9.2 by editing the configuration files delivered with the product. This allows users who do not have access to a Graphical User Interface such as the OpenWindows or Motif environments to carry out a full configuration of the X.25 software.
- The ability to connect to the Defense Data Network via X.25 Standard and Basic Service.

Components of the Solstice X.25 9.2 Product

The Solstice X.25 9.2 product contains the following components:

X.25 Packet Layer	Layer 3 of the ITU-T X.25 Recommendation is known as the X.25 Packet Layer. Sometimes this is shortened to just X.25.
LLC2	Logical Link Control Class 2. This provides the datalink layer for 802 LANs, such as Ethernet, Token Ring and FDDI.
LAPB	Link Access Procedure Balanced. This provides the datalink layer over WAN interfaces.
MLP	MultiLink Procedure. This provides the datalink layer allowing a DTE and a DCE to connect using more than one WAN interface.
EXPX	The driver for the SCiiExpress-X card used by the x86 version of the product.
Loopback	The driver for the loopback interface.
XTY	A pseudo-device that lets applications access the PAD software to make outgoing calls.
PAD Software	The Packet Assembler/Dissassembler software. This allows you to make PAD calls to remote machines that are running X.25.
PAD Daemon	The software that listens for incoming PAD calls and determines how they are to be treated.

PAD Printer	Printing is routed through an X.25 server, making it possible for a user to print to the local printer even if the user is logged in remotely.
XXX	The three ITU-T software implementation recommendations —X.3, X.28 and X29— that control operation of the PAD. They are often referred to as the triple X standards.
IXE	Software providing an interface between IP, the Internet Protocol and the X.25 Packet Layer.
Domain Manager Agent	The Domain Manager agent (formerly known as SunNet Manager agent) allows access to the MIB through the RPC protocol.
SNMP Agent	The Simple Network Management Protocol (SNMP) agent allows access to the MIB through the SNMP.
Call Filtering Module	This optional facility enables the X.25 administration software to define a list of authorized remote stations.

The Solstice X.25 9.2 product, together with the software provided with the Solaris 2.x operating software, is enough to make full use of the facilities offered by X.25. You can also interwork with the other Sun products shown in Figure 1–2.

Standards Support

The X.25 Recommendations were first specified in 1976, and have subsequently been revised on a number of occastions. It is common to refer to versions of the X.25 Recommendation by the year in which they were issued—for example X.25(1984). The 1980, 1984 and 1988 versions are the most widely used.

Solstice X.25 supports the following features from the 1984 and 1988 X.25 recommendations:

- optional user facilities:
  - extended packet sequence numbering
  - one-way incoming and one-way outgoing logical channels
  - non-standard default packet and window sizes
  - default throughput classes assignment
  - flow control parameter negotiation
  - throughput class negotiation

    - CUG-related facilities
    - bilateral CUG-related facilities
    - fast select and fast select acceptance
    - reverse charging and reverse charging acceptance
    - local charging prevention
    - charging information
    - RPOA selection
    - incoming and outgoing calls barred
    - called line address modified notification
    - call redirection notification
    - call deflection
    - transit delay selection and indication
    - TOA / NPI address format
    - Network User Identifier (NUI)
    - protection
    - priority
- permanent virtual circuits
- two-way logical channels
- called and calling AEF
- expedited data negotiation
- minimum throughput class
- user data on Accept and Clear with Fast Select
- non-X.25 facilities (in Call Request and Call Accepted packets)
- programmable facilities field
- up to 32 bytes of interrupt data
- up to 109 bytes of facilities in Call Request and Call Accepted packets
- DTE-originated cause codes
- MLP

Solstice X.25 does not support:

- on-line facility registration
- the hunt group facility

How Solstice X.25 9.2 Interworks With Other Sun Products

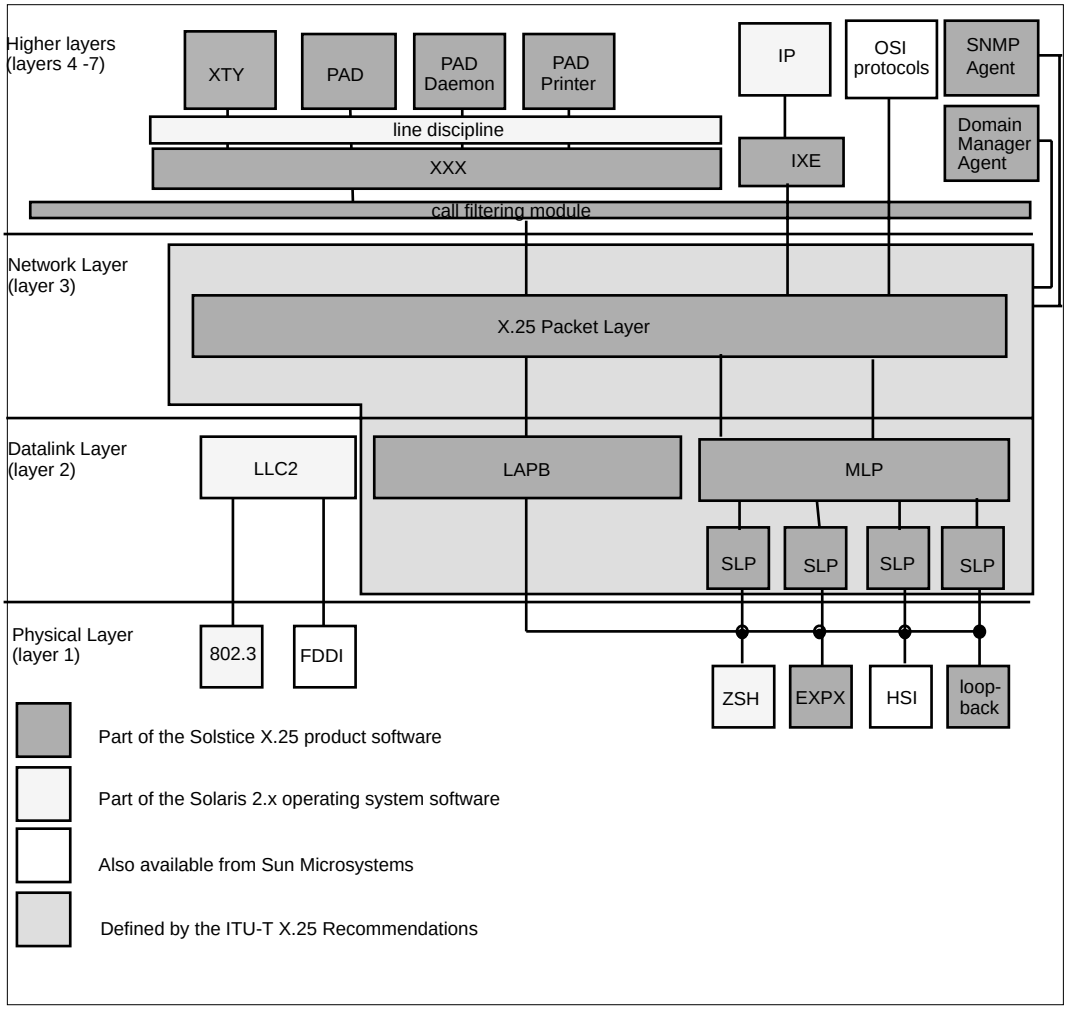

Figure 1–2 How Solstice X.25 Interworks With Other Sun Products

Solaris System Software used with Solstice X.25

The Solstice X.25 9.2 product can be used in conjunction with the following software that is supplied as part of the Solaris 2.x system software:

IP — The Transmission Control Protocol/Internet Protocol. The TCP/IP protocol suite is the de facto standard for networking. IP, the Internet Protocol, can be run above X.25, creating a Wide Area Network using TCP/IP. This allows for the use of `rlogin`, `ftp` and other useful facilities. The TCP/IP protocol suite is delivered as part of the Solaris system software

Line Discipline — The standard STREAMS line discipline modules.

802.3 — The Ethernet interface.

ZSH — The onboard serial port of a Sun workstation.

Products that Interwork with Solstice X.25

Solstice X.25 9.2 forms part of a complete networking solution. As such, it interworks with other products—both from Sun and from other vendors. You can use the following software, available from Sun Microsystems, with the Solstice X.25 9.2 product:

OSI — You can run the OSI protocol stack, using the Solstice X.25 9.2 product as the bottom 3 layers.

FDDI — You can run Solstice X.25 9.2 on an FDDI network.

HSI — This is the High Speed Interface, available from Sun Microsystems. This provides four WAN interfaces and allows for higher speeds and better performance than the onboard serial port.

CHAPTER 2

About X.25

This section provides an overview of X.25 concepts. None of the information in this chapter is specific to Solstice X.25 9.2—it applies to any implementation conforming to the X.25 Recommendations. Understanding the concepts explained here will help you make better use of the Solstice X.25 9.2 product.

Refer to Chapter 1 for an overview of Solstice X.25 9.2.

The X.25 protocol suite enables the exchange of data between X.25 systems across Packet Switched Data Networks (PSDN), and Local Area Networks. Systems running one implementation of X.25, for example Solstice X.25, can exchange data with systems running any other implementation of X.25.

X.25 Overview

It is conventional to represent an X.25 network as a cloud, as in Figure 2–1.

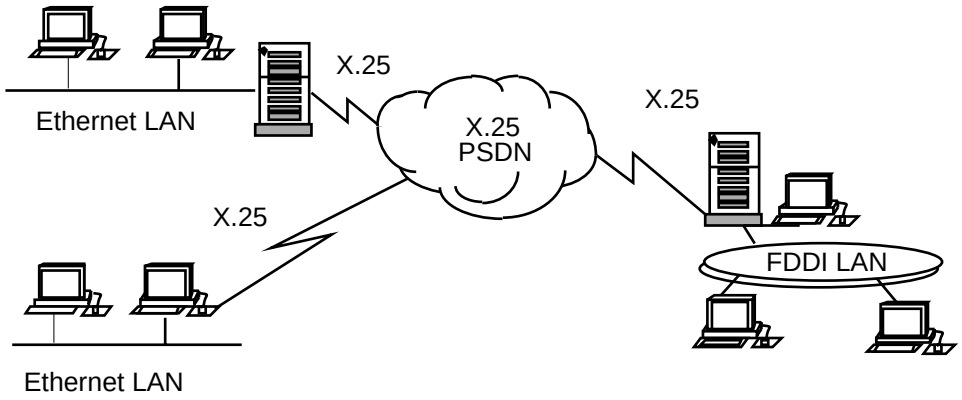

Figure 2–1 X.25 Overview

As Figure 2–2 shows, X.25 defines the way the interface between a system running X.25 (often referred to as a DTE) and a system providing a network connection (often referred to as a DCE) works. There is almost always a modem between the DTE and the DCE to handle the physical connection. However, this is transparent to X.25. X.25 does not define the means of transmission that should be used between the two DCEs.

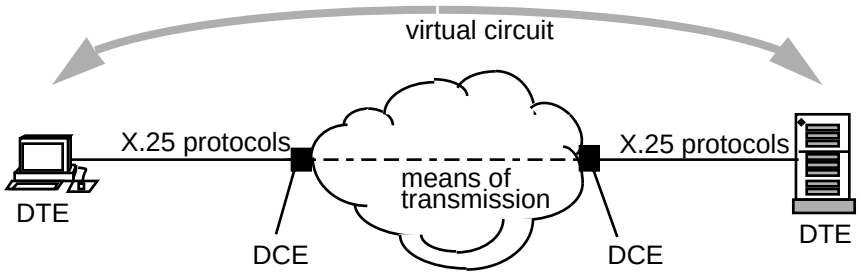

Figure 2–2 X.25 Detail

Dial-Up and Leased Lines

When connecting to a public network, for example one administered by a phone company, you must choose between using dial-up access and leased lines.

A leased line is a line allocated to you by the network's administration. You pay for exclusive use of this line and for it to be configured to your specification. You can only change the characteristics of this line in consultation with your network provider. For leased lines, the service provider typically provides a suitable modem for connecting your DTE to the network.

Dial-up access means that there is no particular line allocated for your use. When a DTE needs to access the public network, it uses a modem to place a call to the network. This means that there are no rental or set-up charges as there are with a leased line; charging is done on a per-call basis. Most dial-up services use the X.32 protocols to provide a degree of authentication, so the network knows the call is coming from an approved user.

Permanent and Switched Virtual Circuits

The end-to-end (DTE to DTE) connection provided by the X.25 Recommendations is called a virtual circuit. This is *not* a physical connection between the DTEs; it is a *logical* communication path. Public networks offer two types of virtual circuit—permanent and switched. Typically a subscription consists of a mixture of the two.

A permanent virtual circuit (PVC) is a permanent association between two DTEs that is established when a user subscribes to a public network. Many providers charge a flat rate per month for a PVC in addition to the charge per unit of data.

A switched virtual circuit (SVC) is a temporary association between two DTEs that exists only for the duration of a call. Most providers charge per minute for an SVC in addition to a charge per unit of data.

In general, SVCs are less expensive than PVCs unless two end-points need to be in constant communication, but this varies between providers depending on their tariff structure.

SVCs and PVCs can both be used across both dial-up and leased lines. However, using a PVC with a dial-up line is unlikely to be useful.

The X.25 Recommendations

X.25 is defined in a series of documents issued by the International Telecommunication Union—Telecommunication Standardization Sector. These documents are called the X.25 Recommendations and specify the following:

- X.25 Physical Layer
- X.25 Datalink Layer - LAP, LAPB and MLP
- X.25 Packet Layer Protocol

The component layers of X.25 fit together as shown in Figure 2–3:

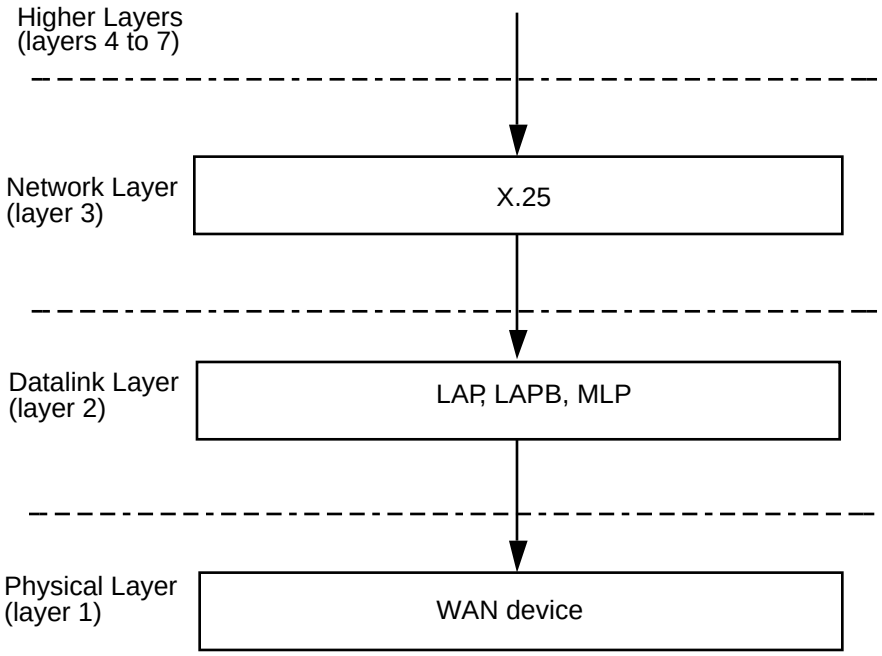

Figure 2–3 X.25 Protocol Layers Overview

X.25 Physical Layer

As with any protocol stack, the physical layer specifies the mechanical, electrical, functional, and procedural characteristics that are necessary to activate, maintain, and terminate a physical connection between the DTE and DCE.

The ITU-T X.25 Recommendation does not itself specify how the physical layer should work. Instead, it refers to other ITU-T Recommendations, and specifies which of these may be used. The Recommendations specified are: X.21, X.21 bis, X.31 and the V-series interfaces, that is V11, V24 and V25bis.

Electronic Industries Association (EIA) specifications are often compatible with the V-series interfaces and can be used with X.25. The chart below lists equivalent standards.

TABLE 2–1 ITU-T V-series and Equivalent EIA Inferfaces

ITU-T	Equivalent EIA
V24, V28	RS232, RS423
V11	RS449

X.25 Datalink Layer

The *datalink layer*'s role is to specify the link access procedure for the exchange of data across the physical link. This layer must ensure that all data transmitted at one end of a link reaches the other end intact.

This means that as well as mechanisms for transmitting data, the datalink layer must provide ways of telling whether data has reached its destination correctly, and retransmitting if it has not.

The X.25 Recommendation defines two possible datalink layers: LAP and LAPB. In practice, LAP is rarely used. A Multilink Procedure (MLP) allows for multilink operations. It is used along with LAPB.

Single Link Operations

Figure 2–4 shows the standard frame structure for a bit-oriented datalink layer frame. The shaded parts are supplied by the datalink layer. The Data field contains the data supplied by higher layer protocols. Sizes are given in octets

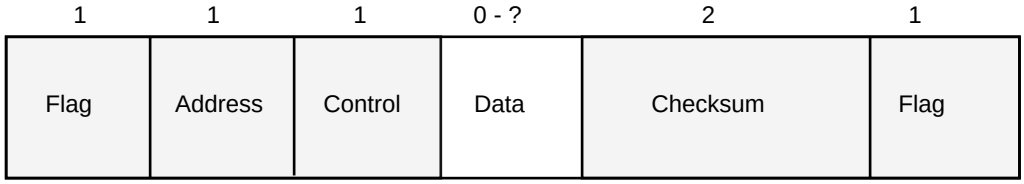

Figure 2–4 Datalink Layer Frame Structure

Datalink layer frames are structured as follows:

Flag Frames are delimited at each end by a flag, with the value 01111110. This is necessary because X.25 is synchronous -

	in other words, data is transmitted as a continuous stream.
Address	This is one octet. The value varies, depending on the direction of data flow, and on whether this is a single or multilink operation.
Control	The control octet define the type of frame this is: an I(nformation)-frame containing data, a S(upervisory)-frame, which is a response frame, or an U(nnumbered)-frame, which performs control functions.
Data	The data field contains X.25 protocol information, as well as user data from higher layer protocols. A frame need not contain data.
Checksum	The two-octet checksum follows the data, and is derived from the contents of the data packet. It is usually generated automatically by the hardware.

Multilink Operations

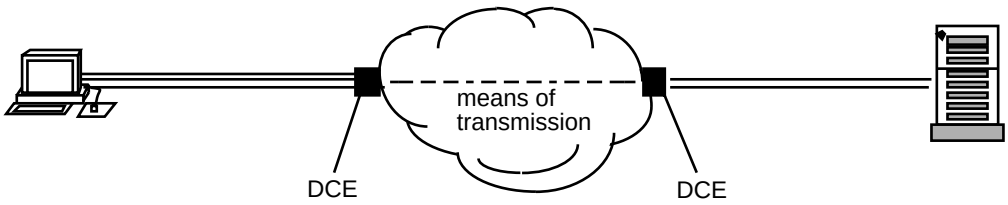

Figure 2–5 Multilink Operation

The Multilink Protocol (MLP) lets you use more than one *physical* connection to make a single *logical* connection. This increases the amount of bandwidth available between the DTE and DCE improving response times and increasing traffic levels. An MLP connection does not provide a multiple channel end to end connection to remote DTEs. Not all of the DTEs attached to the PSDN need to use MLP and not all DTEs need to use the same number of physical connections.

The internal structure of X.25 when using MLP is shown below:

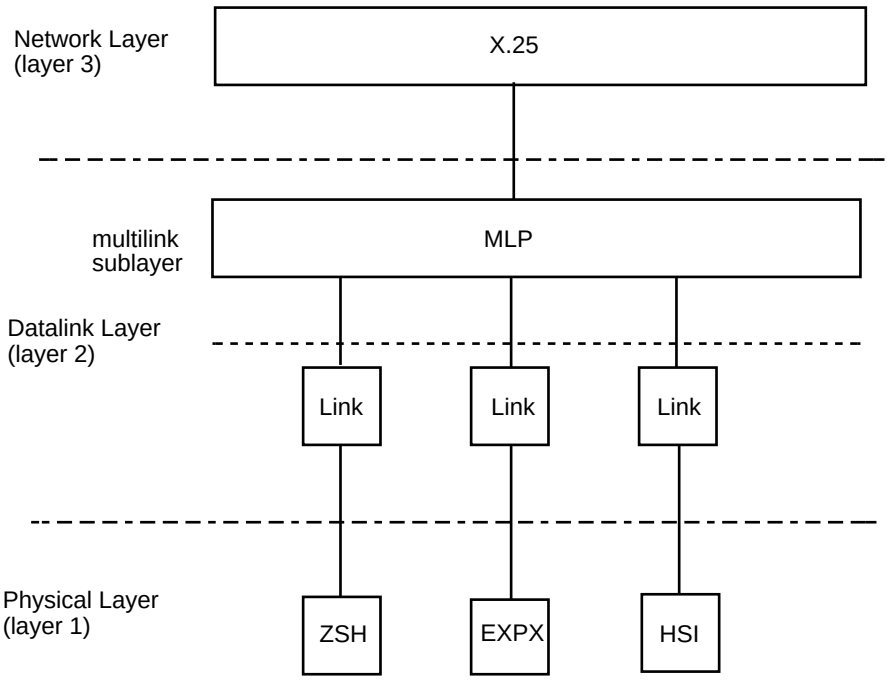

Figure 2–6 Internal Structure of X.25 When Using MLP

MLP frames have two additional octets placed between the control octet and the data. These octets enable each frame to have a sequence number so that it can be reassembled in the correct order at the receiving end. The two extra octets are not present in the standard datalink frame shown in Figure 2–4.

X.25 Packet Layer

Within layer 3, the Packet Layer Protocol manages the exchange of data packets between DTE and DCE. This layer establishes, maintains, and terminates user sessions, handles addressing and carries out fault-management.

The general format of an X.25 packet header is shown below:

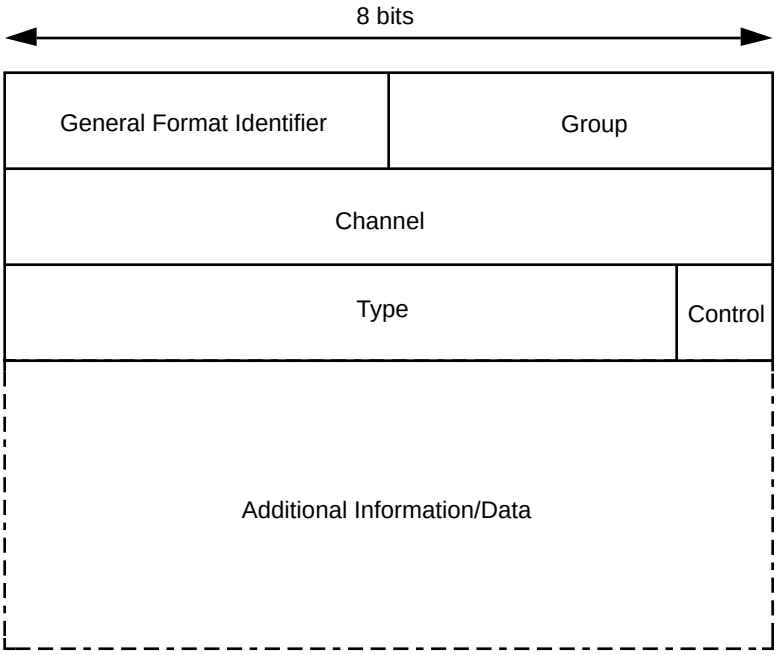

Figure 2–7 X.25 Packet Header Format

The components are:

General Format Identifier — This specifies the format of the rest of the header, which varies according to packet-type.

Group and Channel — Together, the Group and Channel fields identify the virtual circuit to be used for a call.

Type — In a control (non-data) packet, the type field identifies the type of the packet. In a data packet, the type field is used for setting flow control, sequencing, and piggybacking information.

Control — The Control field specifies whether this is a control or a data packet. It is set to 1 for control packets and 0 for data packets.

In data packets, the header is followed by data. In control packets, the header is followed by additional information that specifies, among other things, addressing and any special facilities that are to be used.

CHAPTER 3

Planning Your Solstice X.25 Configuration

Before you install and configure Solstice X.25 9.2, you need to decide how it will be used and how it will interact with other software present on your network.

Connecting to a Public Network

If you want to connect to a public network, for example one managed by a PTT, you need to provide the network administering body with information about the kind of connection and configuration you would like. Typically, when you contact the administering body, you are sent a network subscription form. Use this to specify what you want. Public networks vary in the services they offer and in the information they require. You may need to answer some or all of the following questions:

- Do you want a dial-up line or a leased line? Consider the tariff structure of the public network you are connecting to and how you want to use your network connection.
- Do you want a single connection or an MLP connection? You can only use MLP across a public network if you have subscribed to an MLP type line.
- What mix of Permanent and Switched Virtual Circuits do you need? A Permanent Virtual Circuit (PVC) is a permanent association between two specified end-points. A Switched Virtual Circuit (SVC) is a temporary association between two endpoints, established for the duration of a call. Compare the tariff structures for PVCs and SVCs before deciding how many of each you need. Some network providers charge a flat rate per month for PVCs and a charge per minute for SVCs, as well as a charge per unit of data on either type of virtual circuit. In general,

SVCs tend to be cheaper unless two end-points need to be in permanent communication, but this may not be true for all networks.

- What line speed would you like? This is worth investigating carefully, as line speed can have a significant impact on network performance and on the price you will pay for your connection. Consider factors such as the volume of data you expect to transfer, the level of interactive traffic, the type of virtual circuits you plan to have, the expected duration and frequency of connections, the types of modems you have available, and so on.
- What is the maximum size of Information Frame (I-Frame) you need? This must be larger than the maximum possible packet size on your network.
- How many times should a frame be retransmitted before an error is reported? A large value increases the chance of data getting through correctly. A small value allows fast detection of errors. The value you choose may also depend on whether or not the public network charges for each failure.
- What is the maximum packet size you require? In most cases, use of the default value of 128 is appropriate.
- What is the maximum window size you require? In most cases, use the default value of 2. A larger window size increases throughput but will probably also increase the cost.
- Which throughput class do you require? The throughput class determines the amount of resources allocated to a virtual circuit. It is determined by the line speed. The default value is 2.
- Do you need non-standard flow control? If you have chosen non-default packet and window sizes, you may need to use non-standard flow control.
- Do you want local or remote packet acknowledgment? Local packet acknowledgment is simpler, so use this, unless a particular application requires remote packet acknowledgment.

Connecting to a Private Network

If you are connecting to or creating a private network, you need to consider all of the issues described in “Connecting to a Public Network” on page 17, although cost is not an issue in this case. If you are creating a new network, you may find it simpler to use the default values provided by the Solstice X.25 9.2 software, at least in the beginning. You can fine-tune the configuration later.

Planning a Configuration to Run IP Over X.25

This section gives you an idea of how to plan a configuration to run IP over X.25, and to help you find the information you need to do so. *Internetworking with TCP/IP: Principles, Protocols, and Architecture*, by Douglas Comer, is a useful source of information on IP routing. The SunOS 5.0 manual Administering TCP/IP and UUCP also has information on routing that will help you to plan for your own particular system.

The following is a summary of what you need to do if you plan to use IP routing over X.25:

- Obtain and allocate IP addresses.

  Every IP network that you intend to connect with other IP networks must have a unique IP network number.

- Decide whether to use dynamic or static IP routing. You need to weigh the cost of running a dynamic routing protocol such as RIP across an X.25 connection, against the cost of network downtime caused by out-of-date static routing tables. This decision will be influenced by the size and complexity of your network, as well as by the importance of maintaining connections.

  If you decide to use dynamic routing, you need to initiate RIP, the Routing Information Protocol. This is provided in the file `in.routed`. The contents of the file are broadcast every 30 seconds. You can also use `gated`, if it is available on your system.

  A good compromise between using dynamic and static routing is to configure a static route to a routing gateway that is not attached to the X.25 network. The routing gateway can then handle the dynamic routing of traffic that does not need to cross the X.25 network.

  To look at the contents of the routing table, enter `netstat ---r`.

- Provide address resolution information, to allow IP addresses to be translated into X.25 addresses, and vice versa. You do this using the IP Interface Configuration window and the Remote Host to X.25 Address Map window. Both windows can be accessed through the Services menu in `x25tool`. You do not need to provide the address resolution information if you are connecting to the DDN. The DDN uses an automatic address translation mechanism, defined in RFC 1236.

CHAPTER 4

Configuring Solstice X.25 Using x25tool

This chapter describes how to access and use x25tool to configure X.25.

x25tool Overview

x25tool provides a graphical interface to the parameters required to configure and maintain the Solstice X.25 software. The parameters are contained in a set of configuration files which also can be edited directly. See Chapter 5, for more information.

Starting x25tool

To start x25tool with read and write permission, log in as root or become superuser, and type:

```
hostname# /opt/SUNWconn/bin/x25tool
```

Note - Starting x25tool without root permission gives you read-only access.

Using x25tool

When you start x25tool, the main window appears. The top of the window provides menu options for configuring X.25. Directly underneath the menu is a list of currently configured links.

The lower half of the window displays output messages. For example, when you start or stop a link, information is displayed in the output window.

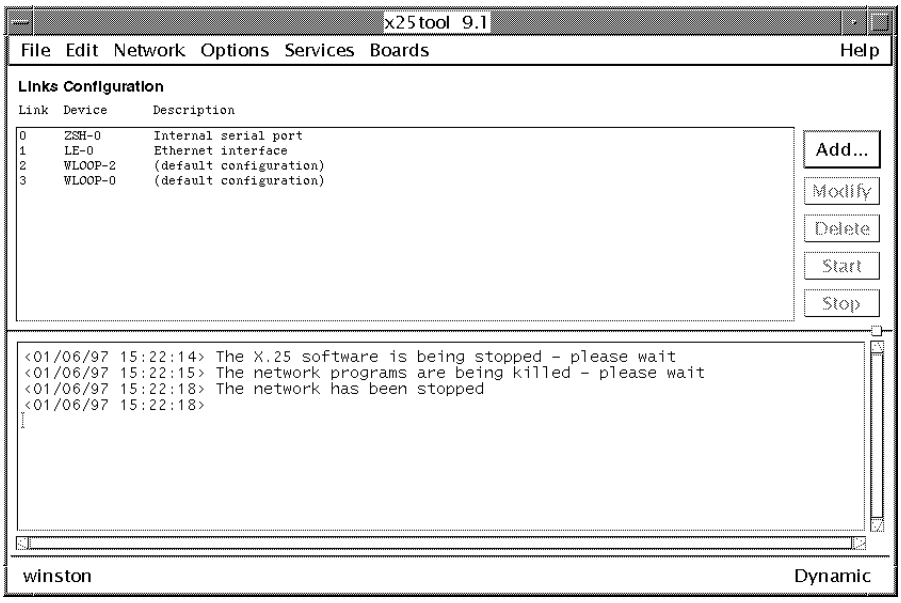

Figure 4–1 x25tool Main Window Overview

To select an item in x25tool, position the mouse cursor on the item and click the left mouse button.

Note - If you move the mouse cursor into the output window and click on the right mouse button, you will see a pop-up window for saving or clearing the output.

Some menu options are “yes/no” options; the menu contains a list of items. Click on the box next to an item to select or unselect it. A shaded button indicates that the option is currently selected.

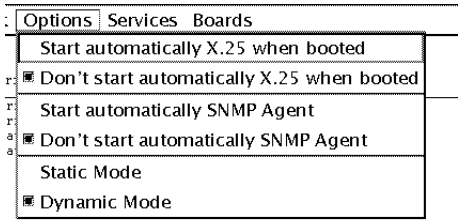

Figure 4–2 Selecting an Option

Some menu options are associated with pop-up windows:

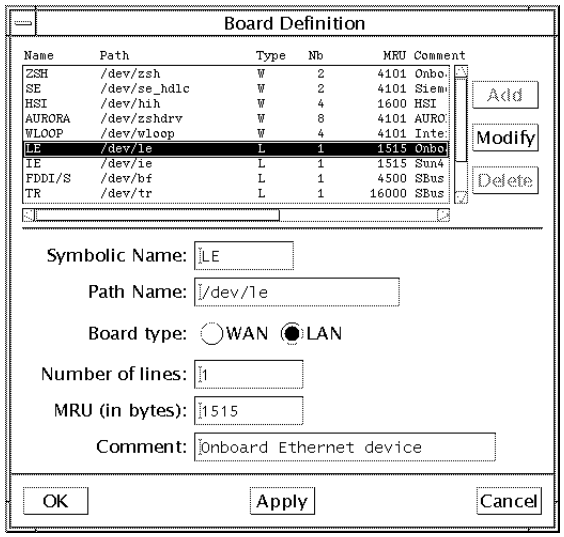

Figure 4–3 A Menu Option Associated with a Pop-Up Window

There are various ways to enter information. You may need to type the information in directly, select the information from a list, or click on a button to access additional parameters in another window.

Updating the Configuration

Once you have made changes and are ready to exit the window, you have three options: OK, Apply, or Cancel.

- OK updates the changes you have made and dismisses the window.
- Apply updates the changes, but does not dismiss the window.
- Cancel discards the changes you have made and dismisses the window.

Dynamic Mode and Static Mode

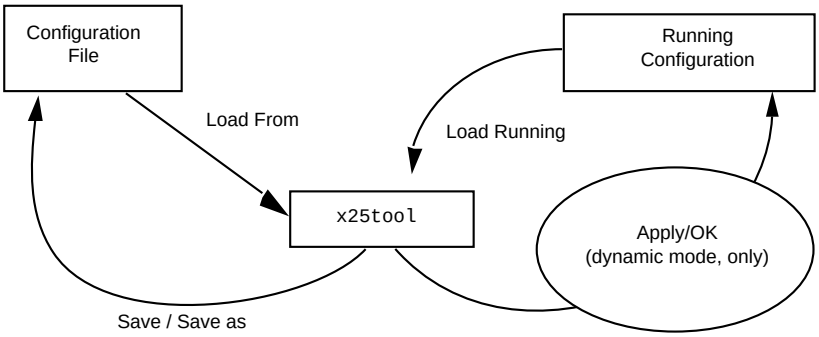

Figure 4–4 Updating the Network Configuration

The `x25tool` runs in one of two modes: *dynamic* and *static*. Which mode you use affects how modifications to the configuration are handled.

To set the mode, select Options from the `x25tool` menu and click next to the mode in which you want to run `x25tool`.

If you run `x25tool` in *dynamic* mode, when you click on OK or Apply, all the modifications are transmitted to the protocol stack that is currently running on the machine, but are not permanently stored to the configuration files.

If you run `x25tool` in *static* mode, any modifications you make will not be applied to the currently running configuration. If you want to transmit the modifications to the currently running protocol stack, you must first save the configuration modifications using File ⇒ Save, or File ⇒ Save As, then select Network ⇒ Stop X.25 or Network ⇒ Start X.25.

Note - In both dynamic and static modes, the configuration modifications are not automatically saved. If you want to store the configuration to use the next time you start the network, you must use File ⇒ Save, or File ⇒ Save As.

---

x25tool Menu Items

File

Save

Save changes to the default configuration files. When you click on Save, a window displays a list of settings (IP Configuration, Link #, PAD Host Database, etc.) and you can choose which settings you want to save to the default configuration. By default, all modified items are listed under Save.

Save as

Save changes to a named configuration. You might want to keep a backup, for example, or create a template configuration suitable for your particular network.

As with the Save option, you can choose which information to save to the configuration files.

Load from

This lets you load different configuration information into `x25tool` from a previously saved configuration.

Load running

This lets you load configuration information related to links, routing, and NUI mapping, from the X.25 session currently running into `x25tool`.

Exit

Exit `x25tool`.

Edit

Add Link

When you select Add Link, a list of configuration templates is displayed. Choose the template that most closely matches your configuration needs (e.g. TELENET, TRANSPAC, or TYMNET) or choose the Default. The Link Editor window will appear. You can then add a new link and configure it.

Modify Link

Lets you modify the link that is currently selected in the Links Configuration list by bringing up the Link Editor window. (Alternatively, you can double-click on the link to bring up the Link Editor window.) You can then modify the selected link.

Delete Link

Deletes the link that is currently selected in the Links Configuration list.

Note - The link must not be running when you delete it. See “Stop Link” on page 31, for more information.

Copy Link

Copies the link configuration information for the link that is currently selected in the Links Configuration List. You can only copy configuration information for one link.

Paste Link

Pastes the most recently copied configuration information of a single link into the Link Editor window.

Link Editor

When you choose Edit ⇒ Add to add a link, or Edit ⇒ Modify to modify an existing link, (see “Add Link” on page 26 and “Modify Link” on page 26 for more information), the Link Editor pop-up window will appear. The Link Editor window contains the options you need to configure the link.

The Link Editor is divided into three rows which correspond to the three lowest layers of the OSI seven-layer model. The top row contains the layer one physical

parameters; the middle row contains the layer two frame parameters, and the bottom row contains layer three packet parameters.

The Link Editor window is also arranged so that the left side contains the more basic parameters used to configure a link. In most cases, these parameters are all you need, but the buttons on the right side of the Link Editor will take you to the Advanced Configuration windows. You can use the parameters in these windows to further fine-tune the link configuration.

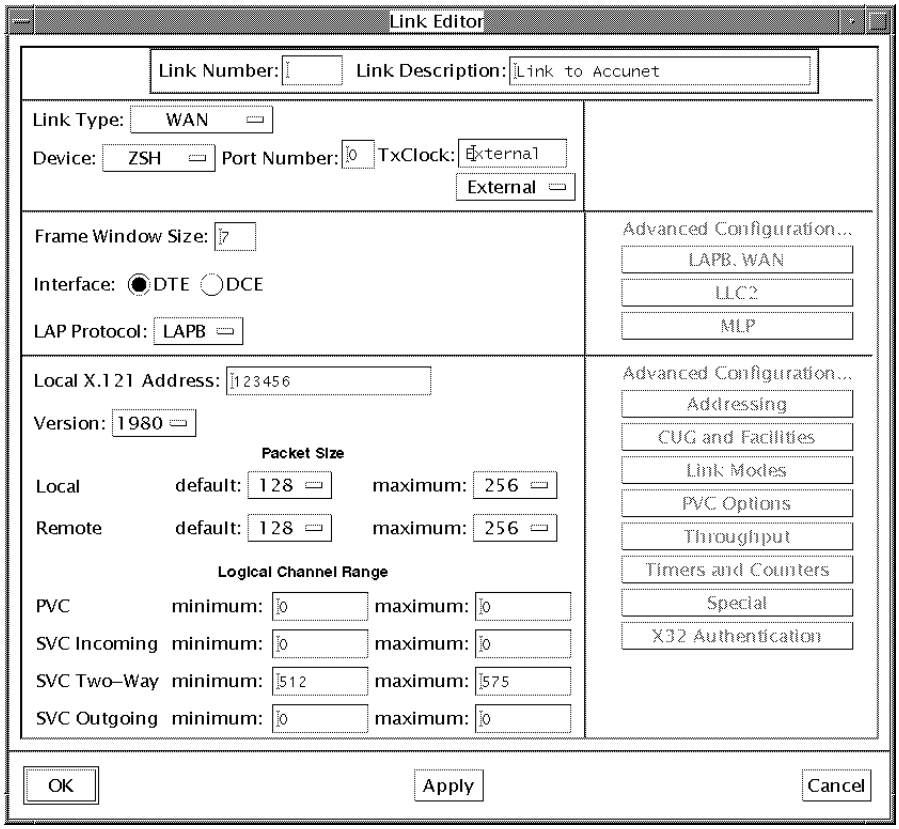

Figure 4–5 Link Editor Window

Network

Start X.25

Starts the Solstice X.25 network.

Stop X.25

Stops all the daemons associated with the X.25 system software.

Statistics X.25

Gathers and displays statistics on traffic. When you select this option, a pop-up window will appear. The options displayed in this window let you determine the kind of statistical information to be generated:

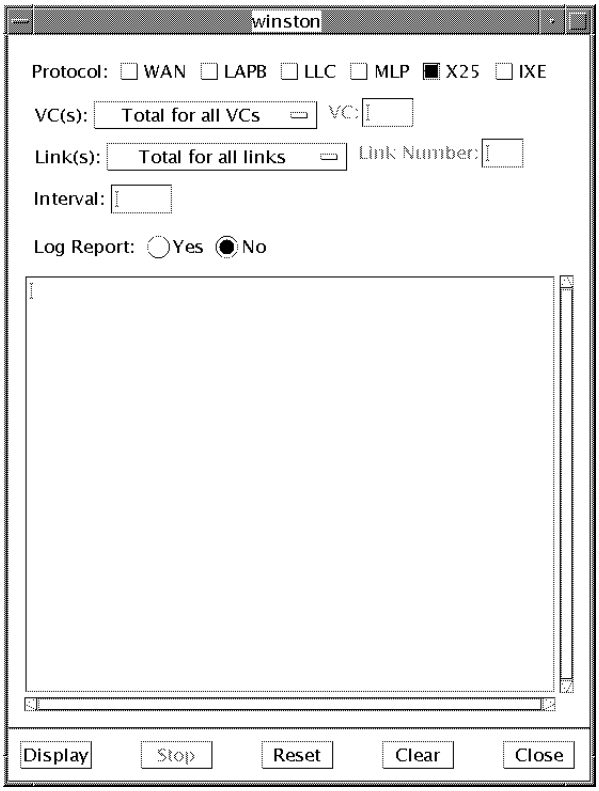

Figure 4–6 Network X.25 Statistics Window

Protocol

Select the protocol(s) you want to generate statistics for: WAN, LAPB, LLC, MLP, X.25, or IXE.

VC(s)

Select one of the following: Total for all VCs; Per-VC, all VCs; Per-VC, single VC; or Per-VC, range of VCs.

Note - Statistics for the VC (virtual circuit) are reported only if X.25 is one of the protocols selected.

VC or VC Range

If you set VC(s) to Per-VC, you will need to specify the VC number. If you select Per-VC, range of VCs, you will need to enter the range of VCs to be used for gathering the statistics.

Link(s)

Select one of the following: Total for all links; Per-link, all links; Per-link, single link; Per-link, range of links

Link Number or Link Range

If you set Link(s) to Per-link, single link, you will need to specify the link number. If you select Per-link, range of links, you will need to enter the range of links to be used for gathering the statistics.

Interval

This field is optional. If you enter a value, the updated statistics will be continuously re-displayed after the interval specified. Interval values are in seconds.

Log Report

If you select Yes, you will be prompted to give a file name for storing the statistics. If you select No, the statistics are displayed in the statistics window, only.

To generate a report, click on the protocols you want statistics for, specify the link(s) and VC(s) to test, and the interval. Then click on Display. Following is an example of how the statistics are reported:

```
GLOBAL STATISTICS FOR X25
           -------------------------------------
           Packet type              TX        RX
           -------------------------------------
                        Call        20        20
              Call accept           20        20
                     Clear           0         0
            Clear Confirm           0         0
                   Restart          5         5
          Restart confirm           0         0
                      RNR           0         0
                       RR        2431      2430
                   Resets           0         0
           Reset confirms           0         0
               Diagnostic           0         0
               Interrupts           0         0
             Registration           0         0
              Reg confirm           0         0
            Packets(total)       4250      4212
              Bytes(total)     483584    483640
           -------------------------------------
           Running totals
           -------------------------------------
           Tot no of VCs established            2
```

(continued)

```
Connections refused                0
Connections currently open         2
Max connections open               2
```

A separate block of statistics is reported for each protocol selected.

Start Link

Starts the currently selected link without affecting the Solstice X.25 software as a whole. All counters and timers associated with the link protocol are reset to their initial values.

Stop Link

Stops an individual link without affecting the Solstice X.25 software as a whole. All counters and timers associated with the link protocol are reset to their initial values.

Once the link has been stopped, the LAPB will not respond to any incoming frames until the link is restarted using the Start Link option.

Reset Link

Resets an individual link to its initial state without affecting the Solstice X.25 software as a whole. All counters and timers associated with the link protocol are reset to their initial values.

Link(s) status

Displays the status of the internal state of the LAPB for the configured links. When the link is operating normally, i.e. the SABM/UA handshake has successfully completed, the state for both LAPB and Packet is displayed as NORMAL.

When used on a MLP link, the highest status of the different SLPs is displayed.

For more information on link status, see Chapter 11.

Note - The link status option does not work with LLC2 links.

Options

Start X.25 automatically when booted

The X.25 network will automatically start the next time you reboot the machine.

Don’t start X.25 automatically when booted

The X.25 network will not automatically start when you reboot the machine. If you want to bring up the network later, then you must select Network ⇒ Start X.25.

Start SNMP Agent automatically

This starts the SNMP agent when you start X.25 or reboot the machine. The SNMP agent allows access to the MIB through SNMP (the Simple Network Management Protocol). For more information on the SNMP agent, see Appendix E.

Don’t start SNMP Agent Automatically

The SNMP agent will not be started when you start X.25 or reboot the machine.

Static mode

When `x25tool` is set to *static* mode, any changes you make will not be applied to the currently running configuration. However, if you save the changes to the default configuration files, they will come into effect the next time you stop and restart the Solstice X.25 software.

Dynamic mode

When `x25tool` is set to *dynamic* mode, any change you make will affect existing X.25 connections, and may disrupt users, so use caution. Changes to the dynamic configuration are made in the kernel and are lost the next time you restart the Solstice X.25 software, unless you save the changes.

Services

The following Service options are described in more detail in Chapter 6 and Chapter 7.

IP

Configure X.25 to run IP above it. There are two IP windows: the IP Interface Configuration window, and the Remote Host to X.25 Address Map window.

PAD

Configure the PAD Hosts Database with information to make it easier for users to make PAD calls to a remote host.

The PAD Daemon Listen Database window lets you determine how incoming calls will be handled.

The PAD Printer lets you install a printer over an X.25 network so that users logged in from a remote terminal can still print to their local printer.

NUI Mapping

Configure the Network User Identifier parameters to create a mapping between the Network User Identifiers and facilities.

Routing

If you have multiple links, use the parameters in this window to configure the address information in a Call Request packet. This determines which link Solstice X.25 will use for outgoing calls.

X.25 Call Filtering

Use X.25 Call Filtering to define which incoming calls will be authorized.

Boards

Definition

This pop-up window contains a list of physical serial port boards. Click on Add to add a board, or click on a board already displayed in the list, then select Modify.

When you click on Apply or OK, the changes are stored in a file and the Device list for the Link Editor is updated to reflect any additions or modifications.

The items contained in the definition window are:

Symbolic Name

This is what you want to call the board.

Path Name

This is the path for the device driver, for example, `/dev/zshdrv` is the location for the Aurora board driver.

Board type

Set to either WAN or LAN.

Number of lines

This is the number of lines that the board will support.

MRU (in bytes)

The size of the largest frame (Maximum Receive Unit) that can be received by the board.

Comment

Type in any additional information you want to include, for example, “Onboard Serial Port”.

Help

On-line help for `x25tool` is available in HTML format. It is specifically structured to help you quickly find the answers to questions about `x25tool`. For example, if you are not sure what sort of information to type in the Local X.121 Address field in the Link Editor window, you can use on-line help to find out.

The first time you use on-line help, you need to specify which browser to use. To do this, click on Help and select Properties. Then type in the path and name of the browser and click on OK.

Alternatively, you can specify the browser in your `.login` file by adding the following line:

`setenv X25HTMLBROWSER =` */pathname/browsername*

Then, to bring up the on-line help, just click on Help ⇒ Help. This starts the browser and brings you to the main help menu. You can then follow the hyperlinks to the information you need.

Configuring a Single WAN Link

This section describes how to use the Link Editor in `x25tool` to configure a single dedicated WAN link for Solstice X.25. The configuration described in this chapter uses the default values provided with the product. It should work in the majority of situations, although it will not necessarily make the best possible use of the product's capacities.

No changes will be made to the Advanced Configuration settings in this example; however, once you have a link that works, you can use the Advanced Configuration options to fine-tune it. See Chapter 7 for more information.

This example uses the SPARC™ version of the product. The process is almost identical for all versions of the product, but the device names change. Refer to Chapter 8, for an example using the x86 version of the product.

The procedure for setting up a dial-up link is slightly different from that for setting up a leased line, and involves some extra considerations. Refer to Chapter 8 for an example.

This section describes setting up the following configuration:

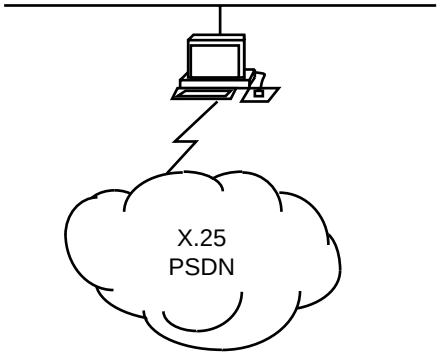

Figure 4–7 Configuring a Single WAN Link using `x25tool`

The onboard serial port of the workstation is connected to a modem using a straight-through cable. When you subscribe to a PSDN, your supplier almost always provides a modem. If not, contact the supplier to find out what kind of modem you need.

To configure Solstice X.25, you need to:

- configure some information about the link
- change the logical channel ranges used by the Solstice X.25 software to match those used by your PSDN

Before you start, make certain that your PSDN supplier has provided the following information:

- the version of the X.25 Recommendation used on the PSDN
- the X.121 address of the port you intend to use
- the logical channel ranges used by the PSDN

By default, there are two template links already configured, one WAN link and one LAN link.

In this example, you will configure a single WAN link:

1. **In the `x25tool` main window, pull down the Edit menu, select Add Link and choose a template configuration.**

   If you don't know what template configuration you need, choose Default. The Link Editor window appears:

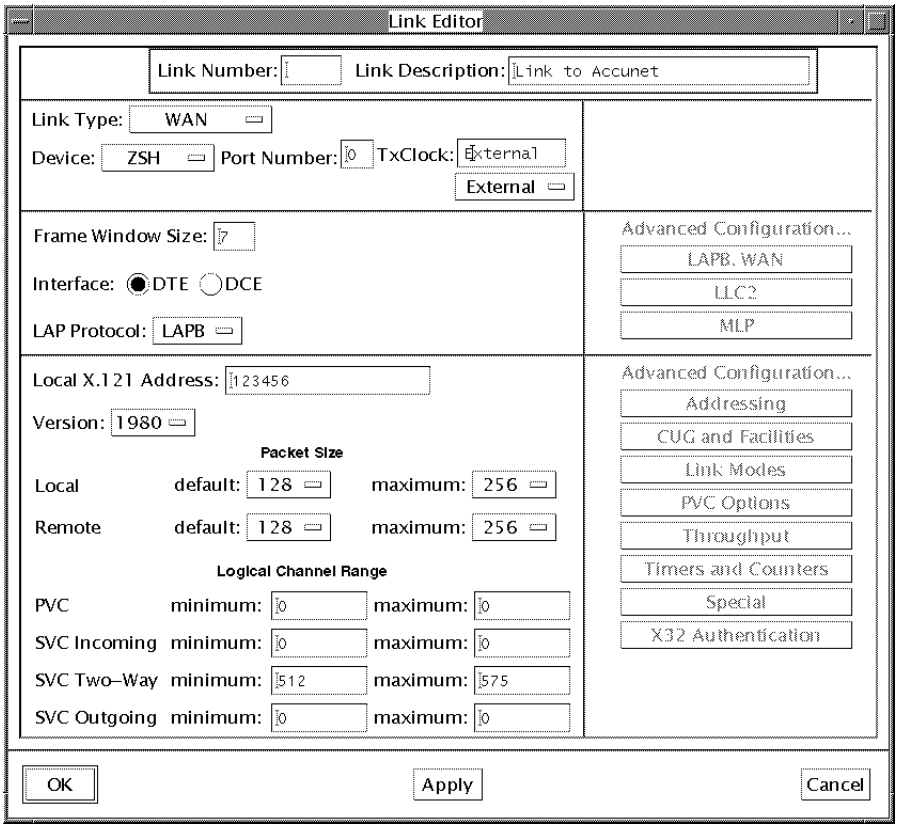

Figure 4–8 The Link Editor Window

2. Set the Link Number.

This is a unique number that you assign to the link to identify it, both in `x25tool` and in the configuration files.

3. Type a link description (this is optional).

In the Link Description field, type in a description of the link. For example, Internal serial port.

4. Set the Link Type.

Pull down the Link Type menu and choose WAN.

5. Set the Device type and Port Number.

The example uses the default `zsh0` device. If you are using a different device type, pull down the menu of available device types and select the relevant one, then type in the port number.

6. **Make sure the Interface is set as DTE.**

   You only need to set the Interface as DCE if you are running two machines back-to-back, for example for testing.

7. **Set the LAP Protocol to LAPB, unless you are sure your PSDN uses a different LAP Mode.**

   LAP and LAPBE are used very rarely.

8. **Set the Local Address.**

   Type the port address in this field. This is the X.121 address assigned to you by your supplier. This address is often referred to as an X.25 address. Your service supplier should tell you this address.

Note - The Full Address and Extended Address parameters are not used when the product is in normal operation. You only need to enter these if you are using an application that expects to read them. In this case, your service provider will tell you what you need to enter here.

---

9. **Select the Version.**

   Choose the version of the X.25 recommendation used by your PSDN.

10. **Set the Logical Channel ranges**:

    Your PSDN will tell you which values to use here. If you are configuring a private network, all machines on the network must use the same logical channel ranges. In this case, you can choose any values you like as long as they comply with the X.25 Recommendations.

11. **Click on OK.**

    This confirms your changes and closes the Link Editor window.

12. **Click on File, then click on Save.**

    This makes sure your changes will be used next time you start X.25.

Note - For a default configuration, you do not need to configure the datalink layer parameters, the defaults should be adequate.

---

13. Start X.25 by pulling down the Network menu and clicking on Start X.25.

14. Check that the configuration is valid.

First, check the link status by clicking on Network, Link Status. The link status should be NORMAL.

15. Next, make a PAD call to yourself. To do this, enter the pad **command at a command line, followed by your own X.121 address**:

```
hostname% pad X.121 address
```

Once you have created a link that works, you can fine-tune it, or configure the application(s) you want to run over it.

Chapter 8 contains additional examples.

CHAPTER 5

Configuring Solstice X.25 by Editing the Configuration Files

This chapter describes how to configure Solstice X.25 by editing the configuration files.

Configuration Files Overview

If you need to configure a machine that does not have a windowing system such as OpenWindows or Motif, you can configure Solstice X.25 by directly editing the configuration files.

Solstice X.25 9.2 automatically converts the configuration files of Solstice X.25 9.*x* as part of the installation process. Older versions of X.25 are not supported.

Note - Whenever possible, configure X.25 links and applications using the `x25tool`. Directly editing the files makes it more likely that errors will accidentally be added to the configuration files.

Editing the Configuration Files

Chapter 7 specifies the keyword and valid arguments for each parameter used in the configuration files. For additional information, consult the `man` pages (make certain your path includes `/opt/SUNWconn/man`).

The following configuration files are contained in the `/etc/opt/SUNWconn/x25/config` directory:

`link_config_0000.cfg`, `link_config_0001.cfg`

Contains the link configuration templates. See “Using the Link Configuration Files” on page 43 for more information. To see the `man` page description, type `man x25_config`.

The following configuration files are contained in the `/etc/opt/SUNWconn/x25` directory:

`ipconf`

Contains the IP interface configuration information.

`ixemapconf`

Contains information about the mapping between the Internet addresses of the network hosts and underlying X.25 addresses.

`nuimapconf`

Contains information of mapping between the Network User Identifiers and associated facilities.

`paddconf`

Contains the set of called addresses from which the PAD daemon will accept connect indications.

`padmapconf`, `x29profile`, `xhosts`

Contain the X.25 hosts information that the PAD host database needs.

`xtpmapconf`

Contains PAD printer parameters definitions.

`pvcmapconf`

Contains the PVC packet and window size information.

`routes`

Contains routing configuration information.

`x25secuconf`, `x25secupid`

Together contain the authorized incoming calls information needed for call filtering.

Using the Link Configuration Files

File `link_config_0000.cfg` configures link 0. In the default configuration, this is a WAN link. File `link_config_0001.cfg` configures link 1. In the default configuration, this is a LAN link.

There is a separate configuration file for each link. The filename format is `link_config_`*nnnn*`.cfg`, where *nnnn* is a four digit link number. These are the files that will be read when the Solstice X.25 is next started. Editing them is equivalent to modifying the configuration using `x25tool` while in *static* mode. Use a different naming convention if you want to save changes without using them on the next restart.

Note - You cannot make changes to an active link by editing the configuration files. If you need to make changes to an active link, use `x25tool` to modify the configuration while in *dynamic* mode.

To create a new WAN link use file `link_config_0000.cfg` as a template. Copy it, giving the new file the correct name for the link you want it to apply to. For example, to configure link 3 as a WAN link, call the file `link_config_0003.cfg`.

To create a new LAN link, copy and rename the file `link_config_0001.cfg`. Then edit the new file to use the values you want.

The configuration file consists of a series of keywords and values, divided into sections according to function. The example below shows the `IDENTIFICATION` and `LINK` sections of a file:

```
IDENTIFICATION
    PRODUCT_NAME      Solstice X.25
    PRODUCT_VERSION   9.2
    FILE_TYPE         config
    MODIFIED_BY       agbell     FILE_DATE         Fri Sept 29 11:41:13 1999


 SECTION LINK
       device         /dev/zsh0
       local_address  0011
       type           WAN
       version        1988
       mode           DTE
       protocol       LAPB
```

(continued)

(Continuation)

```
        description    Link to switch
```

The `IDENTIFICATION` section is the top section of every file. Updating the `MODIFIED_BY` field every time you make changes helps you keep track of who has made changes. The `FILE_DATE` field is updated automatically when you save the file, showing when the last changes were made.

Template Configuration Files

You can also use one of the sample templates instead of the default configuration files. These files are also contained in the `/etc/opt/SUNWconn/x25/config` directory. The template filename format is `def_name_config.cfg`.

To use a template file, select the template that most closely matches your configuration needs (for example, `def_transpac_config`) and copy it. You can then edit the copy as you would any other link configuration file. See “Using the Link Configuration Files” on page 43 for more information.

Configuring a Single WAN Link

This section describes how to configure a single dedicated WAN link for Solstice X.25 by editing the configuration files. The configuration described in this chapter uses the default values provided with the product. It should work in the majority of situations, although it will not necessarily make the best possible use of the product’s capacities. However, once you have a link that works, you can fine-tune it. See Chapter 7 for more information.

This example uses the SPARC version of the product. The process is almost identical for all versions of the product, but the device names change. Refer to Chapter 8 for an example using the x86 version of the product.

The procedure for setting up a dial-up link is slightly different from that for setting up a leased line, and involves some extra considerations. Refer to Chapter 8 for an example.

This section describes setting up the following configuration:

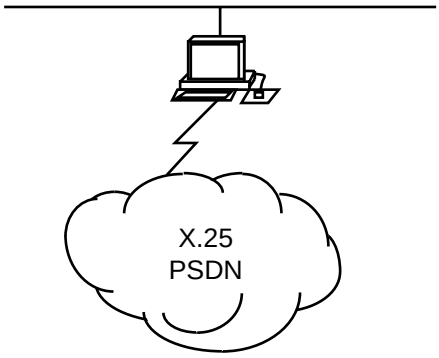

Figure 5–1 Configuring a Single WAN Link

The onboard serial port of the workstation is connected to a modem by a straight-through cable. When you subscribe to a PSDN, your supplier almost always provides a modem. If not, contact the supplier to find out what kind of modem you need.

To configure Solstice X.25, you need to:

- configure some information about the link
- change the logical channel ranges used by the Solstice X.25 software to match those used by your PSDN

Before you start, make sure your PSDN supplier has provided the following information:

- the version of the X.25 Recommendation used on the PSDN
- the X.121 address of the port you intend to use
- the logical channel ranges used by the PSDN

Editing the Link Configuration Files

To configure a single link to a PSDN across using the onboard serial port:

1. **Open the file** `/etc/SUNWconn/x25/config/link_config_0000.cfg` **for editing.**

   This is the file that configures link 0.

2. **Scroll down to** `SECTION LINK`**.**

   This is the first section below the identification section, and looks like this:

```
SECTION LINK
    device          /dev/zsh0
```

(continued)

(Continuation)

```
    local_address   0011
    type            WAN
    version         1988
    mode            DTE
    protocol        LAPB
    alias           switch
    description     Link to switch
```

3. **Change the** `local_address` **parameter to your local X.121 address.**

   This is the X.121 address of your modem. Your service supplier should tell you what it is.

4. **If necessary, change the** `version` **parameter to the year of the X.25 Recommendations used by your PSDN.**

5. **Optionally, set an** `alias` **and** `description`**.**

6. **Scroll down to** `SECTION X25` **and find the Logical Channel Range parameters.**

   These are called `pvc_range`, `inc_range`, `out_range`, and `two_range` and are near the top of `SECTION X25`:

```
SECTION X25
    network         X25_88
    plpmode         Normal
    pvc_range       0-0
    inc_range       0-0
    out_range       0-0
    two_range       1-30
```

7. **Set the appropriate Logical Channel Ranges by editing the existing entries.**

   Don’t leave any spaces between the values and the hyphen. Your service supplier will tell you the appropriate values to use.

8. **Save and exit the file.**

9. **Start X.25 by entering the following as root:**

```
# /etc/init.d/x25.control start
```

This brings up the software.

To check that the configuration is valid, make a pad call to yourself. To do this, enter the pad command at a command line, followed by your own X.121 address:

```
hostname% pad X.121 address
```

Once you have created a link that works, you can fine-tune it, or configure the application(s) you want to run over it. See Chapter 8 for more information.

CHAPTER 6

Configuring Solstice X.25 Services

This chapter explains how to set up some of the basic configurations listed under Services in the `x25tool` menu. For additional configurations, see Chapter 8.

Configuring Solstice X.25 to Route IP

The TCP/IP protocol suite is the de facto standard for networking. IP can be run above X.25, creating a Wide Area Network using TCP/IP. This allows for the use of rlogin, ftp and other useful facilities. The TCP/IP protocol suite is delivered as part of the Solaris system software.

To route IP over Solstice X.25, you must set up a mapping between the X.121 addresses used by the X.25 software and the IP addresses used by the IP software. The IP over X.25 Configuration window contains many parameters, but you only need to use a few of them. You can configure information about your local system, mapping its X.121 address to an IP address and setting any necessary parameters, and also information about remote systems.

To access the IP Interface Configuration window, pull down the Services menu and choose IP ⇒ IP Interface:

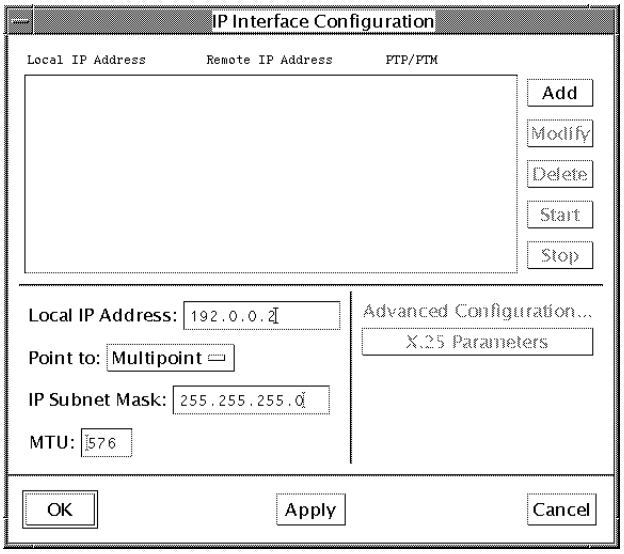

Figure 6–1 Setting the Local IP Address and IP Subnet Mask

First, configure information about your local system. To do so:

1. **Click on the Add button.**

2. **Enter the Local IP address of the interface you are configuring.**
   Enter either an address in IP dotted notation, or a hostname.

3. **Select either Point-to-Point, or Point-to-Multipoint.**

4. **Enter the Remote IP Address for a Point to Point configuration, or enter the IP Subnet Mask for a Point to Multipoint configuration.**

5. **Click on the Apply button.**

6. **Select the Local Address, and click on the Modify button.**
   You must do this before you can access the X.25 Parameters window.

7. **Select X.25 Parameters and configure any other relevant parameters.**
   See “IP Interface Configuration” on page 93 for information about the available parameters.

8. **Click on OK to apply the changes and to exit the X.25 Parameters window.**

9. **Click on Start to start the IP interface.**

10. **Click on OK to apply the changes and to exit the IP Interface window.**

You also need to add information about remote hosts to the IP Mapping window. This lets the Solstice X.25 software translate the IP addresses it receives into X.25 addresses it can use. To access the IP Mapping window, pull down the Services menu and choose IP ⇒ IP Mapping:

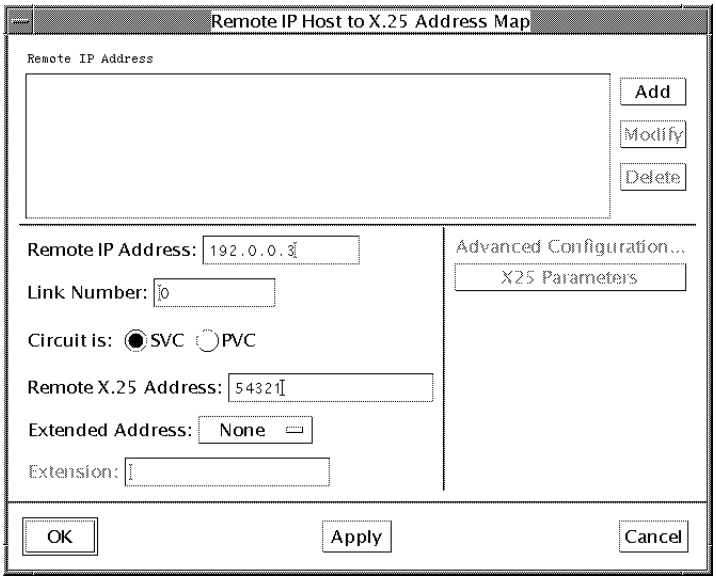

Figure 6–2 Adding Information About Remote Hosts in the IP Mapping Window

1. **Click on the Add button.**

2. **Enter the IP Address of the remote system.**

3. **Specify the link to be used by traffic to this destination (or use 255 for automatic routing).**

4. **Set the circuit to SVC (switched virtual circuit) or PVC (permanent virtual circuit).**

5. **Enter the X.25 (X.121) address of the remote system.**

6. **Click on the Apply button.**

7. **Select the Remote IP Address, and click on the Modify button.**
   You must apply the changes before you can access the X.25 Parameters window.

8. **Click on the X.25 Parameters button and configure any other relevant parameters.**

   See “IP Interface Configuration” on page 93 for information about the available parameters.

9. **Click on OK to apply the changes and to exit the X.25 Parameters window.**

10. **Click on OK to apply the changes and to exit the IP Mapping Window.**

    Once you have carried out the configuration described above, you should be able to use the TCP/IP protocol suite over your X.25 connection. To check that all is working properly, make sure that you can `ping` and `rlogin` to the hosts you added to the IP Host to X.25 Address Map.

Configuring the PAD

Once you have a working connection to a network, you can use it to make PAD calls using the PAD software delivered with the Solstice X.25 software.

Users can make PAD calls without you carrying out any configuration. However in order to do so, they need to know addressing and configuration information for their destination. You can use `x25tool` to create a database of remote hosts containing relevant addressing and configuration information. This lets users make calls using aliases instead of addresses.

You can also set up a database of parameters to be applied to incoming calls. This is particularly useful if you have a server that receives a large number of calls.

Configuring the PAD Hosts Database

To access the PAD Hosts Database, pull down the Services menu and choose PAD ⇒ PAD Hosts Database:

The PAD Hosts Database window looks like this:

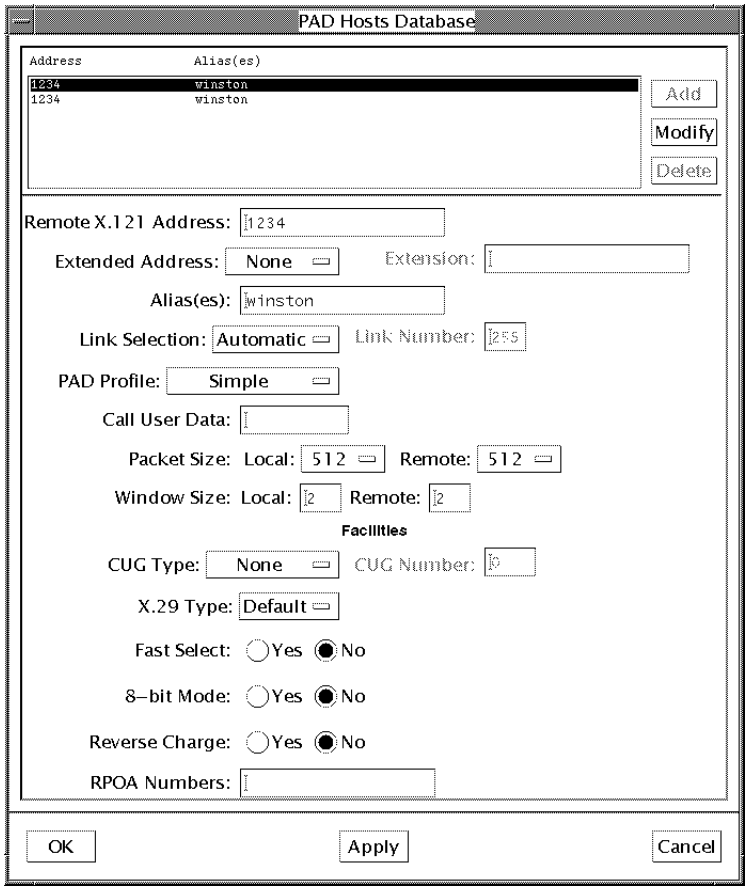

Figure 6–3 PAD Hosts Database Window

To add an entry:

1. **Click on Add.**

2. **Specify the X.121 Remote Address.**

   For a WAN link, this is the DTE address of the remote host. A valid DTE address has 15 or fewer decimal digits.

   For a LAN link, this is the LSAP of the remote host. A valid LSAP (MAC plus SAP) address is 14 hexadecimal digits in length. In most cases, the last two digits of an LSAP address are 7e. You can use ARP-style notation, with colons separating the bytes within an LSAP address. Within a colon-delimited byte, you can omit a leading zero.

3. **Type the name of the alias you want to use, if appropriate.**

4. **Add any Aliases you want to use to call this destination.**

5. **Set the Link Selection parameter to Automatic.**

   This uses the Solstice X.25 routing link selection feature. In some instances, you may want to specify the link number, instead (a link number of 255 indicates automatic link selection). This allows you to bypass routing specs, or to make certain that the specified link is always used.

6. **Change any other relevant parameters.**

   In most cases you do not need to do this. Refer to “PAD Hosts Database” on page 98 in Chapter 7 for information on the other available parameters.

7. **Click on OK to add the new entry to the database.**

Configuring the PAD Daemon Listen Database

The PAD Daemon Listen Database determines how incoming PAD calls are handled. You can set global default values that are used for all incoming calls and optional values that apply to calls with particular characteristics. To access the PAD Hosts Database, pull down the Services menu and choose PAD ⇒ PAD Daemon.

The PAD Daemon Listen Database window looks like this:

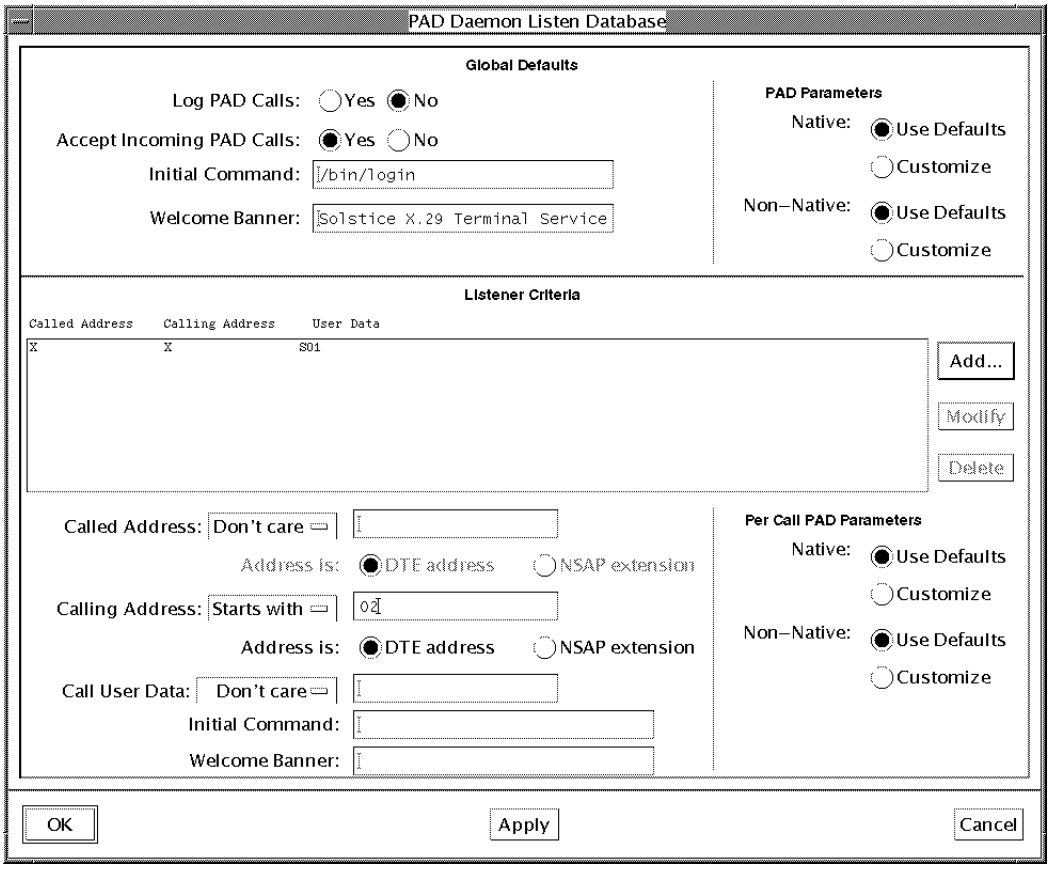

Figure 6–4 PAD Daemon Listen Database

1. **Configure the PAD Daemon Listen Database to log or not to log PAD calls.**

   When the Log PAD Calls option is set to Yes, information about each PAD call made is logged to the file `/var/opt/SUNWconn/x25/x29serverlog`. This file can become very large. If you have problems with disk space, check the `x29serverlog` file size and, if necessary, delete it.

2. **Configure the PAD Daemon Listen Database to accept or not to accept incoming PAD calls.**

   If the Accept Incoming PAD Calls option is set to No, the system will not accept incoming PAD calls. The system can still make outgoing calls.

3. **Configure a Welcome Banner.**

   This is the message that someone logging in to this machine using a PAD call will see when the connection is made. It might be useful to give the machine name or any particular information about this machine that users need.

There are two Welcome Banner fields in the database window. The first is under the Global defaults. The second is displayed under the Listener Criteria. You can specify a Welcome Banner for a particular listener, or you can leave this field blank, in which case the default banner will be used.

If you don't want a Welcome Banner, enter a single space in the field for the global Welcome Banner.

4. **Enter the Initial Command.**

   This determines what happens when a user connects to this machine using a PAD call. The command `/bin/login`, which appears by default in this field, prompts for the user's name and password.

   There are two Initial Command fields in the database window. The first is under the Global defaults. The second is displayed under the Listener Criteria. You can specify an Initial Command for a particular listener, or you can leave this field blank, in which case the default will be used.

   If you don't want an Initial Command, enter a single space in the field for the global Initial Command.

5. **Change the Listener Criteria, if necessary.**

   You can also set the parameters described above so that they are applied differently to certain calls. There are two ways to distinguish which calls they can apply to—using the Called Address and using the Calling Address.

   The Called Address is the address of the local machine. If you use sub-addressing, a remote host can call the local machine using any one of these sub-addresses. You can configure the local machine to behave differently depending on the sub-address called—for example, on a machine with several applications, you could use a different sub-address to call each one, using a combination of the Called Address and Initial Command parameters to set this up.

   The Calling Address is the address of the machine making the call, the remote machine. Again, you might want to use a different Initial Command, depending on where the call is from. You might also need to use different X.3 parameters if the remote host has a non-default configuration. To set the X.3 parameters, select Customize under PAD Call Parameters. For more information on X.3 parameters, see Chapter 7.

   To set parameters applying to a particular Called Address, choose Matches and enter the exact address. To apply the parameters to a particular group of Called Addresses, use Starts With to affect all addresses starting in the same way, or Pattern to use wildcards such as an asterisk (*) or a question mark (?).

   To set parameters applying to a particular Calling Address, choose Matches and enter the exact address. To apply the parameters to a particular group of Calling Addresses, use Starts With to affect all addresses starting in the same way, or Pattern to use wildcards.

To set parameters applying to calls using specific Call User Data, choose Starts With to affect all calls with CUD starting the same way and Matches to affect all calls using identical CUD. For more information on Call User Data, see Chapter 7.

Configuring PAD Printer

The PAD Printer enables a user who is logged on to a remote terminal to print to the remote user's local printer.

Figure 6–5 shows how the print information is routed through the network to the server running X.25. The print information is then routed back to the local printer through PAD.

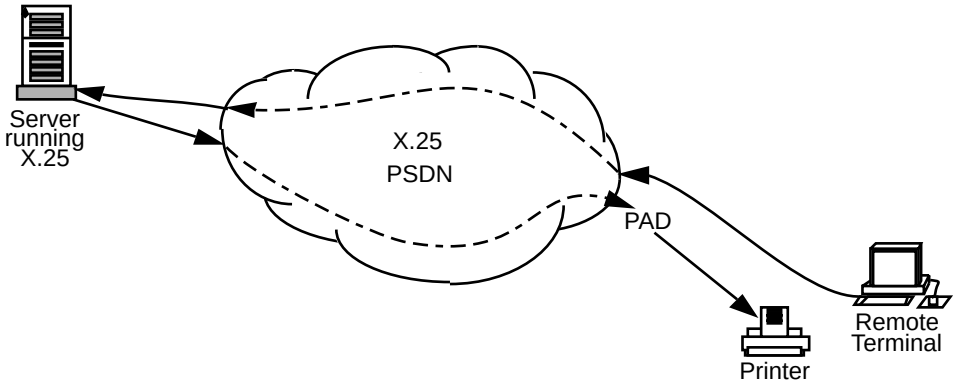

Figure 6–5 Using PAD to Print to a Remote User's Local Printer

1. **Use** `admintool` **to set up the printer.**

   Do this as you normally would, but make certain that you set it up as a Local Printer, and specify an X.25 printer port that also includes a unique printer number, for example `/dev/xtp7`. See *User Account, Printers and Mail Administration* for more information.

2. **In** `x25tool`**, access the PAD Printer window.**

   Pull down the Services menu and choose PAD ⇒ PAD Printer.

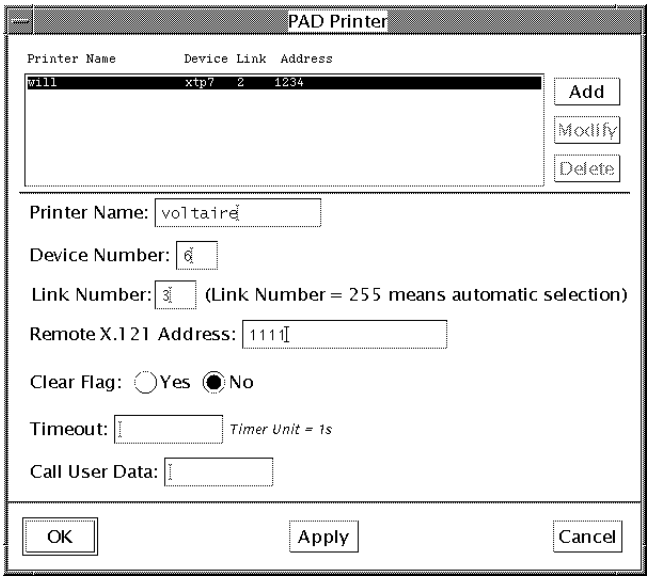

Figure 6–6 The PAD Printer Window

3. **Click on Add.**

4. **Type in the printer name.**

5. **Type in the device number.**

   This is the printer port number. For example, if you entered `/dev/xtp7` for the printer port in `admintool`, then the device number is 7.

6. **Type in the link number.**

   This is the link to use for the outgoing printer connection. If you set this to 255, the link number will be selected automatically.

7. **Type in the remote X.121 address.**

   This enables X.25 to open a connection. The print information can then be routed from the remote terminal, through PAD, to the local printer.

8. **Set Clear Flag to Yes or No.**

   If set to Yes a Clear Invitation packet is sent at the end of the data transfer, and the connection will then be cleared by the remote PAD after all of the data is received. This ensures that all data have reached the remote PAD, but can lead to the connection staying up if the remote does not support Clear Invitation packet.

If Clear Flag is set to No, then a Clear Invitation packet will not be sent at the end of the data transfer. If the remote PAD does not support Clear Invitation, you should set Clear Flag to No and enter a value for the Timeout.

9. **Set the timeout (optional).**

   This is the amount of time, in seconds, that the X.25 server will keep the connection open after the last print packet has been sent. Setting a timeout value can help prevent loss of print data, however, you will have to use your own knowledge of the network to determine how long the connection needs to stay open.

   You only need to set a timeout if Clear Flag is set to No.

10. **Enter the Call User Data.**

    This is the call user data used to establish the virtual connection. Before this information is included, it should have been agreed upon by both sides of the connection.

11. **Click on OK to apply the changes and to exit the PAD Printer window.**

NUI Mapping

The Network User Identifier (NUI) parameters are used to create a mapping between Network User Identifiers and facilities. When a call is made using NUI override, the facilities set here override any other facilities that might otherwise apply to the call.

Configuring the NUI Parameters

To access the NUI Mapping window, pull down the Services menu and choose Routing. The NUI Mapping window looks like this:

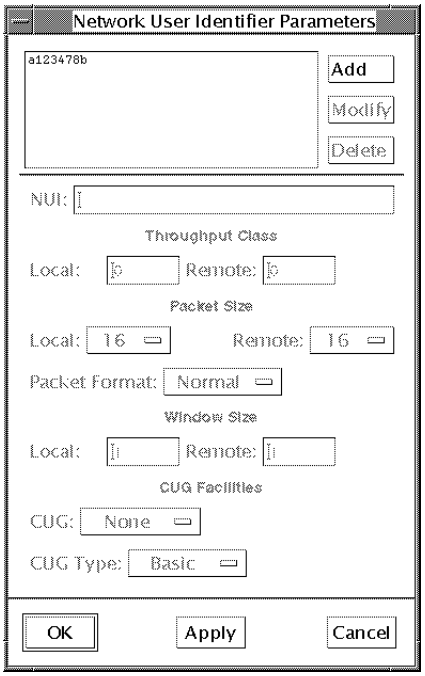

Figure 6–7 Network User Identifier Parameters Window

1. **Click on Add.**

   You can now configure the NUI mapping information.

2. **Enter the NUI.**

   The NUI, the Network User Identifier, is a string of up to 64 alphanumeric characters. The NUI is supplied by your PSDN provider.

3. **Enter the Throughput Class information.**

   This numeric value determines what throughput class is used for incoming (Remote) and outgoing (Local) calls. These can be different.

4. **Select the Packet Size.**

   These are the sizes to use for incoming (Remote) and outgoing (Local) packets. These can be different.

5. **Select the Packet Format.**

   Choose between Normal and Extended.

6. **Enter the Window Size.**

   This is the window size to use for incoming (Remote) and outgoing (Local) calls. These can be different.

7. **Select the CUG.**

   This determines whether Closed User Groups are in use. Choose between None, Normal and Outgoing.

8. **Select the CUG Type.**

   Choose Basic or Extended.

Routing

If you have multiple links, you can control which link X.25 uses by configuring the address information contained in the Routing Parameters window.

Configuring the Routing Parameters

To access the Routing Parameters window, pull down the Services menu and choose Routing. The Routing Parameters window looks like this:

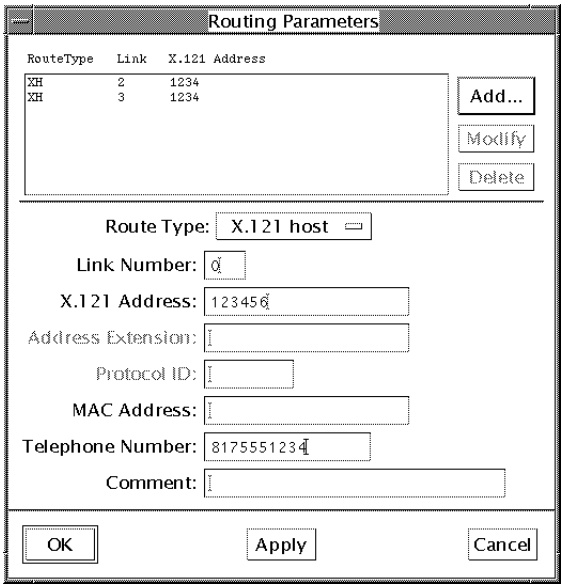

Figure 6–8 Routing Parameters Window

1. **Click on Add and select Top from the list displayed.**

   When you click on Add, you will be prompted to select the position you want the configuration to take in the list. This can be important, since X.25 starts from the top of the list and uses the first set of parameters that match the parameters specified by the application.

2. **Select the Route Type.**

   The default is X.121 Host. This associates the complete X.121 address of a remote host with a link. For a complete description of each of the available route types, see “Routing” on page 111 in Chapter 7.

3. **Type in the number of the link you want to associate with the route type.**

4. **Type in the X.121 host address or prefix.**

   Type in the complete X.121 address if the routing type is set to X.121 host, AEF host, prefix, or default. If the routing type is X.121 prefix, enter the leading digits (for example, the DNIC) of the X.121 address.

5. **For an AEF routing type, enter the address extension.**

   For an AEF host routing type, enter the complete extended address, such as an OSI NSAP address. For an AEF prefix routing type, enter the leading digits (at least one) of an extended address.

6. **Type in the Protocol ID.**

   Enter the protocol id as a string of consecutive digits no longer than 5 bytes (10 decimal digits). The protocol id is an optional addition to an AEF host, AEF prefix, or AEF default entry.

7. **Enter the MAC address to which the call will be routed if the link is a LAN link.**

   You can include a MAC address with any of the route types.

8. **For dial-up configurations, enter the telephone number of the point of attachment to the PSDN.**

   In most cases, the point of attachment is the modem.

9. **Add a comment (optional).**

Call Filtering

Call Filtering defines which incoming calls will be accepted. The default is that all calls are authorized, so if you want to restrict incoming calls, you need to configure the definitions in the Call Filtering window in `x25tool`, or edit the `/etc/SUNWconn/x25/x25secuconf` and `/etc/SUNWconn/x25/x25secupid` configuration files.

Configuring the Call Filtering Parameters

To access the Call Filtering window, pull down the Services menu and choose Call Filtering. The Call Filtering window looks like this:

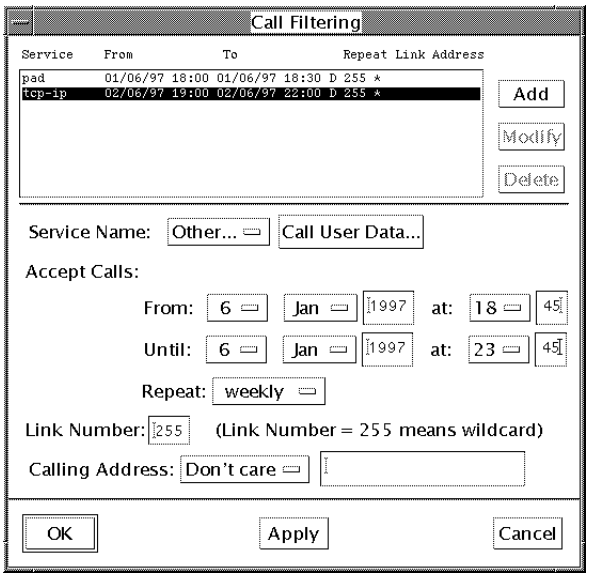

Figure 6–9 Call Filtering Window

1. **Click on Add.**

   If you need to modify an existing set of parameters, you need to select it from the list of call filtering parameters. To do this, click on the call filtering parameters you want to modify, then click on the Modify button.

2. **Select the Service from which to accept calls.**

The available services are PAD,TCP-IP, CLNP, OSI, None, or Other. If you select Other, a pop-up window will prompt you to enter the service name, and call user data.

3. **Set the time period when calls will be accepted.**

   You can set this up so that the time period specified is repeated daily or weekly. If you select “one time”, the time period will not be repeated.

4. **Set the link number from which you will accept calls.**

   You can restrict which networks you will accept calls from by specifying the link number. If the link number is set to 255, X.25 will accept calls over any link.

5. **Specify the calling address of the machine from which calls will be accepted.**

   If you set the Calling Address to Don’t Care, X.25 will accept calls from any address. If you set the Calling Address to Starts with, or Ends with, you must also enter the appropriate numbers. For example, if you want to accept calls that have an X.25 address beginning with 1234, you select Starts with, and enter 1234 in the adjoining field.

6. **Click on OK to add the information to the list of Call Filtering parameters and to dismiss the window.**

CHAPTER 7

Parameter Reference

This chapter contains reference information for all available Solstice X.25 parameters. All of the parameters described here can be set by using `x25tool`, or by editing the configuration files.

Note - Whenever possible, configure X.25 links and applications using the `x25tool`. Directly editing the files makes it more likely that errors will accidentally be added to the configuration files.

The parameters are grouped together functionally, according to the `x25tool` window that they are located in. The name of the corresponding configuration file or files is also included.

The name used to identify the parameter in `x25tool` is given as a header, with the keyword used by the configuration file included in brackets. In some cases no key word is used, but the configuration file itself will contain information on editing the parameters.

Note - For a list of parameter values, refer to Appendix B.

Link Parameters

The parameters described in this section are located in the Link Editor window in `x25tool`.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the

four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

These parameters are used to configure a physical link.

Link Number

A number that identifies the link (which is a connection over a specific network interface). This can be either a PSDN or LAN. Each link must have a unique number. This number is used to identify which link is being configured in various parts of `x25tool`.

Link Description (`description`*)*

This is an optional field. Enter an alphanumeric string of 80 or fewer characters. Spaces are allowed.

Link Type (`type`*)*

Table 7–1 lists the available values:

TABLE 7–1 Link Type values

Value	Meaning
WAN (1988)	A connection to a WAN conforming to the 1988 version of the X.25 Recommendations.
WAN (1984)	A connection to a WAN conforming to the 1984 version of the X.25 Recommendations.
WAN (1980)	A connection to a WAN conforming to the 1980 version of the X.25 Recommendations.
LAN	A connection to a LAN.
MLP *n* - links	A multi-link protocol connection using *n* physical links.

Device (`device`*)*

The name of the link level device. Table 7–2 lists the available types:

TABLE 7–2 Device Types

Value	Meaning
ZSH	One of the onboard serial ports.
HSI	High Speed Interface. A serial port on the Solstice HSI/S SBus card.
EXPX	A serial port on the SCiiExpress-X card.
WLOOP	The loopback driver.
LE	An Ethernet interface on a SPARCstation.
IE	An Ethernet interface on a SPARCstation.
BE	A fast Ethernet interface.
QE	The SBus Quad Ethernet card.
SMC	A PC Ethernet interface.
EL	A PC Ethernet interface.
ELX	An Ethernet interface on the 3Com Etherlink III card. The default Ethernet interface type for a PC.
SMCE	A PC Ethernet interface.
SMCEU	A PC Ethernet interface.
IEE	A PC Ethernet interface.
HEE	A PC Ethernet interface.
IEEF	A PC Ethernet interface.
EEPRO	A PC Ethernet interface.
NEI	A PC Ethernet interface.
RI	A PC Ethernet interface.
XP	A PC Ethernet interface.
PCN	A PC Ethernet interface.

TABLE 7–2 Device Types *(continued)*

Value	Meaning
FDDI	An FDDI interface.
TR	A Token Ring interface.

For the x86 version of the product, the device type depends on the type of Ethernet card used by your PC. The default `ELX-0` applies to the 3Com Etherlink III card. If IP is running, you can find out what device type your PC uses by entering the following command: Included in the information returned by this command is the name of the device that IP is running over. Use this same device type for X.25.

```
hostname% ifconfig -a
```

Note - The list of device types available for the x86 version of the product is constantly being updated. Therefore, your PC may use a device that is not shown in Table 7–2. If this is the case, you can add the new device to the device types list in the Boards Definition window. See “Definition” on page 33 for more information.

Port Number (`device`*)*

The port number of the LAN or WAN device used beneath X.25. The Device Type plus the Port Number must form a unique identifier for each link.

Tx Clock (`line_speed`*)*

Set this to either External, or specify the appropriate bit rate (in `x25tool`, you select the bit rate from the drop down menu). If you choose External, both the transmit clock and receive clock are set to external This means that the clocking speed is provided by a synchronous modem or modem eliminator.

If you specify a bit rate, this means that the local machine supplies the clocking, so make certain that the bit rate you select matches the transmission rate of the local machine.

Frame Window Sizes (`locmaxwinsize`, `remmaxwinsize`, `locdefwinsize`, `remdefwindsize`*)*

Window sizes can be in the range 1 to 7 for modulo 8 networks, or 1 to 127 for modulo 128 networks. The default must be less than or equal to the maximum.

*Interface (*mode*)*

This applies to WAN connections only. Choose between DTE and DCE. If you are connecting to a PSDN via a modem, the machine running the Solstice X.25 software is the DTE and the modem acts as the DCE. If you are connecting two machines back-to-back, make one the DTE and the other the DCE.

*LAP Protocol (*protocol*)*

This applies to WAN connections only. Choose between LAP, LAPB and LAPBE. Almost all PSDNs use LAPB.

*Local X.121 Address (*local_address*)*

For WAN interfaces this is your DTE or DCE address, normally an X.121 address, consisting of a DNIC, NTN, and, optionally, a subaddress. Your service provider should notify you of what this address is. A small number of public networks require that the calling address in an outgoing packet not contain the full X.121 address (for example, Transpac only requires the sub-address). In such a case, enter the “short” version of your X.121 address (as specified by your service provider) in this field. Your service provider will inform you if you need to do this.

For LAN interfaces, this is a six-byte (12 hexadecimal) digit address. The default of twelve zeroes tells Solstice X.25 to use your machine’s default MAC address. To use the MAC address stored on an interface controller card (such as the address on the FDDI/S SBus card) enter the address as twelve consecutive hexadecimal digits or as pairs of hexadecimal digits, with colons between each pair and leading zeroes within pairs omitted.

*Version (*network*)*

The version of the X.25 Recommendation that your PSDN conforms to—1980, 1984, or 1988.

*Packet Size (*locmaxpktsize, locdefpktsize, remmaxpktsize, remdefpktsize*)*

Sets the packet size for all priority call requests and incoming calls. Possible values are: Default, 16, 32, 64, 128, 256, 512, 1024, 2048 and 4096.

Note - In the configuration file, packet sizes are expressed as powers of 2. For example, to specify 128, enter 7.

---

*Logical Channel Ranges (*pvc_range, inc_range, out_range, two_range*)*

Consult your service provider to find out the correct logical channel ranges to use. For each type of virtual circuit you use, you must set the channel ranges so that they match the range of numbers specified by your PSDN. For back-to-back or LAN connections, you must match the logical channel numbers used by the remote hosts with which you intend to communicate. Mismatches between logical channel number ranges are frequently the cause of inability to establish connections. A common symptom of an LCR mismatch is that connections operate in one direction only.

LAPB and WAN Parameters

You can access the LAPB and WAN Parameters window from the Link Editor.

The parameter values are stored in the link configuration files /etc/opt/SUNWconn/x25/config/link_config_*nnnn*.cfg, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

Use the LAPB and WAN Parameters screen to configure the datalink and physical layer parameters used by a LAPB link.

LAPB Parameters

The LAPB layer parameters are:

*Ack Timer (T1) (*t1_timer*)*

The period, in tenths of a second, during which the LAPB software expects to receive an acknowledgment to an outstanding I-frame or during which LAPB expects a response to a sent unnumbered frame. The valid range for values of this parameter is between 1 and 3000.

*P-bit Timer (*pf_timer*)*

The period, in tenths of a second, during which the LAPB software expects to receive a frame with the F-bit set to 1 in response to a command with the P-bit set to 1. This value should be less than that specified for the Ack Timer. The valid range for values of this parameter is between 1 and 3000.

*Reject Timer (*reject_timer*)*

The period, in tenths of a second, during which the LAPB software expects to receive a reply to a sent Reject frame. The valid range for values of this parameter is between 1 and 10000.

*Busy-state Timer (*busy_timer*)*

The period, in tenths of a second, during which the LAPB software waits for an indication of the clearance of a busy condition at the other end of the link. The valid range for values of this parameter is between 1 and 30000.

*Link Idle Timer (*idle_timer*)*

The period, in tenths of a second, during which the LAPB software expects to receive a frame from the other end of the link. If this timer expires, the Poll/Final cycle—which might result in link disconnection—is initiated. A zero value disables this function. The valid range for values of this parameter is between 0 and 32000.

*Max. RR Delay (*rr_ack_delay*)*

The maximum delay, in tenths of a second, before transmitting a delayed Receiver Ready. The value for this parameter must be significantly lower than the Ack Timer value. The valid range for values of this parameter is 0 to 3000.

*Max Tries (N2) (*n2_count*)*

The maximum number of times that an I-frame (information frame) is sent following the expiration of the Ack Timer, the P-bit Timer, or the Reject Timer. It also limits the number of times Receive Ready with P-bit set is sent when the remote side is busy and the Busy Timer expires. The valid range for values of this parameter is 1 to 255.

*Max UnACKed IPDUs (*unack_max*)*

The maximum number of unacknowledged I-frames that can be received before the Receive Ready acknowledging those I-frames must be sent. The valid range for values of this parameter is 0 to 127 for modulo 128, and 0 to 7 for modulo 8.

*Transmit Probe (*local_probe*)*

The position within a window at which the LAPB software sends an I-frame with the P-bit set, to ask for an acknowledgment from the receiver. The valid range for values of this parameter is 0 to 127.

*MLP Priority (*mlp_priority*)*

Note - This parameter appears in the LAPB and WAN Parameters window when the Link Type is set to MLP in the Link Editor Window. In this instance, to access the LAPB and WAN Parameters window, you must call up the MLP Parameters window, then double click on the SLP you want to configure. For more information, see "MLP Parameters" on page 76.

This parameter defines how many unacknowledged frames can be sent on one line before the next line is used. Setting this correctly forces traffic to be distributed between the lines in an MLP link. The values you set depend on the absolute speed of each line, and on the relative speeds of your lines. In general, don't set an MLP Priority of less than 3. If your lines operate at 64kbps, or more, you should increase the MLP Priority.

The following combinations of values provide efficient (90%) line use in two-line MLP configurations:

- For two 64Kbps lines, set the MLP Priority for each line to 10. In the MLP Parameters window, set the MLP Window and MLP Guard to 25. See "MLP Parameters" on page 76 for more information.
- For one 512Kbps line and one 128Kbps line, set the MLP Priorities to 30 and 5, respectively. In the MLP Parameters window, set the MLP Window to 40. See "MLP Parameters" on page 76 for more information.

Link Conformance

*Ignore UA if in ERROR state I (*ign_ua_error*)*

When the connection is in an Error state, ignore any Unnumbered acknowledgment frames received.

*FR on receipt of FR if in ERROR (*frmr_frmr_error*)*

When the connection is in an Error state, retransmit a Frame Reject if one is received.

*FR on Inv. Resp. if in ERROR (*frmr_invrsp_error*)*

When the connection is in an Error state, transmit a Frame Reject if an invalid Frame Response is received.

*Send FR if S-Frame & no P-bit (*sframe_pbit*)*

If an S-frame is received without the P-bit set, send a Frame Reject.

*No DM on entry to ADM state (*no_dm_adm*)*

Do not transmit a DM on entry to the ADM state.

*Abandon X.32 registration on SABM(*sabm_in_x32*)*

Abandon X.32 registration if a SABM is received.

*ISO8882 Conformance (*iso8882*)*

Run the link so that it is conforms *exactly* to the specifications in the ISO 8882 standard.

*Initial state of link is "Off" (*initial_down*)*

When the Solstice X.25 software comes up, the link is off. To switch it on subsequently, use the `linkstart` command.

Enable X.32 Authentication (x25_x32_enable_authen)

When this is set to Yes, an X.32 identity and signature can be configured for a subnetwork. X.32 authentication procedures are used with dial-up configurations to prevent people from dialing in without permission This is a client-only implementation of X.32.

*Signature (*x25_x32_sign*)*

An X.32 signature of up to 32 hexadecimal characters. Do not use whitespace.

*Identity (*x25_x32_identity*)*

An X.32 identity of up to 32 hexadecimal characters. Do not use whitespace.

WAN Parameters (V25bis)

The physical layer parameters for a single LAPB link are:

Calling Procedures (`connect_proc`*)*

The type of calling procedure to use: None or V25*bis*.

V.25bis Call Request Timer (`v25_callreq`*)*

Set this if you are using the V.25 Calling Procedures. This timeout is only needed if the network does not support call fail indications. The valid range for values for this parameter, in tenths of a second, is between 60 and 300.

LLC2 Parameters

You can access the LLC2 Parameters window from the Link Editor.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

The parameters described in this section configure the datalink and physical layers of a LAN link.

Ack Timer (T1) (`t1_timer`*)*

The period, in tenths of a second, during which the LLC2 software expects to receive an acknowledgment to an outstanding I-frame. The valid range for values of this parameter is between 1 and 3000.

Max Tries (N2) (`n2_count`*)*

Maximum number of times the LLC2 software sends a PDU following the expiration of the Ack Timer, the P-bit Timer, or the Reject Timer. The value of this parameter also limits the number of times Receive Ready with P-bit set is sent when the remote side is busy and the Busy Timer expires. The valid range for values of this parameter is between 1 and 255.

*P-bit Timer (*pf_timer*)*

The period, in tenths of a second, during which the LLC2 software expects to receive a frame with the F-bit set to 1 in response to a command with the P-bit set to 1. This value should be less than that specified for the Ack Timer. The valid range for values of this parameter is 1 to 3000.

*Max UnACKed IPDUs (*unack_max*)*

The maximum number of unacknowledged I-frames that can be received before the Receive Ready acknowledging those I-frames must be sent. The valid range for values of this parameter is 0 to 127.

*Reject Timer (*reject_timer*)*

The period, in tenths of a second, during which the LLC2 software expects to receive a reply to a sent Reject frame. The valid range for values of this parameter is 1 to 10000.

*Transmit Probe (*local_probe*)*

The position within a window at which the LLC2 software sends an I-frame with the P-bit set, to ask for an acknowledgment from the receiver. The valid range for values of this parameter is 0 to 127.

*Busy-state Timer (*busy_timer*)*

The period, in tenths of a second, during which the LLC2 software waits for an indication of the clearance of a busy condition at the other end of the link. The valid range for values of this parameter is 1 to 3000.

*Link Idle Timer (*idle_timer*)*

The period, in tenths of a second, during which the LLC2 software expects to receive a frame from the other end of the link. If this timer expires, the Poll/Final cycle is initiated. A zero value disables this function. The valid range for values of this parameter is 0 to 32000.

*Max RR Delay (*rr_ack_delay*)*

The maximum delay, in tenths of a second, before transmitting a delayed Reset Request. The value for this parameter must be significantly lower than the Ack Timer value. The valid range for values of this parameter is between 0 and 3000.

XID Parameters

XID Window Size (`xid_window`*)*

This determines the receive window size. That is, the maximum number of unacknowledged I-frames that the remote end of the link can send. The valid range for values of this parameter is 1 to 127.

Duplicate MAC XID Count (`xid_ndup`*)*

This indicates the number of times the LLC2 software tries to find stations with duplicate MAC addresses. A value of 0 means no attempt is made. The valid range for values of this parameter is 0 to 255.

Duplicate MAC XID Timer (`xid_tdup`*)*

The period, in tenths of a second, during which incoming XID response frames are checked for a duplicate response to the station LSAP. A value of 0 tells the LLC2 software not to perform the duplicate address check. The valid range for values of this parameter is 0 to 3000.

MLP Parameters

You can access the MLP Parameters window from the Link Editor. The MLP Parameters window is divided into two sections. The first section contains parameters that apply to the multiple link in general. The second section contains a list of the physical ports that are associated with each link.

Note - You can access the MLP Parameters window only when the Link Type is set to MLP in the Link Editor window.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

The parameters described in this section configure the additional datalink parameters for an MLP link.

*MLP Window (*mlp_window*)*

The maximum number of outstanding unacknowledged frames allowable. This should be larger than the total of the MLP Priority values. The valid range for this parameter is 0 to 4095.

Note - All of the machines connected to the same network must use the same MLP Window size. If you are connecting to a PSDN, check with your service provider to find out the appropriate MLP Window size to use. This may restrict the MLP Priority values that you can set, as the total of the MLP Priority values must not be greater than the MLP Window size.

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*N1 Count (*mn1_val*)*

The maximum number of times that MLP attempts to send a frame to an SLP without receiving an acknowledgment. The valid range for this parameter is 1 to 255.

*Lost Frame Timer [MT1] (*mt1_val*)*

The time, in tenths of a second, during which MLP expects to receive an acknowledgment to an outstanding frame. The valid range for this parameter is 1 to 3000.

*Group Busy Timer [MT2] (*mt2_val*)*

The time, in tenths of a second, during which MLP waits for system resources, for example buffer space, to become available before declaring a frame as blocked and dropping it. The valid range for this parameter is 1 to 3000.

*Reset Confirm Timer [MT3] (*mt3_val*)*

The length of the timer, in tenths of a second, that determines how long the DTE waits for confirmation from the DCE that it has reset. The valid range for this parameter is 1 to 3000.

Physical Ports Associated with this Link

In x25tool, the physical ports associated with the link are displayed in the bottom half of the MLP Parameters window. Double clicking on a port here brings up the LAPB and WAN Parameters window described in “LAPB and WAN Parameters” on page 70. You need to configure the parameters for each SLP that is associated with the link.

Addressing

To access the Addressing parameters window from `x25tool`, click on the Addressing button in the Link Editor window. The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

Extended Address (`full_address`*)*

Choose None (the default), OSI, or non-OSI. This is the type of extended address you use in the network to which the link you are configuring is attached. Not available for WAN (1980) link types.

Extension (for non-OSI) or OSI NSAP (for OSI extended addresses)

Enter a hexadecimal address of 40 digits or fewer. Not available for WAN (1980) link types.

LAN Addresses

The following parameters apply to LAN addresses, only.

Local SAP

This applies to LAN connections, only. It is a one-byte (two-hexadecimal-digit) address. The default of `7e` is the standard SAP for LLC2 under X.25.

Loopback SAP

This applies to LAN connections only. It is a one-byte (two-hexadecimal-digit) address. The default of `70` is the standard loopback SAP for LLC2.

Max Conns (`max_lan_conns`*)*

It is the maximum number of simultaneous connections to be made over this link.

Closed User Groups and Facilities

You can access the Closed User Groups and Facilities window from the Link Editor.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

Closed User Groups (`sub_cug`, `sub_pref_cug`, `sub_cugoa`, `sun_cugia`, `bar_cug_in`*)*

Choose any of the settings, listed below, that correspond to the CUG options to which you subscribe.

- CUG, no other access
- Preferential CUG
- CUG, with outgoing access
- CUG, with incoming access
- Reject incoming CUG calls

CUG Format (`cug_format`*)*

Choose either Basic or Extended.

Facilities (`accept_revchg`, `prev_chg`, `bar_incall`, `bar_outcall`, `sub_toa_npi_fmt`, `bar_toa_npi_fmt`, `sub_nui_override`, `bar_call_x32_reg`*)*

Choose any of the settings, listed below, that correspond to PSDN facilities to which you subscribe.

- Incoming Reverse Charging
- Local Charging Prevention
- Bar Incoming calls
- Bar Outgoing calls
- Allow TOA / NPI Addressing
- Bar TOA / NPI Addressing
- Allow NUI Override

- Bar Outgoing during X.32 registration

*Size Negotiation (*use_negotiation*)*

Choose *Request size negotiation* or *Disallow size negotiation* or neither.

If you select Request size negotiation, outgoing calls automatically contain packet and window size negotiation. Incoming calls are negotiated if they contain packet and window size negotiation.

If you select Disallow size negotiation, incoming calls containing packet and window and size negotiation are rejected.

If you select neither option, outgoing calls will not contain any packet or size negotiation information. However, incoming calls with packet and size negotiation information will still be accepted.

*Fast Select (*fast_select*)*

The options for Fast Select are *With no restriction on response* and *With restriction on response*. You can select one or both options. *With no restrictions* allows incoming fast select calls with no restriction on response. *With restrictions* allows incoming fast select calls with restriction on response. When these options are selected together, all incoming fast select calls are allowed.

Link Modes

You can access the Link Modes parameters window from the Link Editor window.

The parameter values are stored in the link configuration files /etc/opt/SUNWconn/x25/config/link_config_*nnnn*.cfg, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

These parameters deal with options and requirements of the PSDN to which you are connecting.

*Allow omission of diagnostic packets (*acc_nodiag*)*

Allow the omission of the diagnostic byte in incoming Restart, Clear and Reset Indications.

*Use diagnostic packets (*use_diag*)*

Force the use of the diagnostic byte in incoming Restart, Clear and Reset Indications.

*Restrict Clear Lengths (*ccitt_clear_len*)*

Restrict the length of a Clear Indication to 5 bytes and Clear Confirm to 3 bytes. This parameter only applies to 1980 networks.

*Disallow diagnostic packets (*bar_diag*)*

Disallow the use of the diagnostic byte in incoming Restart, Clear, and Reset Indications.

*Discard diagnostics on non-Zero LCN (*disc_nz_diag*)*

Some PSDNs use channels other than zero to transmit diagnostic information. This parameter lets you discard this information, should you need to.

*Allow hex digits in DTE addresses (*acc_hex_add*)*

Use this parameter if you want to be able to use addresses that do not conform with the X.121 specification.

*Bar nonprivileged listeners (*bar_nonpriv_listen*)*

Only the superuser can start a process, like the PAD daemon, that “listens”.

*Strict ISO8882 Conformance (*iso_8882_mode*)*

This parameter is for test purposes only.

*Keep X.121 address in Call Request to LAN(*send_x121_to_lan*)*

Includes X.121 address in X.25 packet.

*Insert X.121 address in Call Indications from LAN (*insert_x121_from_lan*)*

Inserts the X.121 address into Call Indications.

Process Priority According the DATAPAC (1976) rules (`datapac_priority`*)*

Apply the rules used by the 1976 Datapac recommendations to calls.

Prioritize International Calls (`intl_prioritised`*)*

Some networks let you give priority to international calls. If you set this parameter, you need to set Priority Encoding. See Table 7–3 for information.

Priority Encoding (`prty_encode_control`*)*

The value of this parameter determines Solstice X.25's action with respect to prioritizing international calls.

Table 7–3 lists the available choices:

TABLE 7–3 Priority Encoding

Priority Encoding Parameter	Parameter Value	Meaning
No special action	0	Solstice X.25 performs no special encoding.
DATAPAC Priority Bit	1	The software encodes the priority request using the DATAPAC Priority Bit (1976 version).
DATAPAC Traffic Class	2	Priority request encoded using the DATAPAC Traffic Class (1980 version using the Calling Network facility marker).

Outgoing International calls (`intl_addr_recogn`*)*

The value of this parameter determines how outgoing international calls are handled.

Table 7–4 lists the available choices:

TABLE 7–4 Outgoing International Call Parameters

Outgoing International Call Parameter	Parameter Value	Meaning
Not distinguished:	0	No special action taken for international calls.
Check National DNIC:	1	Solstice X.25 compares the DNIC in the called address to the local DNIC. The software assumes that a mismatch indicates an international call.
Prefix digit of 1	2	The software assumes a called address with a prefix of 1 indicates an international call.
Prefix digit of 0	3	The software assumes a called address with a prefix of 0 indicates an international call.

National DNIC (`dnic`*)*

Enter your national DNIC number. You must enter this code if you choose Check National DNIC in the Outgoing International calls menu.

Forced Packet Size (`prty_pkt_forced_value`*)*

This sets the packet size for all priority call requests and incoming calls. The possible values are: Default, 16, 32, 64, 128, 256, 512, 1024, 2048, and 4096.

In the configuration file, the packet sizes are expressed as powers of 2. For example, to specify 128, enter 7.

Source Address Control (`src_addr_control`*)*

Determines the value inserted in the calling address field of outgoing call requests over a WAN link. It does not apply to LAN links.

The choices as shown in Table 7–5 are:

TABLE 7–5 Source Address Control Parameters

Source Address Control Parameter	Parameter Value	Meaning
No special action	0	Solstice X.25 puts the calling address in the outgoing call request exactly as it receives it from an application making the call.
Omit calling address	1	Solstice X.25 sets the calling address to null in the outgoing call request, regardless of what was specified by the calling application.
Default to local address	2	Solstice X.25 uses the local address as the calling address if no calling address is supplied by the application.
Force use of local address	3	Solstice X.25 uses the local address as the calling address, even if a calling address is supplied by the application.

The term *local address* refers to the value of the Local Address parameter in the Interface Configuration window.

PVC Options

If you plan to use one or more permanent virtual circuits (PVCs) you can specify different local and remote packet and window sizes for each PVC.

The PVC options are only available for LAPB links. You *only* need to use them if you plan to use one or more permanent virtual circuits (PVCs) to connect to your X.25 network *and* you require different packet and window sizes for the PVCs than those used for switched virtual circuits on the same link.

You can access the PVC Options window from the Link Editor.

The PVC parameter values are stored in the configuration file `/etc/opt/SUNWconn/x25/pvcmapconf`.

Using `x25tool` to Set PVC Options

In `x25tool`, to access the PVC window you must first enter values for PVC minimum and maximum in the Logical Channel Range section of the Link Editor, and then click on Apply.

The PVC Options window displays a list of PVC numbers for the currently selected link. To add a PVC, click on Add, then edit the options. Once you have configured the options to meet your requirements, click on Apply. The parameters for the PVC will be added to the displayed list.

To modify an existing PVC, click on the appropriate PVC number in the displayed list of PVC parameters. Edit the options as required and click on Apply.

PVC Number

The number of the PVC you want to configure.

Local Packet

The local packet size. Choose from 16, 32, 64, 128, 256, 512, 1024, 2048, and 4096. In the configuration file, the packet sizes are expressed as powers of 2. For example, to specify 128, enter 7.

Remote Packet

The remote packet size. Choose from 16, 32, 64, 128, 256, 512, 1024, 2048, and 4096. In the configuration file, the packet sizes are expressed as powers of 2. For example, to specify 128, enter 7.

Local Window

The local window size. Enter a number in the range 1 to 7 for modulo 8 networks, or 1 to 127 for modulo 128 networks.

Remote Window

The remote window size. Enter a number in the range 1 to 7 for modulo 8 networks, or 1 to 127 for modulo 128 networks.

Throughput Class and Packet Sizes

You can access the Throughput Class and Packet Sizes window from the Link Editor.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

The Throughput Class and Packet Sizes window allows you to set values for throughput class parameters and to set Layer 3 (network layer) window and packet sizes.

Throughput Class (`thclass_type`*)*

The standard range for throughput class, as specified in ISO 8208, is 3 through 12, corresponding to a range of 75 to 48000 bps. However, Solstice X.25 supports 0 through 15, allowing for non-standard X.25 network implementations. If you connect to a non-standard network, use the throughput class options in the Special Parameters window (see “Special Parameters” on page 90) to specify values for that network. If you need to use non-standard values, your service provider should tell you what they are.

Negotiate Toward Defaults (`thclass_neg_to_def`*)*

Allows for configuration for non-standard X.25 networks, such as TELENET (a US network). The default (No) is the appropriate choice for the vast majority of network connections. When set to No, negotiation is towards mutually acceptable minima, rather than the default values.

Packet Size - Maximum NSDU Length (`maxnsdulength`*)*

This determines the maximum size (in bytes) to which packets with the M (more data) bit set can be concatenated. This parameter has a range of values from 1 to 32000. The default maximum size is 256.

Network Profile (`modulo`*)*

Set to modulo 8 or modulo 128 according to whether your network uses packet sequence numbers ranging from 1 to 7 or 1 to 127.

*Window Size (*locmaxwinsize, remmaxwinsize, locdefwinsize, remdefwindsize*)*

You need to specify the Default and Maximum packet sizes for the local and remote networks. Window sizes can be in the range 1 to 7 for modulo 8 networks or 1 to 127 for modulo 128 networks. The default must be less than or equal to the maximum.

Timers and Counters

You can access the Timers and Counters window from the Link Editor.

The parameter values are stored in the link configuration files /etc/opt/SUNWconn/x25/config/link_config_*nnnn*.cfg, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

These parameters set CCITT-defined timers. The values are:

X.25 Timers

*Restart Response [T20] (*t20value*)*

This timer starts when the DTE issues a Restart Request. It terminates when the DTE receives a Restart Confirmation or a Restart Indication. If neither is received in the time allowed, the DTE retransmits the Restart Request. The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The recommended value is 1800.

*Call Req Response [T21] (*t21value*)*

This timer starts when the DTE issues a Call Request. It terminates when the DTE receives a Call Connected, Clear Indication or Incoming Call. If none of these are received in the time allowed, the DTE issues a Call Request. The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The recommended value is 2000.

*Reset Response [T22] (*t22value*)*

This timer starts when the DTE issues a Reset Request. It terminates when the DTE receives a Reset Confirmation or a Reset Indication. If neither is received in the time allowed, the DTE retransmits the Reset Request or sends a Clear Request. The valid

range for values of this parameter, in tenths of a second, is 0 to 32000. The recommended value is 1800.

*Clear Req Response [T23] (*t23value*)*

This timer starts when the DTE issues a Clear Request. It terminates when the DTE receives a Clear Confirmation or Clear Indication. If neither is received in the time allowed, the DTE retransmits the Clear Request. The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The recommended value is 1800.

*DTE Window Status [T24] (*t24value*)*

This timer does not exactly match the DTE Window Status Transmission Timer, T24. Instead, it specifies the maximum time for which data received from the remote side can remain unacknowledged due to a flow control condition. After expiration of this timer, any outstanding acknowledgments are carried by an X.25 Receive Not Ready packet. This timer makes sure that the remote side not receiving an acknowledgment does not cause resets within the virtual circuit. This timer should be about half the value of Window Rotation (see next section). The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The default value is 600.

*Window Rotation [T25] (*t25value*)*

This timer starts when the DTE transmits a data packet, or the DTE's window is rotated, but there are still outstanding data packets. It terminates when there are no outstanding data packets in the window. If this does not happen within the allowed time, the DTE initiates an error procedure by transmitting a Reset Request with diagnostic `0x92`. The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The default value is 2000.

*Interrupt Response [T26] (*t26value*)*

This timer start when the DTE sends an Interrupt packet. It terminates when the DTE receives an Interrupt Confirmation. It this is not received in the time allowed, the DTE transmits a Reset Request. The valid range for values of this parameter, in tenths of a second, is 0 to 32000. The default value is 1800.

*Registration Request [T28] (*t28value*)*

The ISO Registration Request timer. The valid range for values of this parameter, in tenths of a second, is 0 to 32000.

*Pending Ack Delay (*ackdelay*)*

Specifies the maximum time during which a pending acknowledgment is withheld. Solstice X.25 tries to suppress the generation of Layer 3 Receiver Ready control packets. Acknowledgment carried by data or multiple acknowledgments is preferred to each data packet being explicitly and separately acknowledged. The valid range for values of this parameter, in tenths of a second, is 1 to 32000.

*DTE/DCE Resolution (*connectvalue*)*

The period in which the DTE/DCE resolution should be completed. This prevents two packet-level entities failing to resolve their DTE/DCE roles. When this timer expires, the link connection is disconnected and all pending connections aborted. The valid range for values of this parameter, in tenths of a second, is 0 to 32000.

*Idle Disconnect (LAN or Dialup) (*idlevalue*)*

The period, in tenths of a second, over which Solstice X.25 maintains an idle link-level connection. For a WAN dial-up, the idle disconnect period should not be set to zero. For LANs, the default is 600.

X.25 Retransmission Counters

*DTE Restart Request[R20] (*r20value*)*

The number of Restart Requests that will be sent before the link is assumed to be down. The allowable range is 1 to 255. The default is 1. Make sure you set a value that is high enough to cope with lost traffic and network delays, but low enough to resolve problems with little disruption to users.

*DTE Clear Request[R22] (*r22value*)*

The number of Clear Requests that will be sent before the link is assumed to be down. The allowable range is 1 to 255. The default is 1. Make sure you set a value that is high enough to cope with lost traffic and network delays, but low enough to resolve problems with little disruption to users.

*DTE Reset Request[R23] (*r23value*)*

The number of Reset Requests that will be sent before the link is assumed to be down. The allowable range is 1 to 255. The default is 1. Make sure you set a value

that is high enough to cope with lost traffic and network delays, but low enough to resolve problems with little disruption to users.

DTE Registration Request[R28] (`r28value`*)*

The number of Registration Requests that can be sent without acknowledgment. The allowable range 1 to 255. The default is 1.

X.25 Transit Delays

Internal Delay (`local_delay`*)*

The maximum period in milliseconds by which transmission can be delayed due to internal processing. The allowable range is 0 to 32000 milliseconds. The default is 5.

Line Delay (`access_delay`*)*

The maximum period in milliseconds by which transmission can delayed due to the effects of line transmission rate. The allowable range is 0 to 32000 milliseconds. The default is 5.

Special Parameters

You can access the Special Parameters window from the Link Editor.

The parameter values are stored in the link configuration files `/etc/opt/SUNWconn/x25/config/link_config_`*nnnn*`.cfg`, where *nnnn* is the four-digit number that indicates the link number (for example, the file link_config_0004.cfg contains the parameters for link number 4).

Use these parameters to set values for D-bit options and throughput class. The throughput class parameters are only for those X.25 networks that do not use standard X.25 packet and window size negotiation.

D-bit Control

The following parameters are available:

*Call Accept In (*dbit_accept_in*)*

Determines Solstice X.25's response when it receives a Call Accept packet with the D-bit set and end-to-end acknowledgment was not requested. The options are:

- Leave D-bit set
- Clear call
- Zero D-bit

*Call Accept Out (*dbit_accept_out*)*

Determines Solstice X.25's response when it sends a Call Accept packet with the D-bit set and receives a packet from the remote side with the D-bit turned off. The options are:

- Leave D-bit set
- Clear call
- Zero D-bit

*Data In (*dbit_data_in*)*

Determines Solstice X.25's response when it receives a Data packet with the D-bit set. The options are:

- Leave D-bit set
- Reset call
- Zero D-bit

*Data Out (*dbit_data_out*)*

Determines Solstice X.25's response when an application tries to send a data packet with the D-bit set. The options are:

- Leave D-bit set
- Reset call
- Zero D-bit

Throughput Class Packet/Window Mapping

*Throughput Class Type (*thclass_type*)*

The values are:

- Normal Negotiation
- Use Low Nibble of Map
- Use High Nibble of Map
- Use Both Nibbles of Map

Throughput maps entry number

If you are connecting to a non-standard X.25 network and the map entry of 0 is not appropriate for your X.25 network, choose a value between 1 and 15.

Packet Map (`thclass_pmap`*)*

The range for valid packet sizes is 16 to 4096.

Note - In the configuration file, packet sizes are expressed as powers of 2. For example, to specify 128, enter 7.

Window Map (`thclass_wmap`*)*

A number in the range from 1 to 127.

Identity (`x25_x32_identity`*)*

An X.32 identity of up to 32 hexadecimal characters. Do not use whitespace.

IP over X.25

Solstice X.25 can route IP if you set up a mapping between IP and X.25 (X.121) addresses. In `x25tool`, the parameters for IP over X.25 configuration are divided into two windows: the IP Interface Configuration window and the Remote IP Host to X.25 Address Map. To access one of these windows, from the Services menu, click on IP and select either IP Interface or IP Mapping.

The parameter values are stored in the configuration files `/etc/opt/SUNWconn/x25/ipconf` and `/etc/opt/SUNWconn/x25/ixemapconf`.

IP Interface Configuration

Local IP address

Enter an IP address in either name or numeric form.

Point to

Choose between point-to-multipoint, or point-to-point.

IP Subnet Mask/Remote IP Address

For point to multipoint networks, this is “IP Subnet Mask”; for point-to-point networks, the item is “Remote IP Address”.

For *IP Subnet Mask*: The mask number used in the specified IP network, expressed in IP dot notation. For example: 255.255.255.0, indicates a Class C subnetwork mask. Enter + to use the local default.

For *Remote IP Address*: The IP address, in name or numeric form, for the host at the remote end of the point-to-point connection.

MTU

This sets the maximum transmission unit size for the network service access point that the IP protocol will use to transmit data over X.25.

Note - The MTU value you set here must be smaller than the NSDU value specified under Packet Size in the Throughput window.

X.25 Parameters

The following X.25 parameters are related to the IP interface. In most cases you will not need to modify the default values.

Listen Information

Called Address

Specifies the pattern of digits Solstice X.25 uses to match the called address on incoming calls for IP. The options are:

- *Starts with:* Solstice X.25 accepts calls from callers that have called addresses that have leading digits that match the string of hexadecimal digits you enter here.
- *Matches:* Solstice X.25 accepts calls from callers that have called addresses that exactly match the string of hexadecimal digits you enter here.
- *Don't care:* Solstice X.25 accepts calls from any caller, regardless of its called address.

If you choose *Starts with* or *Matches*, enter a string of digits to be matched.

Address Mapping

Choose between CCITT, DDN Basic and DDN Standard. These options are alternative ways of mapping between IP and X.25 addresses.

Call User Data

Specifies the pattern of digits Solstice X.25 uses to match the Call User Data on incoming calls for IP. X.25 software uses the first 2 digits of the call user data (CUD) field to distinguish between PAD and IP calls. The CUD field of a PAD call always begins with `01`. The CUD field of an IP call always begins `CC`. If you want to add any further CUD to be used in outgoing PAD calls, make sure you append it to the `01`. Do not delete the `01`—if you do, the X.25 software receiving the call will not know which application to pass it to and the call will fail.

The options are:

- *Starts with:* Solstice X.25 accepts calls from callers that have CUD fields that have leading digits that match the string of hexadeciaml digits you enter here. The default of "Starts with" CC is the standard Call User Data value for IP over X.25 as specified in RFC 877.
- *Matches:* Solstice X.25 accepts calls from callers that have CUD fields that exactly match the string of hexadeciaml digits you enter here.
- *Don't care:* Solstice X.25 accepts calls from any caller, regardless of its CUD field.

If you choose *Starts with* or *Matches*, enter a string of hexadecimal digits to be matched.

Timers

Pre-emption Timer

This is the time in seconds that a connection must have been open before it can be closed (pre-empted). If all X.25 virtual circuits available to IP are in use and an IP packet arrives for transmission to a new destination, Solstice X.25 closes one of the existing connections—the one that has been idle the longest. The pre-emption timer determines the minimum time a connection must be open before it can be pre-empted in this way.

When setting this timer, take into account the amount of traffic on your link and the speed your link runs at. The default is suitable for links running at 9600 bps.

Hold Down Timer

The minimum amount of time, in seconds, to wait before re-trying a call to a host after an unsuccessful call.

Disconnection Timer

This is the time, in tenths of a second, that a connection to a given network can remain idle before being closed. This timer is configurable for each X.25 network to which you connect. When the disconnection timer expires, if there is no data on a connection, the virtual circuit to the X.25 network is closed. If data arrives from IP after this, the circuit is reopened.

When setting this timer, take into account the amount of traffic on your link and the speed your link runs at. The default is suitable for links running at 9600 bps.

Actions

Reset Action

The options are:

- *Acknowledge and discard:* Acknowledge Reset Request packet and discard it.
- *Disconnect:* Causes a Clear Request packet to be sent to remote host.

Expedited Data Action

For expedited data, the menu options are defined as follows:

- *Acknowledge and discard:* Acknowledge expedited data and discard it.
- *Disconnect:* Disconnect connection in response to expedited data.
- *Reset connection:* Reset connection in response to expedited data.

Accept Unknown Hosts

To restrict access, adding a measure of security, you can choose not to accept calls from unknown hosts, that is hosts who addresses are not in the Remote Host to X.25 Address Map.

Remote IP Host to X.25 Address Map

Link Number

Enter a link number specifying the link over which you reach the IP network specified in the IP Subnet Mask/Remote IP Address.

Remote IP Address

The IP address of the remote IP host, in either hostname or numeric form.

Circuit is

Set to either SVC (switched virtual circuit) or PVC (permanent virtual circuit). If this parameter is set to SVC, you will need to include the remote X.25 address. If this parameter is set to PVC, you will need to set the PVC number.

Remote X.25 Address

The X.25 (X.121) address of the specified remote host. If you are attached to the DDN, the X.25 address is generated using the IP address. You do not need to enter it here, although if you do other information you enter can be taken into account. If you do want to enter the X.25 address, you need to calculate it in the same way as the DDN software.

Extended Address

If you are using extended addressing, choose either OSI or non-OSI. Otherwise, choose None.

Extension

If you are using extended addressing, enter the OSI NSAP address or non-OSI address extension. An OSI NSAP address is 40 or fewer hexadecimal digits.

X.25 Parameters for IP Mapping

Packet Size

The size of the X.25 packet that will carry IP datagrams. In accordance with RFC 877, when IP datagrams are longer than the X.25 packet size, Solstice X.25 uses the M-bit to transmit the datagrams as complete packet sequences. Fragmentation of IP datagrams occurs only if the size of an IP packet exceeds the maximum transmission unit (MTU) size for a given subnetwork.

Window Size

This parameter applies to calls in both directions and should not be larger than the window size value you specified for X.25.

Reverse Charge

Determines whether the software will request reverse charging when proposing calls to the remote host.

RPOA Numbers

A four-digit number that provides networks between you and the remote host with additional routing information. You can have up to four RPOA numbers. If you have multiple RPOA numbers, enter them together in the same sequence of digits, with no spaces between.

Closed User Group

CUG Type

Possible values are none, multi-user and bilateral CUG.

CUG Number

If your host is a member of a multi-user or bilateral CUG, enter the CUG number.

PAD Hosts Database

In `x25tool`, the parameters for the PAD Hosts Database can be accessed through the Services menu.

The parameter values are stored in the configuration files:
`/etc/opt/SUNWconn/x25/padmapconf`,
`/etc/opt/SUNWconn/x25/x29profile`,
and `/etc/opt/SUNWconn/x25/xhosts`.

The PAD Hosts Database contains information about remote hosts that makes it easier for users to make PAD calls to them.

Default values for these parameters can be configured on a per-call basis. See *Solstice X.25 9.2 PAD User's Guide*. The parameters are:

Remote X.121 Address

The DTE or LSAP address of the remote host. A DTE address is of 15 or fewer decimal digits. An LSAP is 14 hexadecimal digits in length. In most cases, the last two digits of an LSAP (the SAP) are `7e`. The `x25tool` program accepts ARP-style notation, with colons separating the bytes within an LSAP address. Within a colon-delimited byte, you can omit a leading zero.

Extended Address

Choose None (the default), OSI, or non-OSI. This is the type of extended address you use in the network to which the link you are configuring is attached. Extended Addressing is not available if your call is traversing a 1980-type WAN.

Extension (for non-OSI) or OSI NSAP (for OSI extended addresses)

Enter a hexadecimal address of 40 digits or fewer. This feature is not available if your call is traversing a 1980-type WAN.

Alias(es)

A PAD user can substitute any aliases entered here for the host name of a remote host when making a PAD call.

Link Selection

Choose Automatic or Specified. Automatic uses the Solstice X.25 routing (link selection) feature. If you choose Specified you must specify the link number yourself.

Link Number

The link over which PAD makes calls to the specified remote host. This parameter only applies if you have multiple links.

PAD Profile

Profile names refer to specific sets of PAD (X.3) parameter settings. If the Simple profile (the default) is not appropriate for the specified remote host, choose one of the other named profiles. Your network provider should tell you which profile you need to use.

If none of the seven profiles provided with the product suits your needs, you can modify some or all of the 22 parameters defined in the 1988 CCITT X.3 recommendation. See “X.3 Parameters” on page 104 for more information.

Call User Data

A string of up to 124 ASCII characters that the PAD software will include in Call Request packets.

Packet Size (local and remote)

This is a number determined by the requirements of your remote host and PSDN. If your packet sizes are different from the default of 512, press MENU in the Local (or Remote) Packet Size button and select the packet size appropriate for your remote host.

Window Size (local and remote)

This is determined by the requirements of your PSDN and your remote host.

CUG Type

If your host is a member of a Closed User Group, choose the appropriate CUG type.

CUG Number

If your host is a member of a multi-user or bilateral CUG, type the CUG number here.

X.29 Type

Specifies the year of the X.29 recommendation supported by the remote host. Default means that you use the X.25 type specified for a given link.

Fast Select

Determines whether Fast Select is in effect for the calls to the specified host. If you enter more than 12 characters of Call User Data, the PAD software automatically uses Fast Select, regardless of the setting here. For more information on Call User Data, see “Call User Data” on page 94.

8-bit Mode

In 7-bit mode (the default), characters are seven bits long and parity is filtered. In 8-bit mode, characters are eight bits long with no parity.

Reverse Charge

Determines whether the PAD software can make reverse charge calls.

RPOA Numbers

A four-digit number that provides networks between you and the remote host with additional routing information. You can have up to four RPOA numbers. If you have multiple RPOA numbers, enter them together in the same sequence of digits, with no spaces between.

PAD Daemon Listen Database

In `x25tool`, the parameters for the PAD Data Listen Database can be accessed through the Services menu.

The parameter values are stored in the configuration file: `/etc/opt/SUNWconn/x25/paddconf`.

The PAD daemon handles incoming PAD calls. Some parameters are available on a per-host basis as well as globally. The per-host parameters override any global settings.

Global Defaults

Log PAD calls

When set to Yes, information about each PAD call made is logged to the file `/var/opt/SUNWconn/x25/x29serverlog`. This file can become very large. If you have problems with disk space, check the size of `x29serverlog` and, if necessary, delete it.

Accept Incoming PAD calls

Setting this to No prevents this system from accepting incoming PAD calls. The system can still make outgoing calls.

Initial Command

The command that the PAD daemon invokes automatically when a connection is established with an incoming PAD caller. By default, the initial command is `/bin/login`.

Welcome Banner

A string that the PAD daemon displays to incoming PAD callers. Enter 80 or fewer alphanumeric (including whitespace) characters. If you do not set a string, the default is `Solstice X.29 Terminal Services`. The new Welcome Banner comes into effect the next time you restart the PAD Daemon.

PAD Parameters

Native

In native mode the default parameter settings are: echoing disabled, data forwarding timeout enabled, no line folding, and local editing disabled. If you set this to Customize in PAD Daemon Listen Database, the X.3 Parameters window is activated. See “X.3 Parameters” on page 104 for more information.

Non-native

In non-native mode the default parameter settings are: echoing on, data forwarding disabled, no line folding, and editing disabled. If you set this to Customize in PAD Daemon Listen Database, the X.3 Parameters window is activated. See “X.3 Parameters” on page 104 for more information.

Listener Criteria

Called Address

Specifies the pattern of digits the PAD daemon uses to match the called address on incoming PAD calls. The options as shown in Table 7–6 are:

TABLE 7–6 Called and Calling Address Parameters

Parameter	Meaning
Starts with	The PAD daemon accepts calls from PAD callers that have called addresses that have leading digits that match the string of digits you enter here.
Matches	The PAD daemon accepts calls from PAD callers that have called addresses that exactly match the string of digits you enter here.

TABLE 7–6 Called and Calling Address Parameters *(continued)*

Parameter	Meaning
Don't care	This is the default parameter. The PAD daemon accepts calls from any PAD caller, regardless of its called address. You do not enter a string of digits with this parameter.
Pattern	Allows the use of standard wildcard characters in order to match on part of an address. Select this option to use the style of addressing used by SunNet X.25 7.0.

If the Called Address is not set to Don't Care, you also need to use the Address is parameter to specify the type of called address.

Address is:

Specify the type of the called address. If the called address is not a DTE address (the default), click on NSAP.

Calling Address

Specifies the pattern of digits the PAD daemon uses to match the calling address on incoming PAD calls. The options are explained under Called Address, above. You also need to use the Address is: parameter to specify the type of the calling address. If the Called Address is not set to Don't Care, you also need to set the Address is: parameter to DTE or NSAP extension.

Call User Data

Specifies the pattern of digits the PAD daemon uses to match the Call User Data on incoming PAD calls. By convention this is 01. Do not delete the 01 that appears in this field unless you are sure that your network uses a different value to distinguish incoming PAD calls. If this field is blank, or if the value entered is invalid, your machine will not be able to receive PAD calls.

Initial Command

The command that the PAD daemon invokes automatically when a connection is established with an incoming PAD caller. By default, the initial command is `/bin/login`.

Welcome Banner

A string that the PAD daemon displays to incoming PAD callers. Enter 80 or fewer alphanumeric (including whitespace) characters. If you do not set a string, the default is `Solstice X.29 Terminal Services`. The new Welcome Banner comes into effect the next time you restart the PAD Daemon.

X.3 Parameters

The X.3 Parameters window is accessed when you select User-Defined from the PAD Profile window in the PAD Hosts Database, or when you select Customize under PAD Parameters in the PAD Daemon Listen Database.

If none of the seven profiles provided with the product suit your needs, you can modify some or all of the 22 parameters defined in the 1988 CCITT X.3 recommendation. Your network provider should tell you which values you need to set. The parameter numbering is in accordance with the X.3 Parameter standard.

1: Recall Character

Setting this parameter lets you configure a character to use to switch from the data transfer state to recall the PAD. Table 7–7 lists the possible values.

TABLE 7–7 Recall character values

Decimal Value	Character Used
0	none
1	DLE (Ctrl-P)
32 - 126	user defined character

Note - Decimal values 2 to 31 (inclusive) have no effect.

2: Echo

If this is set to On, the PAD echoes characters back to the terminal, in addition to processing them.

3: Dataforwarding

The Dataforwarding characters tell the PAD that it has received a complete packet sequence, which it should assemble and forward. Possible values are:

- A-Z, a-z, 0-9
- CR
- ESC, BEL, ENQ, ACK
- DEL, CAN, DC2
- ETX, EOT
- HT, LF, VT, FF
- Control characters not listed above

If your PSDN has supplied you with a numerical value, you need to find out which character sequence it defines.

4: Forwarding Delay

Determines the interval PAD waits for after receiving at character. If no character is received by the end of this interval, the PAD assumes it has received a whole packet, and forwards it.

5: Flow Control by PAD

Determines the type of flow control used by the PAD on incoming data from the terminal. Make sure that this is the same type as is used by the terminal.

6: Service Signals

Set the decimal value according to the way you want PAD service signals to be handled. Table 7–8 lists the values and possible actions.

TABLE 7–8 PAD service signals

Decimal Value	Action
0	no service signals transmitted to start-stop mode DTE
1	service signals, other than the Prompt PAD service signal, are transmitted in standard format

TABLE 7–8 PAD service signals *(continued)*

Decimal Value	Action
4	prompt PAD service signal transmitted in standard format
8 - 15	PAD service signals transmitted in a network-dependent format

7: Action on BREAK

Determines the action taken when the PAD receives a break signal. Choose from the list of available options. If your PSDN has supplied you with a numerical value, you need to find out which break action it represents.

8: Data Delivery

Choose the value you want.

9: Padding after <CR>

This lets you set the PAD to insert padding characters in the character stream after the occurrence of a carriage return. This lets the terminal process the carriage return correctly.

10: Line Folding

Determines how often the PAD inserts a Line Feed followed by a Carriage Return. In effect, this sets the line length for your terminal.

11: Binary Speed

This displays the speed of the line connecting the PAD and the terminal. You cannot change this parameter.

12: Flow Control by Terminal

Defines the type of flow control used by the terminal on incoming data from the PAD.

13: <LF> Insertion

Determines when the PAD will insert a Line Feed character. This is only relevant when the PAD is in data transfer state. If your PSDN has supplied you with a numerical value, you need to find out which action it represents.

14: Padding after <LF>

This lets you set the PAD to insert padding characters in the character stream after the occurrence of a line feed. This lets the terminal process the carriage returns correctly.

15: Editing

This provides for local editing during the data transfer state as well as during the command state.

16:Character Delete

This determines the ASCII character used as the Character Delete key. Enter the appropriate ASCII number.

17: Line Delete

This determines the ASCII character used as the Line Delete key. Enter the appropriate ASCII number.

18: Line Display

This determines the ASCII character used to redisplay a line. Enter the appropriate ASCII number.

19: Terminal Type

Specify whether you are using a video or hardcopy terminal. This affects how the PAD handles deletions.

20: Echo Mask

Choose the appropriate echo mask. Possible values are:

- All
- Not CR

- Not LF
- Not VT, HF, FF
- Not BEL, BS
- Not ESC, ENQ
- Not ACK, NAK, STX, SOH, EOT, ETB, ETX
- Not chars from P16, P17, P18
- Not <DEL> or other Ctrl chars

If your PSDN has supplied you with a numerical value, you need to find out which mask it represents.

21: Parity

Set the parity to None, Checked, Generated, or Checked and generated.

22: Page Wait

The PAD halts the display after the number of lines you specify here. Pressing the space bar displays the next page of data.

PAD Printer

In `x25tool`, the parameters for the PAD Printer can be accessed through the Services menu.

The parameter values are stored in the configuration file: `/etc/opt/SUNWconn/x25/xtpmapconf.`

You can install a printer over an X.25 network so that users logged in remotely can print to their local printer.

Note - Before you can print through PAD, you must use `admintool` to set up the printer. Do this as you normally would, but make certain that you set it up as a Local Printer, and specify an X25 printer port that also includes a unique printer number, for example `/dev/xtp7`. See *User Account, Printers and Mail Administration* for more information about using `admintool`.

Printer Name

Enter the name of the printer.

Device Number

This is the printer port number. For example, if you entered `/dev/xtp7` for the printer port in `admintool`, then the device number is 7.

Link Number

Specify the link to use for the outgoing printer connection. If you set this to 255, the link number will be selected automatically.

Remote X.121 Address

Enter the destination X.121 address to use for establishing the virtual connection.

Clear Flag

If Clear Flag is set to Yes, then a Clear Invitation packet will be sent at the end of the data transfer, and the connection will then be cleared by the remote PAD after all of the data is received. This ensures that all data have reached the remote PAD, but can lead to connection staying up if the remote does not support this feature.

If Clear Flag is set to No, then a Clear Invitation packet will not be sent at the end of the data transfer. If the remote PAD does not support Clear Invitation, you should set Clear Flag to No and enter a value for the Timeout.

Timeout

This is the amount of time, in seconds, that the X.25 server will keep the connection open after the last print packet has been sent. Setting a timeout value can help prevent loss of print data, however, you will have to use your own knowledge of the network to determine how long the connection needs to stay open.

You only need to set a timeout if Clear Flag is set to No.

Call User Data

This is the call user data used to establish the virtual connection. Before this information is included, it should have been agreed upon by both sides of the connection.

Network User Identifier Parameters

In `x25tool`, the parameters for the NUI Mapping can be accessed through the Services menu.

The parameter values are stored in the configuration file: `/etc/opt/SUNWconn/x25/nuimapconf`.

The Network User Identifier parameters are used to create a mapping between Network User Identifiers and facilities. When a call is made using NUI override, the facilities set here override any other facilities that might otherwise apply to the call.

NUI

The Network User Identifier, a string of up to 64 alphanumeric characters.

Throughput Class

Enter a number value for the throughput class to use for incoming (Remote) and outgoing (Local) calls. These can be different.

Packet Size

The sizes to use for incoming (Remote) and outgoing (Local) packets. These can be different.

Packet Format

Choose between Normal and Extended.

Window Size

The window size to use for incoming (Remote) and outgoing (Local) calls. These can be different.

CUG

Whether Closed User Groups are in use. Choose between None, Normal and Outgoing.

CUG Type

Choose Basic or Extended.

Routing

In `x25tool`, you can configure the routing parameters in the Routing window, which can be accessed through the Services menu.

The parameter values are stored in the configuration file: `/etc/opt/SUNWconn/x25/routes`.

If you have multiple links, Solstice X.25 automatically selects a link for outgoing calls based on address information in a Call Request packet. The parameters for configuring this are:

Route Type

Table 7–9 lists the available route types:

TABLE 7–9 Route Types

Type	Meaning
X.121 Host	Associates the complete X.121 address of a remote host with a link. This type of entry can include a MAC address.
X.121 Prefix	Associates the leading digits (one or more) of an X.121 address with a link. This type of entry can include a MAC address.
X.121 Default	Contains a link and an optional MAC address. This entry (there can be only one) is used if no match is found between a called address and any X.121 host or prefix entries.
AEF Host	Associates the complete extended address (such as an OSI NSAP address) of a remote host with a link. This type of entry can include an X.121 address or a MAC address, and a protocol id.

TABLE 7–9 Route Types *(continued)*

Type	Meaning
AEF Prefix	Associates the leading digits (one or more) of an extended address with a link. This type of entry can include an X.121 address or a MAC address, and a protocol id.
AEF Default	Contains a link and, optionally, an X.121 or a MAC address, and a protocol id. This entry (there can be only one) is used if no match is found between a called address and any AEF host or prefix entries.

Link Number

The link number to be associated with a host address, an address prefix, or a default entry. This is the same number as you specified it in the Link Number item in the Link Editor window in `x25tool`.

X.121 Address

For an X.121 host-type entry, enter a complete X.121 host address, as it would be specified in the called address portion of a Call Request packet. For an X.121 prefix-type entry, enter the leading digits (for example, the DNIC) of an X.121 address. For the optional portion of an AEF routing entry, enter a complete X.121 address.

Address Extension

For an AEF host-type entry, enter a complete extended address, such as an OSI NSAP address. For an AEF prefix-type entry, enter the leading digits (at least one) of an extended address.

Protocol ID

A protocol id of no more than five bytes (10 decimal digits). A protocol id is an optional addition to an AEF host, prefix, or default entry. Enter a protocol id as a string of consecutive digits.

MAC Address

The MAC address to which the call will be routed if the link is a LAN link.

Enter a six-byte (twelve-digit) hexadecimal value, such as an Ethernet or FDDI address. You can enter the address as consecutive digits or with colons separating bytes. For example, both `080020110233` and `08:0:20:11:2:33` are valid entries. When you save a routing entry with a colon-delimited MAC address, `x25tool` removes and subsequently displays the address without colons and with leading zeroes within bytes.

Telephone Number

Used for dial-up configurations, this is the telephone number of the point of attachment to the PSDN. In most cases, this is a modem.

Comment

You can add an optional comment.

Call Filtering

In `x25tool`, the parameters for Call Filtering can be accessed through the Services menu.

The parameter values are stored in the configuration files: `/etc/opt/SUNWconn/x25/x25secuconf` and `/etc/opt/SUNWconn/x25/x25secupid`.

Use X.25 Call Filtering to define which incoming calls will be authorized.

Service Name

Select PAD, TCP-IP, CLNP, OSI, Other, or None to indicate from which service you want to accept incoming calls.

Call User Data

Select Matches, Starts with, or Don’t Care to indicate which callers to accept calls from. If you select Matches, or Starts with, you will also need to type in the data.

Accept Calls

Specify a time period when calls will be accepted. You can set this up so it is repeated Weekly, Daily, or One Time only.

Link Number

You can restrict which networks you will accept calls from by specifying the Link Number you will accept calls from. If the link number is set to 255, then X.25 will accept calls over any link.

Calling Address

This is the address of the machine that initiated the call. Set this to Starts with, Matches, Ends with, or Don’t Care.

CHAPTER 8

Example Configurations

This chapter contains additional example configurations that you may find useful. The first two are configurations that can be useful for test purposes: a loopback configuration and a back-to-back configuration.

Note - In each example, you must first log in as `root` or become `superuser` before starting `x25tool`.

Setting up a Loopback Configuration

A loopback configuration is useful for testing and troubleshooting your local configuration down to, and including, the link layer. Completing a call over a loopback interface is a useful check of your local X.25 and link layer configuration. If you have problems bringing up the X.25 network, a loopback test should be one of the first tests you perform.

Follow the instructions in “Loopback over a WAN (LAPB)” on page 115 to configure a loopback over LAPB and in “Loopback over LLC2 (LAN Links)” on page 119 to configure a loopback over LLC2.

Loopback over a WAN (LAPB)

For a loopback configuration over LAPB, you must have two links. Configure these as follows:

1. **Display the Link Editor window.**

   In the `x25tool` base window, click on Add and select the default template.

2. **Create the first loopback link by assigning the values shown below:**
   - A unique link number
   - WAN as the link type
   - WLOOP as the device type
   - 0 as the port number
   - Interface type as DTE
   - LAP protocol to LAPB
   - Any string of digits as the address

   Keep the default Packet sizes and LCRs.

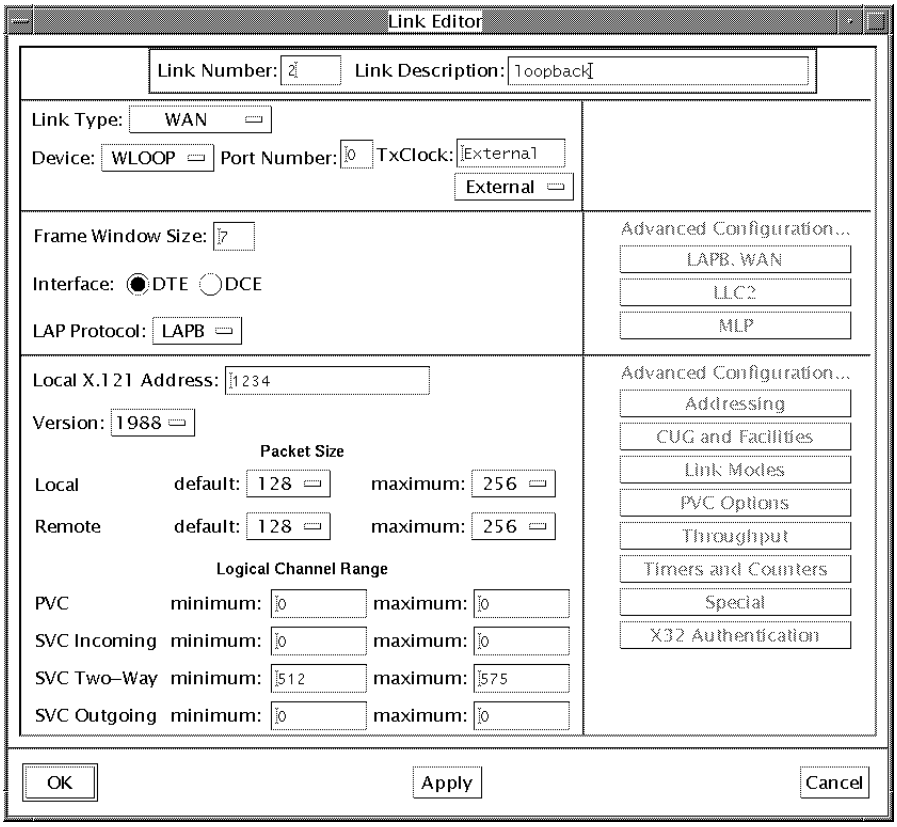

Figure 8–1 Creating the First Link in the Loopback Configuration

3. **Click on OK to apply the changes and to dismiss the window.**

4. **Create a second link.**

Configure the values as shown below:

- A unique link number
- WAN as the link type
- WLOOP as the device type
- 1 as the port number
- Interface type as DCE
- LAP protocol to LAPB
- Any string of digits as the address

Ensure that the packet sizes and LCRs match those used by the first link.

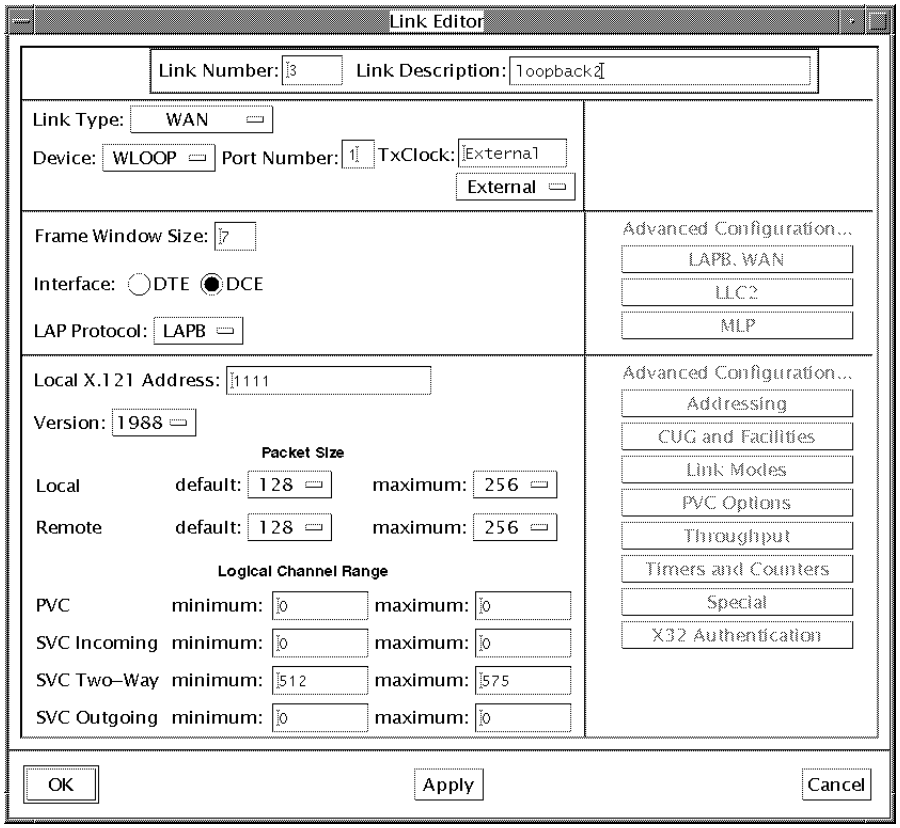

Figure 8–2 Creating the Second Link in the Loopback Configuration

5. Click on OK to apply the changes and to dismiss the Link Editor.

6. **Save the changes to the configuration.**

   From the `x25tool` menu, select File ⇒ Save.

7. **Stop and restart your X.25 network.**

   From the Network menu in `x25tool`, select Stop X.25 Network and Start X.25 Network.

   At this point, you have a usable loopback interface for LAPB. You can test it with a command such as the one below. In this example, you have a loopback interface on link 2 with a Remote Address of 1111:

```
% pad 2.1111  Break-in sequence is '^Pa'

 Connecting...
 Connected
 Solstice X.29 Terminal Service
 login:
```

   You can connect to the other member of the link pair by specifying its link number and its Local Address. For example:

```
% pad 3.1234  Break-in sequence is '^Pa'

 Connecting...
 Connected
 Solstice X.29 Terminal Service
 login:
```

   It is convenient to set up entries for your loopback interfaces in your PAD hosts database. See "Configuring the PAD Hosts Database" on page 52 for instructions. In the PAD Hosts Database window, you need enter values only for the Host Name, Remote Address, and Link Number parameters.

   You can run `x25trace` in another window and observe LAPB and X.25 Packet Layer activity over the loopback interface. To do this, open another window, log on as `root` and type:

```
# /opt/SUNWconn/bin/x25trace -i /dev/lapb
```

   See "Obtaining Packet and Link-Level Traces" on page 163 for instructions on the use of `x25trace`.

Loopback over LLC2 (LAN Links)

The LLC2 layer supports loopback by default, using the loopback SAP of 70. To test a loopback connection over LLC2, simply specify your LLC2 link number, MAC address, and SAP address of 70 as arguments to the `pad` program. For example, if your LLC2 link number is 1 and your MAC (Ethernet) address is `8:0:20:ab:21:6`, enter:

```
% pad 1.080020ab210670  Break-in sequence is '^Pa'

 Connecting...
 Connected
 Solstice X.29 Terminal Service
 login:
```

You can also set up entries for your LLC2 loopback interface in your PAD hosts database. See "Configuring the PAD Hosts Database" on page 52 for instructions. In the PAD Hosts Database window, you need enter values only for the Host Name, Remote Address (your MAC address plus 70), and Link Number parameters.

To observe LLC2 protocol activity over the loopback interface, you can, as `root`, enter an `x25trace` command such as:

```
# /opt/SUNWconn/bin/x25trace -i /dev/llc2
```

See "Obtaining Packet and Link-Level Traces" on page 163 for instructions on the use of `x25trace`.

Setting up a Back-to-Back Test Configuration

If you are using Solstice X.25 to connect to a PSDN, you need to make a call over the PSDN in order to check that your configuration works with it. However, you can test user-developed applications, and certain aspects of your X.25, LAPB, and WAN configuration, by using a null modem cable or modem emulator to set up a "back-to-back" connection to another machine.

Note - See "Building the Null Modem Cable" on page 176, for instructions on building a null modem cable.

Follow the instructions in “Back-to-Back WAN Links” on page 120 to set up a back-to-back WAN connection, and in “Back-to-Back LAN Links” on page 122 to set up a back-to-back LAN connection.

Back-to-Back WAN Links

This example will work for Solstice X.25 9.x and SunLink X.25 8.x. You can also configure a back-to-back WAN link for SunNet X.25 7.0, but the instructions are slightly different. They have been included in the example.

1. **Connect your communications equipment.**

   If you are using a modem eliminator, connect the cables from the modem eliminator to the two machines. If you are using a null modem cable, connect the cable to the two machines.

2. **Create a link on the local machine.**

   Follow the instructions in “Configuring a Single WAN Link” on page 35.

   In the `x25tool` windows use the following values:

   - In the Link Editor window, accept ZSH (the default), or specify HSI for the Device item.
   - Choose a speed that is supported by the remote machine for the Tx Clock parameter. If the remote machine is a SunNet X.25 7.0 machine, on that machine enter a command such as:

```
% grep syncinit /etc/sunlink/x25/rc
 /usr/sunlink/sync/syncinit zss0 speed=19200 txc=baud rxc=rxc   > /dev/console 2>&1
```

     In the example output above, the remote machine is running at 19200 bps. In such a case, specify 19200 for Tx Clock for the local machine.

   - In the Link Editor window, set the Interface parameter to DTE (the default) or DCE. The local machine Interface parameter must be the opposite of the remote end. For example, if the remote machine is a SunNet X.25 7.0 machine, on that machine enter a command such as:

```
remote_host x25config -d /etc/solstice/x25/x25params0 | grep 198
x25 1984 normal dte
```

     In the example output above, the remote machine is a DTE. In this case, you would, specify DCE for the local machine.

   - Still in the Link Editor window, specify a Local Address. Make a note of this address.
   - Under Logical Channel range in the Link Editor window, specify a two-way range that corresponds to the range used by the remote machine. If the remote machine is a SunNet X.25 7.0 machine, on that machine enter a command such as:

```
remote_host% x25config -d /etc/sunlink/x25/x25params0 | grep way
lcn_two_way 512-575
```

In the example output above, the remote machine has a logical channel range of 512-575, the default for SunNet X.25 7.0. In this case, you would specify the same range for the local machine.

- Choose an X.25 configuration file that is appropriate for your local DTE/DCE role and for the X.25 recommendation year supported by the remote machine. For example, if the remote machine is a DTE that supports 1984 X.25, select `def.dce84.x25`.

3. Display the PAD Hosts Database widow.

In the `x25tool` base window, select Services ⇒ PAD ⇒ PAD Host database.

In the PAD Hosts Database window, click on Add and enter the name of the remote machine in the Host Name field and the DTE or DCE X.121 address of the remote machine in the Remote Address field. If the remote machine is a SunNet X.25 7.0 machine, on that machine enter a command such as:

```
remote_host% x25config -d /etc/sunlink/x25/x25params0 | grep ^add
address 1000-5555-22
```

In the example output above, the remote machine has an address of `1000555522`. Enter this value (without the hyphens) in the Remote Address field.

After entering the name and address of the remote machine, click on Apply in the PAD Hosts Database Window. Click on OK to dismiss the window.

4. Start the X.25 network.

5. Repeat Steps 2, 3 and 4 of this procedure on the remote machine to bring up the X.25 software on that machine.

If this machine is running Solstice 9.x or SunLink 8.x, perform the steps exactly as described above. If the remote machine is running SunNet X.25 7.0 or another vendor's X.25, create an equivalent configuration.

6. In a terminal window, enter a command such as:

```
local_host% /opt/SUNWconn/bin/pad remote host
```

where *remote host* is the name you entered for the remote host. You should receive a message indicating that your call is connected. If you do not, it indicates a configuration problem on the local or remote end.

Back-to-Back LAN Links

1. **Ensure that both machines are connected to the same Ethernet segment or FDDI dual ring or concentrator (or back-to-back with FDDI/S).**

2. **Create a link on the local machine.**

   Follow the procedure specified in "Setting up a Workstation Attached to a LAN" on page 141.

   In the `x25tool` windows use the following values:

   - In the Interface Configuration window, specify LE (Ethernet), FDDI/S, or FDDI/DX for the Device item.
   - Under Logical Channel ranges, specify a two-way range that corresponds to the range used by the remote machine. If the remote machine is a SunNet X.25 7.0 machine, on that machine enter a command such as:

```
% x25config -d /etc/sunlink/x25/x25params link number llc2 | grep way lcn_two_way 512-575
```

   In the example output above, the remote machine has a logical channel range of 512-575, the default for SunNet X.25 7.0. Specify the same range for the local machine.

3. **Display the PAD Hosts Database window.**

   In the `x25tool` base window, click on Service ⇒ PAD ⇒ PAD Hosts Database.

4. **Enter information about the remote machine.**

   In the PAD Hosts Database window, click on Add and enter the name of the remote machine in the Remote Host Name field and the MAC address of the remote machine in the Remote X.121 Address field. Append the value `7e` (the LSAP address that designates LLC2) to the MAC address.

   If the remote machine is on the same Ethernet segment or FDDI ring, you can obtain its MAC address by entering the commands shown below on the local machine:

```
local_host% arp remote-hostname   remote-hostname (129.144.41.29) at 8:0:20:10:b5:a2
```

   In the example output above, the last field on the second output line, `8:0:20:10:b5:a2`, is the MAC address. You can copy-and-paste `arp` output into the Remote Address field and append `:7e` to form a full LSAP address.

   After entering the name and address of the remote machine, click on Apply in the PAD Hosts Database Window. Click on OK to dismiss the window.

5. **Start the X.25 network.**

   You do not need to do this if your X.25 network is already up, and you made no changes in the Link Editor window.

6. **Repeat Steps 2, 3 and 4 of this procedure on the remote machine to bring up the X.25 software on that machine.**

   If this machine is running the current release of Solstice X.25, perform the steps exactly as described above. If the remote machine is running SunNet X.25 7.0 or another vendor's X.25, create an equivalent configuration.

7. **In a terminal window, enter a command such as:**

```
hostname% /opt/SUNWconn/bin/pad remote host
```

   where *remote host* is the name of the remote host.

   You should receive a message indicating that your call is connected. If you do not, there is a configuration problem on the local or remote end.

Setting up a Server to Receive PAD Calls

In this example, a server is attached to a PSDN. It needs to be configured so that remote machines can access it using the PAD.

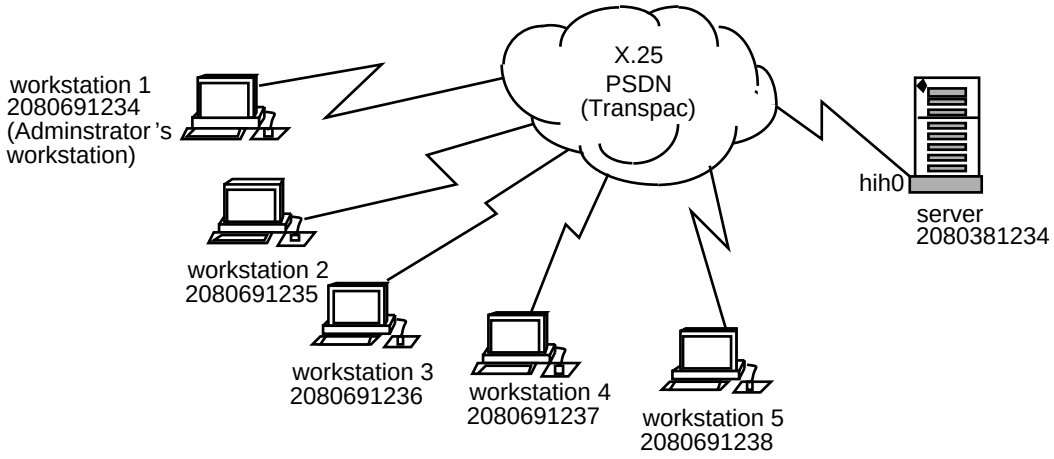

Figure 8–3 Setting up a Server to Receive PAD Calls

In the example:

- All remote workstations are running Solstice X.25 and can access the server. The server must be configured to use Solstice X.25 and to receive PAD calls from the other workstations.
- Workstation 1 is used by the system administrator when at the remote site. It needs full terminal-type access to the server.
- The other machines are used by employees at the remote site. The system administrator has written an application to drop calls to the server straight into a menu system that gives them access only to the information they need.

To create this kind of configuration you need to:

- Create a link between the server and the PSDN.
- Configure the logical channel ranges, and any other optional parameters, used by each PSDN.
- Configure the PAD Listen Database.

Note - The workstations must also be configured so that they can access the server. Refer to "Configuring the PAD Hosts Database" on page 52 in Chapter 6 for instructions.

Configuring the WAN Link

First, create a link between the server and the PSDN:

1. **From the `x25tool` menu, select Edit ⇒ Add. The list of templates will appear. Select TRANSPAC.**

2. **Create a link to the PSDN.**

   Edit the default values to match those required by the PSDN:

3. **Adjust the logical channel ranges to match those used by the PSDN.**

   Enter the values assigned by your PSDN. If there are no values assigned to a particular LCR, leave both minimum and maximum as 0.

   Configuring Parameters

   Once you have created the link, you may also need to configure other packet layer and LAPB layer parameters. To access them from the Link Editor window, select LAPB, WAN. Which values you need to change depends on the PSDN you are attaching to, and on your own configuration.

   For more information, see Chapter 7.

4. **Click on OK to apply the changes and dismiss the window.**

Configuring the PAD Daemon Listen Database

Next, configure the PAD Daemon Listen Database. This determines how the server will handle incoming PAD calls.

1. **In the `x25tool` main window, click on Services, then select PAD ⇒ PAD Daemon.**

   This brings up the PAD Daemon Listen Database window.

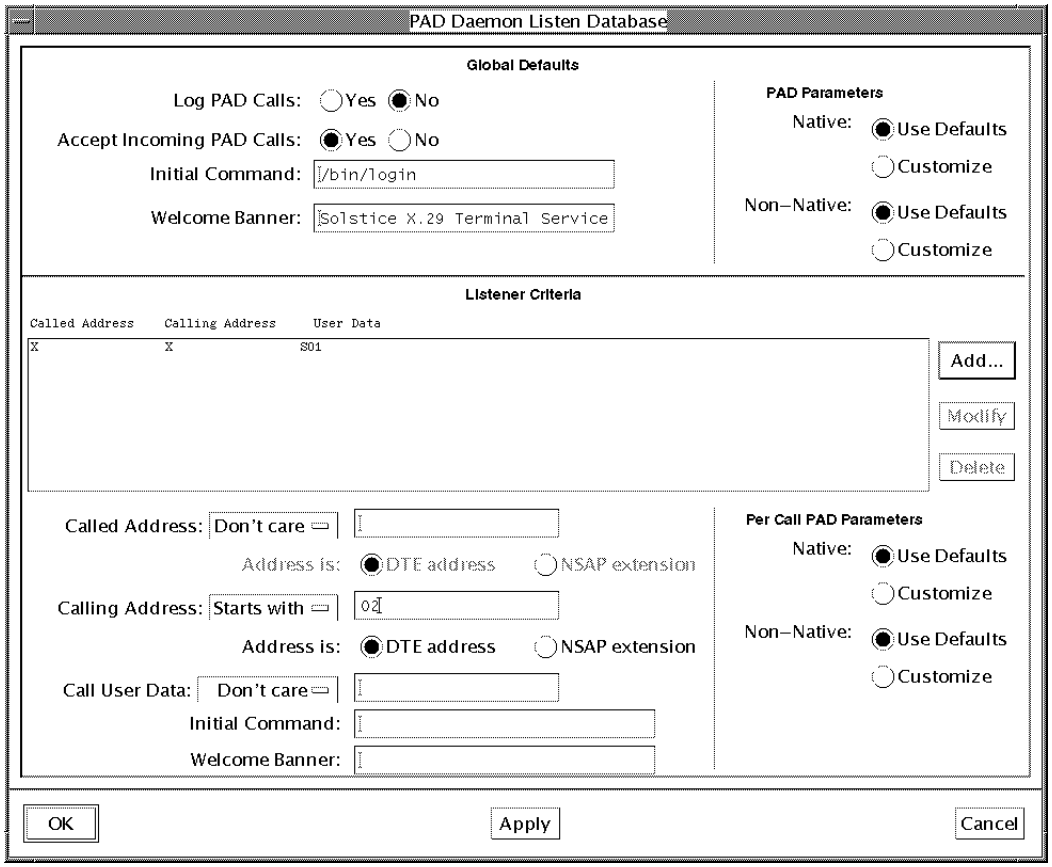

Figure 8–4 Configuring the PAD Daemon Listen Database

2. **Configure the Global default values.**

   These will be used for incoming calls from all machines except the one reserved for the administrator's use. In the top part of the screen, specify that all incoming calls are to start the menu application immediately. The Solstice X.25 9.2 system

software does not include a menu driven application program. You need to write the application, then use the Initial Command parameter to call it.

3. **Add a new “perhost” entry for the system administrator’s workstation.**

   In the middle part of the window, add an entry to the list for the machine used by the system administrator. Click on Add, then set Calling Address to Matches. Next to Calling Address Matches, type in the name of the remote machine. Finally, specify the Welcome Banner, and the Initial Command parameters to determine what should happen when a call is received from that address. If you leave the Initial command line blank, `/bin/login` is launched by default.

4. **Click on OK to apply the changes and to dismiss the window.**

   Once you have finished configuring the PAD Daemon Listen Database, you are ready to start Solstice X.25 by pulling down the Network menu and choosing Start X.25.

   You can check that your configuration is working correctly by trying to make a PAD call from a remote machine.

Setting Up a Server to Operate as an IP Router

In this example, Server A has Solstice X.25 installed. This lets it route TCP/IP traffic and provide a connection to the X.25 PSDN for any machine attached to the same LAN. The other machines on the LAN do not need to run X.25 themselves in order to connect to remote devices across the WAN.

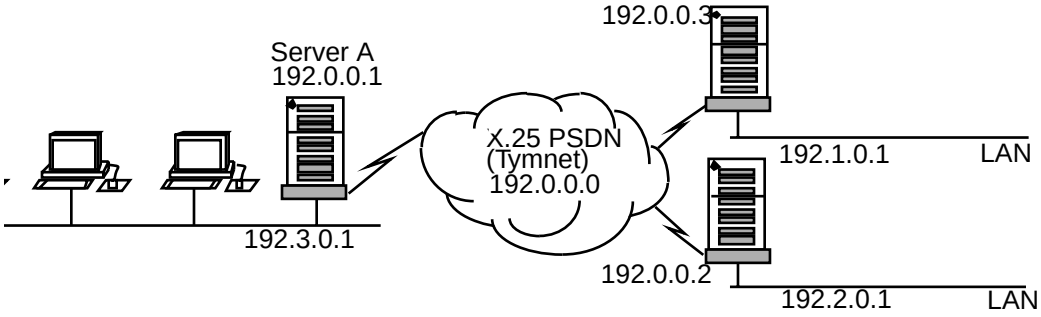

Figure 8–5 Setting Up a Server to Operate as an IP Router

Note - A machine does not need to have X.25 configured on its LAN interface in order to be able to act as a router between a LAN and a WAN. IP will handle sending traffic to the router. X.25 is needed to provide the logical connection to the WAN.

To make a configuration like this, you need to:

- Configure the link between the server and the WAN.
- Configure the logical channel ranges, and any other optional parameters, used by the PSDN.
- Configure the values used for routing IP.

Configuring the WAN Link

First, configure the link between the server and the WAN. This example uses a High Speed Interface.

1. **Bring up the Link Editor window.**

   From the Edit menu, select Add. Select Tymnet from the template list.

2. **Change the other values as shown in the snapshot below.**

   Refer to "`x25tool` Overview" on page 21 for help if you do not know how to change the values.

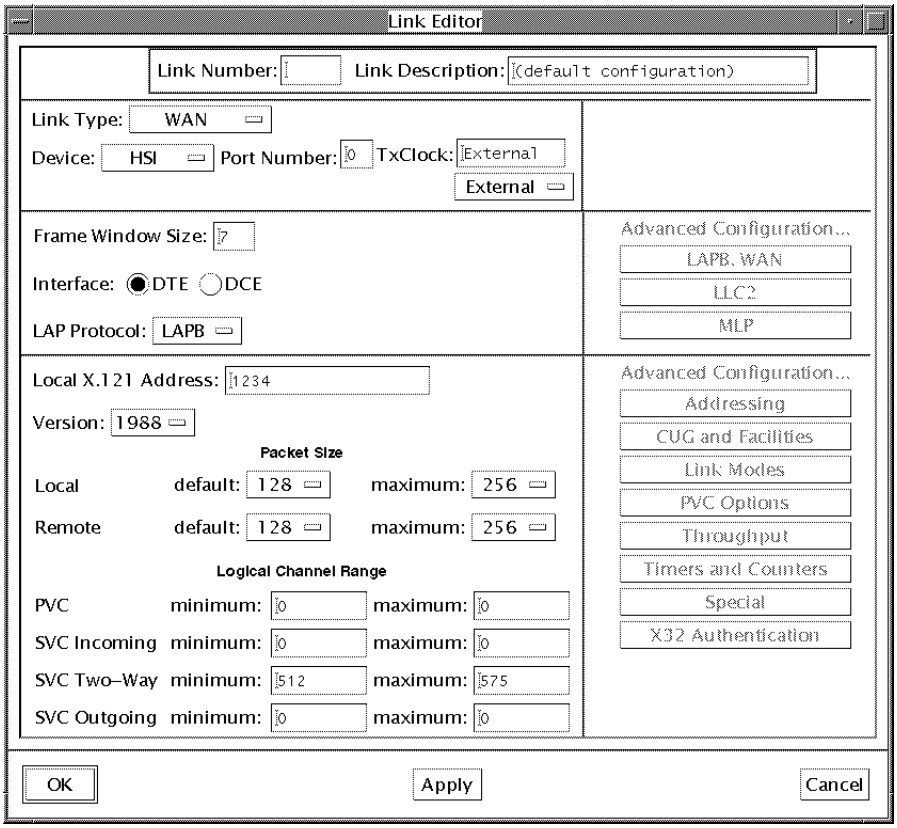

Figure 8–6 Configuring a Link Between the Server and the WAN

3. **Adjust the logical channel ranges to match those used by the PSDN.**

   Enter the values assigned by your PSDN. In the example, there are 63 two way SVCs, numbered from 512 to 575, inclusively. Since there are no PVCs, or one way SVCs, these fields are left as 0.

4. **Click on OK to apply the changes and dismiss the window.**

Configuring Parameters

Once you have created the link, you may also need to configure other packet layer and LAPB layer parameters. To access them, from the Link Editor window, select LAPB, ⇒ WAN. Which values you need to change depends on the PSDN you are attaching to, and on your own configuration. For more information, see Chapter 7.

Configuring IP Routing

Now you are ready to set up the values that will be used for routing IP.

1. **Pull down the Services menu and choose IP ⇒ IP Interface. The IP Interface Configuration window appears.**

2. **Enter the information about the IP network that this router will attach to.**

   Click on the Add button. The snapshot below summarizes the changes you need to make for this example configuration:

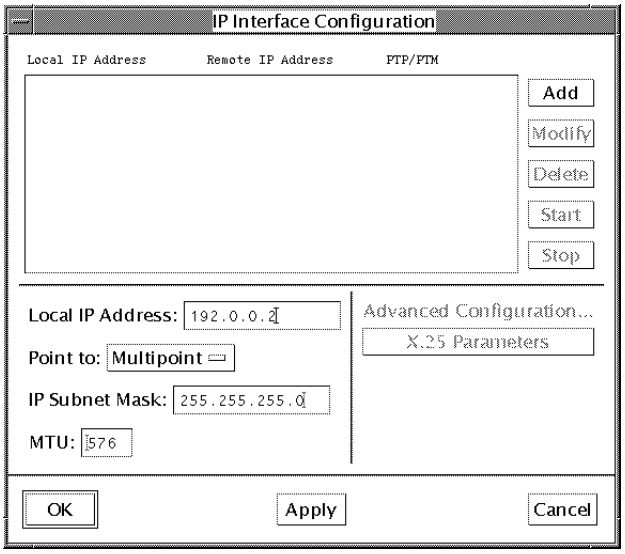

Figure 8–7 Configuring the IP Routing

You always need to specify the local IP address. You should also specify the IP subnet mask. To use the network default, leave the subnet mask field blank.

Once you have made the changes, click on Apply. In most instances, the default settings are sufficient, but if you need to change the default X.25 parameters, click on Modify, then click on the X.25 Parameters button to access the X.25 Configuration for IP Interface window.

The snapshot below summarizes the changes you need to make for this example configuration:

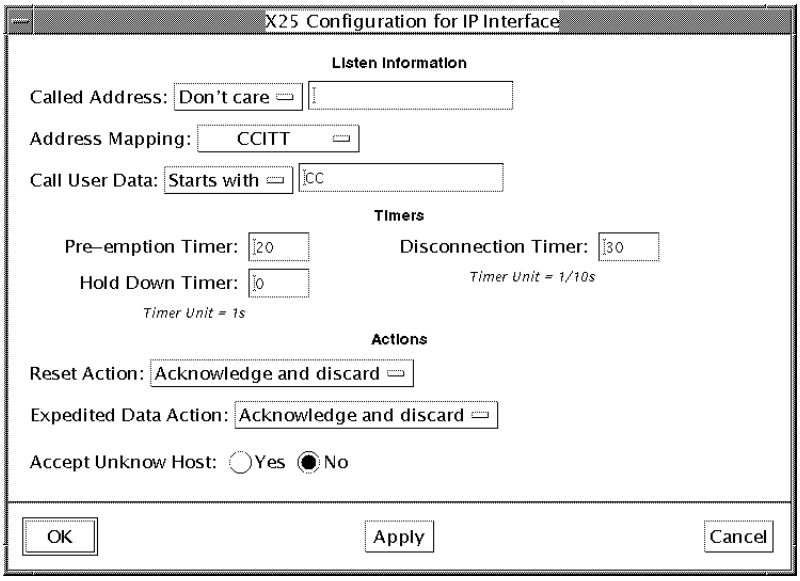

Figure 8–8 Configuring the X.25 Parameters for the IP Interface

Unless you are connecting to the Defense Data Network (DDN), specify CCITT address mapping.

To restrict access and so add a measure of security, you can choose not to accept calls from unknown hosts. A host is unknown if its address is not included in the Remote Host to X.25 Address Map. Refer to “IP Interface Configuration” on page 93.

The Listen Information is useful if the machine you are configuring has more than one address. You can use it to restrict which address(es) will respond.

You can also filter incoming calls based on their Call User Data. Take care not to delete the initial `CC` if you are using this parameter—this specifies that calls are for IP. Without the initial `CC`, calls will fail. Refer to “IP Interface Configuration” on page 93 for more detail.

3. Configure information mapping remote IP addresses to remote X.25 addresses.

Pull down the Services menu and choose IP ⇒ IP Mapping. The Remote IP Host to X.25 Address Map window appears. The snapshot below summarizes the information you need to add. Again, you can keep most of the default values:

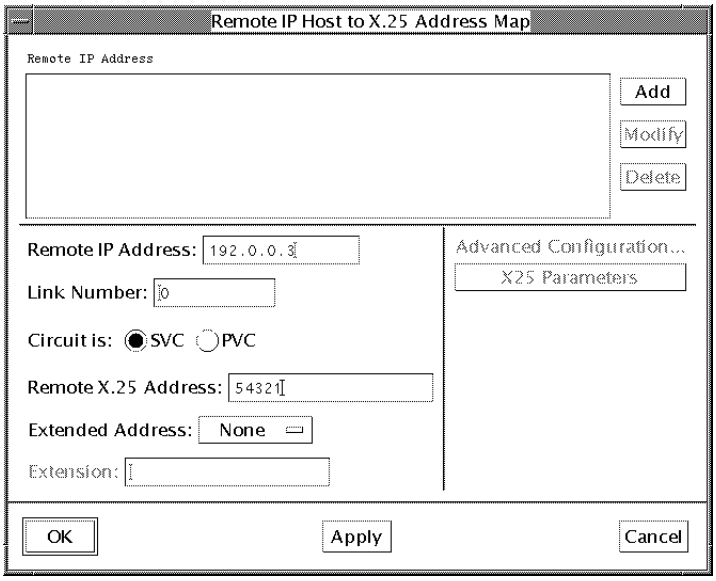

Figure 8–9 Information Mapping of Remote IP Addresses to Remote X.25 Address.

You can enter a host name which has been defined in `/etc/hosts` in place of the remote IP address.

4. **Click on OK to save the changes and to dismiss the window.**

5. **Start X.25 by pulling down the Network menu and clicking on Start X.25.**

   To check that the configuration works, try to `ping` the remote machine or to `rlogin`.

Setting up a Server with Multiple WAN Links

In this example configuration, the server is connected to three different PSDNs. It will be used primarily by users who want to make PAD calls to machines on the remote network.

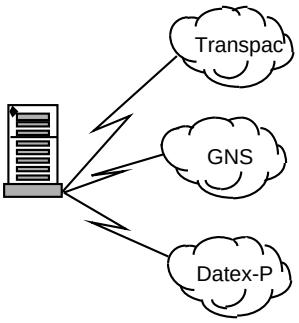

Figure 8–10 Setting up a Server with Multiple WAN Links

To set up a configuration like this, you need to:

- Create a link to each PSDN.
- Configure the logical channel ranges, and any other optional parameters, used by each PSDN.
- Set up X.25 routing, so that traffic can automatically be sent out on the correct link.

Configuring Three WAN Links

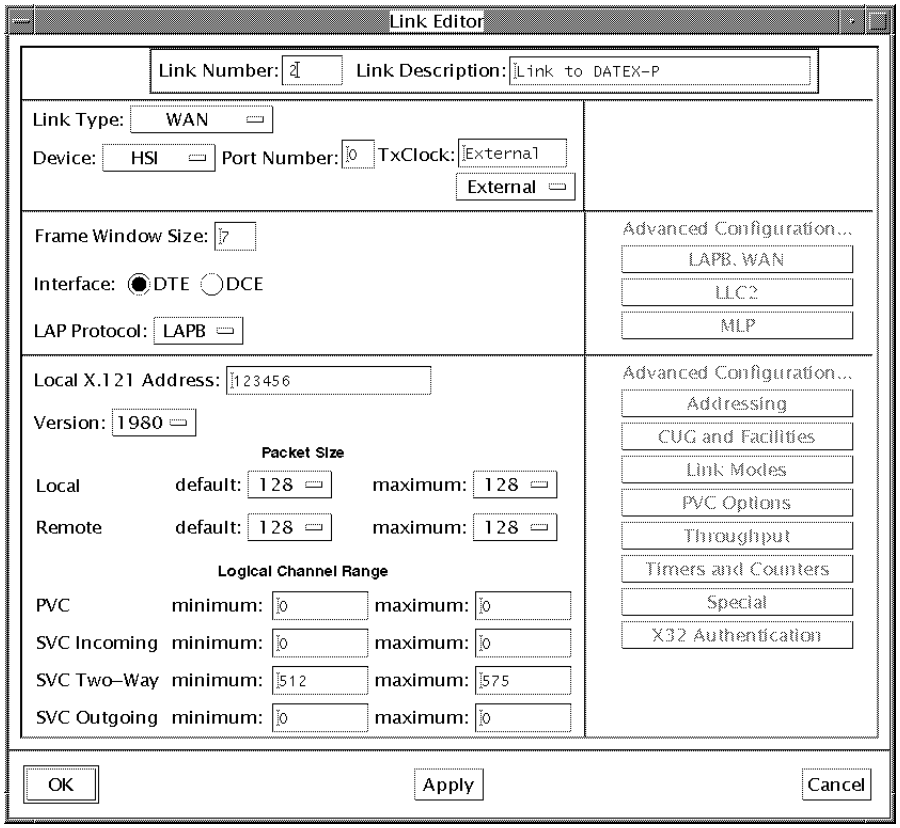

Figure 8–11 Configuring the WAN Links

The first step in creating this configuration is to create the three WAN links. Start `x25tool`, click on Add Link and select the template configuration (Transpac, GNS or Datex-P) to bring up the Link Editor window. Create three links, using the appropriate values for each. In the snapshot, the link parameter values apply to Datex-P, and will be added to the Links Configuration list in `x25tool` when the administrator clicks on the template entry.

When configuring the WAN links, pay particular attention to the logical channel ranges. Different PSDNs allocate different values. Make sure you set the correct values for each link.

In the same way, change any relevant LAPB and WAN values. Which values you need to change depends on the PSDN you are attaching to and on your own configuration.

Note - This example uses three HSI interfaces. You can also mix links that use the onboard serial port (`zsh`) and links that use high speed interfaces. However, you cannot run Solstice X.25 on more than two onboard serial ports on the same machine.

Configuring Parameters

Once you have created the three WAN links, you may need to configure other packet layer and LAPB layer parameters.

1. **Change any other X.25 Parameters for this link.**

   Different PSDNs may require you to change different packet layer parameters.

2. **Save your changes.**

Configure X.25 Routing

When you have multiple links, you must tell your machine which traffic should go out on which link. There are several ways of doing this. Which one you use depends on which applications you are running over your X.25 links. The advice given below applies to the PAD program supplied with Solstice X.25 and to IP routing. You can determine the link to use as follows:

- When making PAD calls, the user can specify the link to use as part of the address. For example, to call the address `2080381111` using link 0, the user could enter:

```
% pad 0.2080381111
```

If your users are calling only a small number of remote machines this may be the easiest option, as it does not require any special configuration. Other applications may also allow you to specify a link when making a call.

- For PAD calls, you can make entries in the PAD Daemon Listen Database that specify the address and link number of a remote machine, and provide an alias that users can use when making calls. Refer to “Configuring the PAD Hosts Database” on page 52 for more information. Using this option saves users from having to remember remote addresses and link numbers.
- For IP, when you make an entry in the Remote IP Host to X.25 Address Map, you can specify the link to use to reach each remote IP address. See “Configuring Solstice X.25 to Route IP” on page 49 in Chapter 6. Or, you can use automatic routing, if you have multiple links. See “Routing” on page 111 in Chapter 7.
- You can use automatic routing. For PAD calls and other applications, you can use the X.25 Routing table. This is the most practical option where there are a large number of remote machines. Making a PAD Hosts Database entry for each one could quickly become unwieldy. The rest of this section looks at how to configure X.25 routing.

Note - The X.25 Routing table is also used in dial-up configurations. Refer to “Configuring the X.25 Routing Table” on page 140.

To display the X.25 Routing window, select Routing, under Services Configuration in the X25tool window. The Routing Parameters window appears. When the window first appears, the parameters are all grayed out. To fill in the parameters:

1. **Click on Add, then select Top, Bottom, Before, or After to determine where in the list to add the new entry.**

   The Routing Parameters window looks like this:

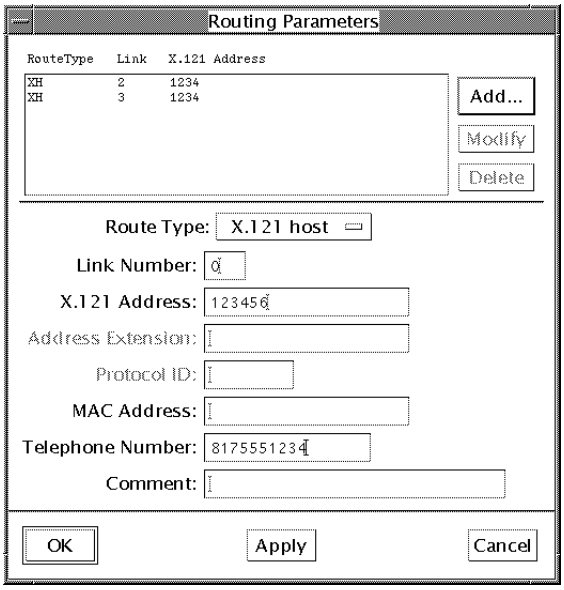

Figure 8–12 Configuring the Routing Parameters Window

2. **Enter the number of the link that reaches this destination.**

   This is the number you assigned to the link when you created it.

3. **Configure the Route Type.**

   - For an individual remote host, choose X.121 Host or AEF Host.
   - For a to a group of similar addresses, choose X.121 Prefix or AEF Prefix.
   - For all calls unless otherwise specified, choose X.121 Default or AEF Default.

   In the example, calls are being routed to three different remote networks. Each remote network address starts with a unique 4 digit sequence, so X.121 Prefix is the appropriate Route Type to choose in all three cases.

Note - AEF addresses are used on OSI networks. Use AEF addresses instead of X.121 addresses if your network uses the OSI protocol stack instead of the TCP/IP protocol stack.

---

4. **Enter the X.121 address prefix.**

   You need to enter enough digits here to distinguish the remote network clearly, without adding so many that you limit which destinations can be reached on the remote network. The 4 digits shown in the example clearly identify each network without restricting calls to part of the network.

Note - When making international calls, some PSDNs require you to precede the X.121 address with a code indicating that this is an international call. For example, to make an international call from Germany, you must add a 0 to the front of the X.121 address. If you are configuring international calls and this applies to your PSDN, make sure you include this as part of the X.121 address prefix.

---

5. **Enter a comment (optional).**

   You could identify the destination that this link reaches, for example.

6. **Save your changes and dismiss the window.**

   Click on Apply, then click on OK to dismiss the Routing Parameters window.

   Once you have finished adding routes, you are ready to start the Solstice X.25 software. Start X.25 by pulling down the Network menu and choosing Start X.25.

   You can check that your configuration is working correctly by trying to make a PAD call to a machine on one of the remote networks.

Setting up a Dial-up Link Configuration

In this example, the workstation is running Solstice X.25 so that it can dial into the PSDN. A modem provides the connection to the PSDN.

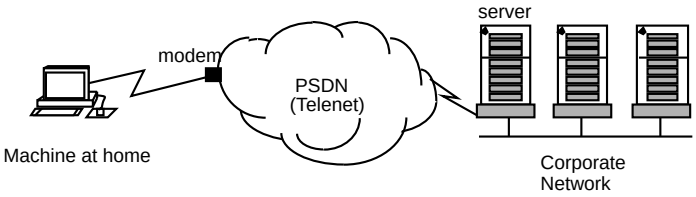

Figure 8–13 Setting up a Dial-up Link Configuration

As there is a server on the corporate network that is attached to the same PSDN, the workstation can access the server, for example, by making a PAD call. From there, it can `rlogin` to other machines on the corporate network. Alternatively, the server

could be configured to act as an IP router, giving direct access to the whole network. To configure a machine to use a dial-up connection:

- Create a link to the PSDN.
- Configure the logical channel ranges.
- Specify that V25bis calling procedures are to be used.
- Set the idle disconnect timer to a reasonable value.
- Configure X.32 authentication procedures.
- Add the telephone number of the point of connection to the network (in this case a modem) to the X.25 Routing table.

Note - Before configuring Solstice X.25 9.2, you must configure your modem to operate in V.25bis mode—refer to your modem manufacturer's documentation for instructions that apply to your particular modem.

Configuring the WAN Link to the PSDN

First configure the link between the server and the PSDN. In the example this is the onboard serial port connected to the modem.

1. **Edit `Link 0`, the default WAN link.**

   Click on the entry for Link 0 in the scrolling list, then click on Modify Link.

2. **Change the other values as shown in the snapshot below.**

   Refer to "`x25tool` Overview" on page 21 for help if you do not know how to change values:

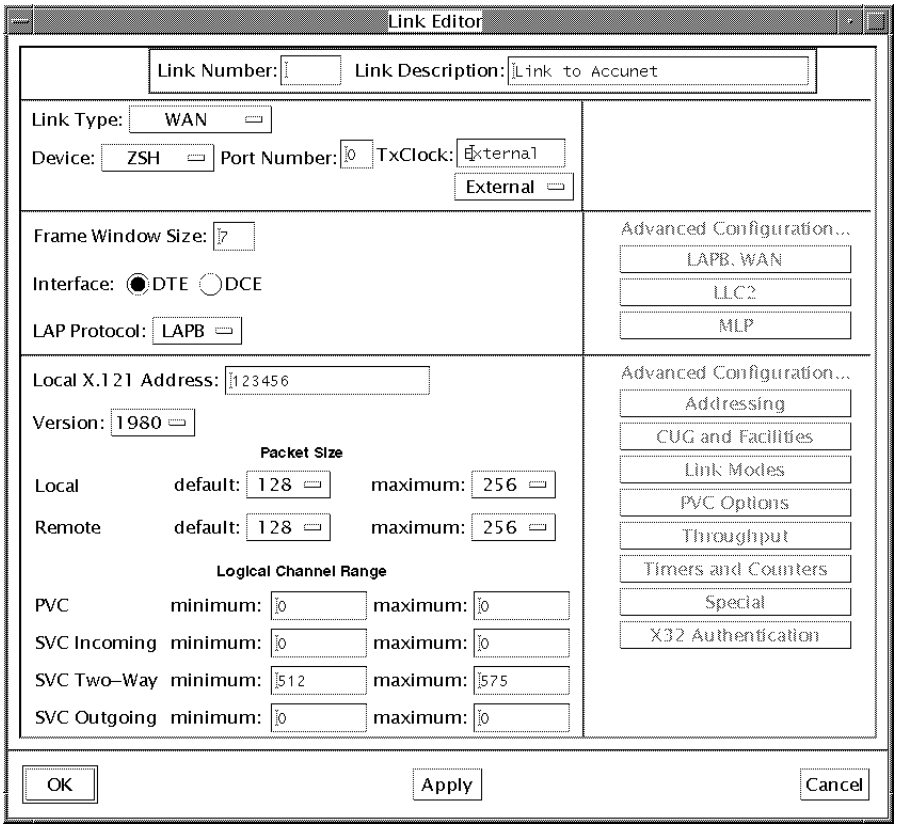

Figure 8–14 Modifying a WAN Link Configuration

3. Click on Apply to update the configuration.

Configuring the Idle Disconnect

You will need to set the Idle Disconnect. This is the period of time, in tenths of a second, that the link will remain idle before closing down.

1. From the Link Editor, select Timers and Counters.

The Timers and Counters button is located under Advanced Parameters.

2. Set the Idle Disconnect.

Set a value (in tenths of a second) that is high enough to allow for lost traffic and retries, but low enough that you are not constantly paying for an idle link.

3. **Click on OK to update the configuration and return to the Link Editor.**

4. **Click on OK to update the configuration and exit the Link Editor.**

Configuring Parameters

Once you have created the link, you need to specify that V25 calling procedures are to be used, and set the idle disconnect to a reasonable value.

Configuring V.25bis Calling Procedures

V.25bis calling procedures are used to control the modem for a dial-up link. You *must* specify that V.25bis calling procedures are to be used. The parameters you need are located in the LAPB and WAN Parameters window. To configure the parameters:

1. **Display the LAPB and WAN Parameters window.**

   In the Link Editor, click on the LAPB,WAN button, which is located under Advanced Configuration. The LAPB and WAN Parameters window appears.

2. **Choose V25 Calling procedures.**

   Pull down the Calling Procedure menu and choose V25.

3. **Set the V25 Call Request Timer.**

   This determines the length of time, in tenths of a second, that your machine will continue trying to connect to the remote network before timing out. If your modem supports call fail indications, set the V25 Call request timer to 0. Check with your modem supplier to find out if this is the case.

Configuring X.32 Authentication Procedures

Next you need to configure the X.32 authentication procedures. These are used on dial-up links by most PSDNs, to prevent people without permission from dialing in. To configure X.32 authentication:

1. **Set Enable X.32 Authentication to Yes.**

   You can choose to carry out X.32 authentication at link level or a packet level. When connecting to a PSDN, use link level as this means the authentication is carried out by the network. Packet level is appropriate when connecting with another machine (back to back, for example) when you want the machine and not the network to do the authentication. Both the Identity and the Signature can be any hexadecimal string, up to 32 characters long, not containing whitespace.

2. **Click on OK to exit the LAPB and WAN parameters window.**

3. **Save the configuration.**

   This makes sure your changes will be used when you start X.25. From the `x25tool` main menu select File ⇒ Save, and save the changes to the current configuration. Or you can select File ⇒ Save As, to save the changes in a different configuration.

Configuring the X.25 Routing Table

The final step in configuring a dial-up machine is to add the telephone number for the network point of connection to the X.25 routing parameters table so that it is mapped to the X.121 address of the machine you want to be able to access. In the example, this is a host on the remote network that is configured to act as an IP router, providing access to the remainder of the network.

To display the X.25 Routing table, in the `x25tool` window, pull down the Services menu and click on Routing. The X.25 Routing parameters table applies across all links. To configure:

1. **Click on Add, then select Top.**

   When the window first appears, the parameters are all grayed out. Clicking on Add, Top creates a new template entry and specifies that the entry will go at the top of the list.

2. **Select the Route Type.**

   The example uses a route to an individual host, so choose X.121 Host.

3. **Enter the number of the link that reaches this destination.**

   This is the number you assigned to the link when you created it. In the example this is link 0.

4. **Enter the X.121 address.**

   Enter the address of the server on the corporate network that also has a connection to the X.25 PSDN.

5. **Enter the Telephone Number used to reach this destination.**

   In a dial-up configuration, this is the address of your point of attachment to the X.25 PSDN, in most cases a modem.

6. **Enter a comment (optional).**

   You could identify the destination that this link reaches, for example.

7. **Save your changes.**

   Pull down the File menu and choose the Save option.

   The completed Routing window for this example looks like this:

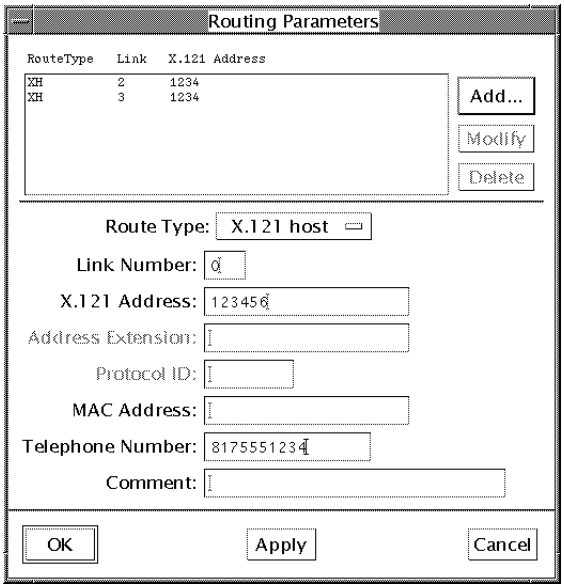

Figure 8–15 Routing Parameters Window

This configuration creates a mapping between the telephone number and the X.121 address of the remote host. When the machine has traffic for the remote host, it knows to dial into the X.25 PSDN. The traffic will then be routed to the remote machine.

Setting up a Workstation Attached to a LAN

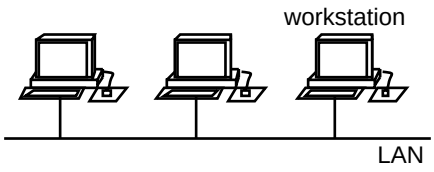

Figure 8–16 Setting up a Workstation Attached to a LAN

In this example, a new workstation is being added to the Local Area Network (LAN). When installed on a machine attached to a LAN, X.25 is configured over LLC2 instead of over LAPB.

This kind of configuration is straightforward. You only need to configure the link to the LAN. The default parameters used at both the Packet layer and the LLC2 layer should work in almost all LAN configurations.

To configure a LAN link:

1. **Start** `x25tool`.

2. **In the Links Configuration list, select Link 1, then click on Modify to bring up the Link Editor window.**

   You can use Link 1 as a template.

3. **Configure the values for your LAN link, as shown below:**

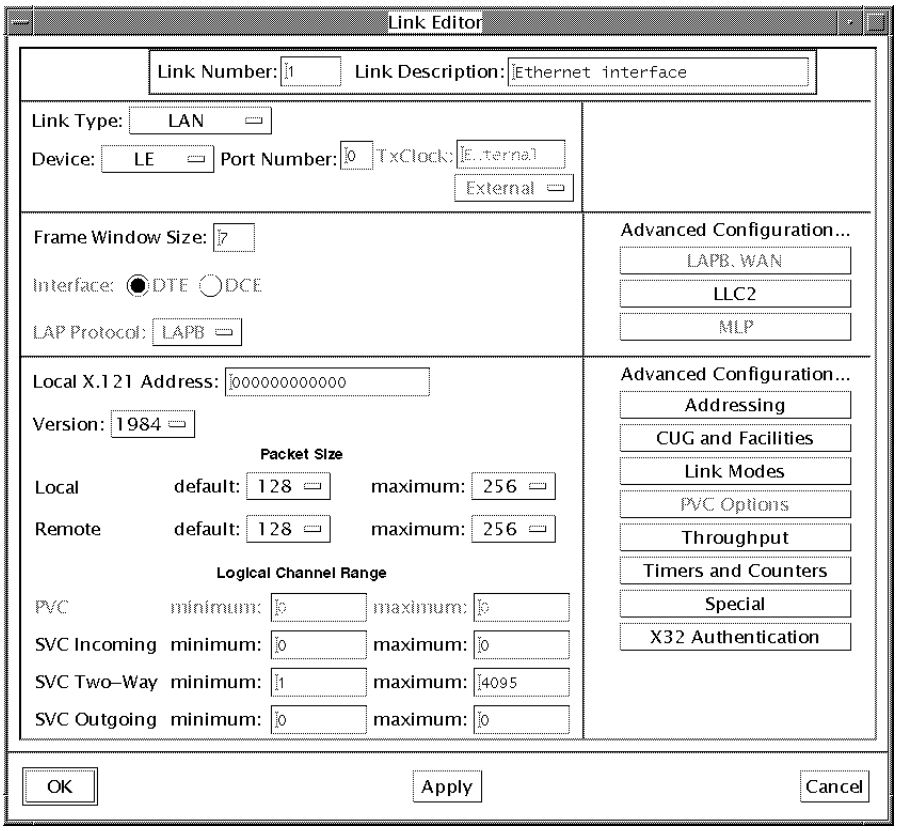

Figure 8–17 Configuring LAN Link Values

You can keep almost all of the default values. The Local Address is the MAC address of your machine. You can find it out by entering the following command:

```
hostname% arp machinename
```

4. **Click on Apply.**

   Should you need to change the Local SAP or Loopback SAP, you can now do this by selecting Addressing, under Advanced Configurations. However, in most instances the default settings should work. Make sure that you do not change or delete the Local SAP or the Loopback SAP, unless you are certain that your network uses different values.

   Once you have added the LAN link like this, you can start the X.25 software. You should now be able to run your applications over the LAN.

   For example, you can make PAD calls to machines on the same LAN by specifying the link number and the MAC address, followed by the SAP, as shown below:

```
hostname% pad 1.0800207111117e
```

   where `1` is the link number, `080020711111` is the MAC address, and `7e` is the SAP.

   See “Configuring the PAD” on page 52 for information on adding entries to the PAD Hosts Database.

Note - Even if the LAN link is the only link on your machine, you need to specify the link number when using applications such as the PAD. This is because Solstice X.25 defaults to use the lowest numbered *WAN* link. If there is no WAN link, there is no default link. Another way to deal with this situation is by using the X.25 Routing table. Map the MAC address plus link number to an X.121 address, then make calls to the X.121 address rather than the MAC address. See “Configure X.25 Routing” on page 134 for an example of configuring the X.25 Routing table.

Setting up a WAN and a LAN Link on a PC Running X.25

This section describes how to configure a WAN and a LAN link on a PC running Solstice X.25. The configuration described in this chapter uses the default values provided with the product.

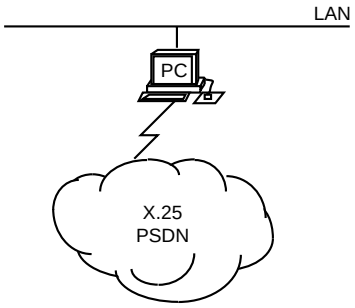

Figure 8–18 Setting up a WAN and a LAN Link on a PC Running X.25

The configuration process is identical to that used for the SPARC version of the product, but the device names change.

To configure Solstice X.25 to be used over the WAN, you need to:

- Install your selected WAN card
- Configure some information about the link
- Change the logical channel ranges used by the Solstice X.25 software to match those used by your PSDN

Before you start, make sure you know the following information:

- The version of the X.25 Recommendation used on the PSDN
- The X.121 address of the port you intend to use
- The logical channel ranges used by the PSDN

To configure the LAN link, you only need to configure the link to the LAN. The default parameters used at both the Packet layer and the LLC2 layer should work in almost all LAN configurations.

Installing Your WAN Card

In order to run Solstice X.25 9.2 over the WAN, the PC must have an appropriate WAN card installed. Install this as described in the manufacturers instructions. You

must use a different interrupt setting for each card that you install—consult your PC manufacturer's documentation for instructions on finding out which interrupts and i/o addresses are available.

Creating the LAN and WAN links.

By default, there are two template links already configured, one WAN link and one LAN link.

First, you will configure a single WAN link by editing the WAN template.

1. **In the `x25tool` window, make sure the entry for Link 0 in the scrolling list is highlighted. Select Modify.**

   The Link Editor window appears.

2. **Set the Device type and Port Number.**

   The example uses the default `expx` device, which is the device type for the SCiiExpress-X card. Currently, this is the only available device for WAN links:

3. **Make sure the Interface is set as DTE.**

   The only time you will need to set the Interface as DCE is if you are running two machines back-to-back, for example for testing.

4. **Set the LAP Mode to LAPB, unless you are sure your PSDN uses a different LAP Mode.**

   LAP and LAPBE are used very rarely.

5. **Set the Local Address.**

   Type in the address of port 0 in this field. This is the X.121 address assigned to you by your supplier. This address is often referred to as an X.25 address. Your service supplier should tell you this address.

Note - The Full Address and Extended Address parameters are not used when the product is in normal operation. You only need to enter these if you are using an application that expects to read them. If this is the case with your PSDN, your service provider will tell you what you need to enter here.

---

6. **Select the Version.**

   Pull down the Version menu and choose the version of the X.25 recommendation used by your PSDN.

7. **Set the Logical Channel Range.**

Your PSDN will tell you which values to use here. Contact them if you require this information. If you are configuring a private network, all machines on the network must use the same logical channel ranges. In this case, you can choose any values that comply with the X.25 Recommendations.

8. **Click on Apply to confirm your changes.**

   Next create the LAN link.

   Using link 1 as a template, configure the values for your LAN link. You can keep almost all of the default values. The device type depends on the type of Ethernet card used by your PC. The default `ELX-0` applies to the 3Com® Etherlink® III card. If you are not sure of the device type used by your PC, enter the following command:

   ```
   hostname% ifconfig -a
   ```

   Included in the information returned by this command is the name of the device that IP is running over. Use this same device type for X.25.

   The Local Address is the MAC address of your machine. You can find it out by entering the following command:

   ```
   hostname% arp machinename
   ```

9. **Click on Apply.**

10. **In the `x25tool` main window, pull down the File menu and select Save.**

    This makes sure your changes will be used next time you start X.25.

Note - For a default configuration, you do not need to configure the Datalink layer parameters; the defaults should be adequate.

---

11. **Start X.25 by pulling down the Network menu and clicking on Start X.25.**

    To check that the configuration is valid, make a PAD call to yourself. To do this, enter the `pad` command at a command line, followed by your own X.121 address:

    ```
    hostname% pad X.121 address
    ```

    Once you have created a link that works, you can fine-tune it, or configure the application(s) you want to run over it. The procedure for doing so is the same as for the SPARC version of the product.

CHAPTER 9

Solstice X.25 Utilities

Table 9–1 summarizes the command line utilities that are delivered with Solstice X.25. Consult the `man` pages for more detailed descriptions of each of the utilities.

TABLE 9–1 Solstice X.25 Command Line Utilities

Name	Description
`linkadd`	Dynamically adds a link while X.25 is running.
`linkdel`	Dynamically removes a link while X.25 is running.
`linklist`	Lists the X.25 links that are currently active.
`ixetune`	Configure IXE driver. The `ixetune` utility reads registration and configuration information from the file `ixetuneconf` and sends this information to the IXE driver. It determines which called addresses a IXE driver is willing to receive connect indications on (listen information). It also specifies the configuration for each IP network, as well as the host's calling/responding address for this network. The options are: `-d` specify a device for the information to be sent to. The default is `/dev/ixe`. `-l` specify the IP interface to tune. If this option is not specified, all the interfaces will be tuned. `-D` specify the pathname of the configuration file to use. The default is `/etc/opt/SUNWconn/x25/`. The filename used is the default, `ixetuneconf`.

TABLE 9–1 Solstice X.25 Command Line Utilities *(continued)*

Name	Description
`linkreset`	Resets the state machine for a LAPB link. This utility cycles the link into disconnected state, and then back to the running state (assuming that the remote end of the link responds correctly). All counters and timers associated with the protocol on that link are reset to their initial values. This command operates on an individual link, so the link identifier must be specified.
`linkstart`	Puts a LAPB link into running state. This command causes the specified link to enter the ADM state, which resets the internal state machine, causing LAPB to attempt to bring up the link. All counters and timers associated with the protocol on that link are reset to their initial values. This command operates on an individual link, so you must specify the link identifier. **Note -** The `linkstart` utility is intended to reverse the effect of the `linkstop` command, and is not the appropriate way to define or create a LAPB link.
`linkstate`	Displays state of a LAPB link. This command displays the internal state of the L:APB for a specified link. When the link is operating normally (i.e. the SABM/UA handshake has been successfully completed) the state displayed is NORMAL. Option is: `-e` causes the linkstate command to exit with a status value of 0 if the link is in NORMAL mode, 254 if the X.25 software has not been started, 255 if the link does not exist or 1 otherwise (the link exist but is not in NORMAL mode). This may be useful when using the command in shell scripts. This command operates on an individual link, so you must specify the link identifier.

TABLE 9–1 Solstice X.25 Command Line Utilities *(continued)*

Name	Description
`linkstop`	Puts a LAPB link into non-running state. This command forces the internal state machine of the LAPB to assume that it has received a disconnect request. This puts the specified link into the disconnected state. The utility also prevents LAPB from responding to any incoming frames on the specified link, until the link has been restarted with `linkstart` or `linkreset`. All counters and timers associated with the link protocol are reset to their initial values. This command operates on an individual link, so you must specify the link identifier. **Note -** When used on a MLP link, `linkstop` returns the highest status of the different SLP. This command does not work with LLC2 links (because there is no status available on such links).
`vcstat`	Checks the virtual circuit status. This command lets you monitor the link and virtual circuit statistic on a cumulative or periodic basis. Options are: `-L` display per-link statistics instead of virtual circuit statistics. `-n` display cumulative (since the last reboot) statistics instead of periodically updating the display. `-l` *interface* specify an interface. `-i` *interval* specify the sampling interval to use for displaying cumulative statistics. If you omit both this and the `-n` option, `vcstat` will display cumulative statistics at 30 second intervals. -s display X.25 addresses in symbolic form, if possible, using the information in the file `/etc/opt/SUNWconn/x25/xhosts`. If a partial match with an entry in that file is found, then the address will be displayed as the name followed by the unmatched digits. `interface` corresponds to the number specified for the interface parameter in your link configuration file. `-p` *period* specify the period of time in minutes that `vcstat` will display the current statistics. By default, vcstat displays statistics for 1440 minutes (24 hours). `-v` *range* specify a virtual circuit, or a range of virtual circuits to be monitored. When specifying a range of virtual circuits, separate the numbers with a hyphen. Example: `-v 11-34`.

TABLE 9–1 Solstice X.25 Command Line Utilities *(continued)*

Name	Description
x25diags	Converts a hexadecimal diagnostic into a short textual description as defined in the X.25 standard This utility can typically be used when a cause and diagnostic code are returned by the PAD program or when such a diagnostic is detected in `x25trace` output. The parameter value must be given in hexadecimal without including the error code.
`x25file`	Generates the configuration file of a running link and echoes it on `stdout`. Option is: -l Generates the configuration file for the link number link_id.
`x25info`	Generates a complete configuration report for an X.25 link. Options are: `-h` display help information (this is the default option) `-ln` specify the link number at the command line level
`x25stat`	Displays per protocol statistics. Options are: `-p` show statistics for a specified protocol or list of protocols. Protocol may be one of `ixe`, `lapb`, `llc`, `mlp`, `wan`, `x25` or `all`. all is used to get statistics for all protocols. `-g` Display statistics global to the specified protocols. No global statistics are displayed for 'wan' level. `-l` link display statistics on a per-link basis. `-L` Display statistics relating to all links. `-v` When x25 protocol is used, display statistics on a per-VC basis. The VC can be an actual VC number or a list of VCs separated by commas, or a range of VCs: VC1-VC2 `-V` When x25 protocol is used, display statistics relating to all VCs. `-s` Display addresses symbolically whenever possible. `-a` When used with -v or -V options, print abbreviated statistics for active VCs. `-F` Display all statistics currently available. `-z` Resets the statistics. The options g, p, l, L, v, V, apply as for displaying the statistics. Note: This option is only available to the super-user.

TABLE 9–1 Solstice X.25 Command Line Utilities *(continued)*

Name	Description
`x25trace`	Run a trace at X.25 packet level. If you are experiencing communication problems, use this command and redirect its output to a file. Options are: `-a` displays total bytes of user data instead of data itself. `-u` buffers output line by line. `-x` decodes packet and displays in hexadecimal. `-D` decodes and displays DLPI messages exchanged between X.25 PLP and LAPB/LLC2. —i specify interface to trace: `/dev/llc2` the LLC interface for X.25 over LLC type 2. `/dev/lapb` the LAPB interface for X.25 over synchronous point-to-point lines. `/dev/x25` the X.25 Packet Layer interface (the default). `-l` specify single link to trace. `-t` use absolute, not relative, time stamps. *filter_expression* specifies one of the following filter expressions: `betweenmac` trace packets between these. `dstmac` trace only packets with this destination MAC address. `mac` trace packets to or from this MAC address. `multicast` trace only LLC2 packets with a multicast address. `pdu_in` trace only incoming PDUs. `pdu_out` trace only outgoing PDUs. `srcmac` trace only packets or frames with this source address. `x25lcn +` trace only packets on the next logical channel set up. `x25lcn` *n* trace only packets on logical channel *n*. **Note -** You can use the logical operators (and, or, and not) with the expressions defined above.

CHAPTER 10

Configuring uucp and tip to Run Over Solstice X.25

The configurations described in this chapter are not part of the Solstice X.25 configuration, but they are provided here for your convenience.

An xty device emulates a tty device, and is required to make outgoing calls using uucp or tip.

By default, Solstice X.25 provides 16 xty devices. This is sufficient for most purposes. If you require more than 16 xty devices, add them by editing the /etc/system file. For example, if you need 20 xty devices, you would add the following line:

```
set xty:xty_cnt = 20
```

Incoming calls are handled directly by the PAD daemon which executes the login process.

Configuring uucp

You need to modify a number of files before uucp/cu calls can be made over the xty driver. All of the files are in the directory /etc/uucp. For more detail, refer to the *SunOS 5.x Administering TCP/IP and PPP* guide. The files you need to modify are:

- Devices Specifies which xty devices are available for outgoing calls.
- Dialcodes Specifies a number of host to X.25 address mappings.
- Permissions Specifies permissions that remote users have when sending files, whether local users can request files, and which commands users are allowed to use. Read the section in the *SunOS 5.x Administering TCP/IP and PPP* guide that

tells you how to configure the permissions. Incorrectly configuring the permissions can compromise system security.

- `Dialers` Specifies the command that `uucp` issues to the PAD to make a `uucp` call.
- `Systems` Specifies the hosts that `uucp` knows about. It includes the login names and character sequences that `uucp` sends and expects to receive.

Editing the `Devices` File

The `xty` device numbers should match those generated by `kernelcreate`, and should number from one upwards. Add lines like the following to the file:

```
Pad   xty1   -   Any   pad
Pad   xty2   -   Any   pad
```

Editing the `Dialcodes` File

Add entries to the `Dialcodes` file to specify name to X.25 address mapping. The names you specify here are used in the `Permissions` and `Systems` files. Add lines like the following to the file:

```
hostname1  x.25-address
hostname2  x.25-address
```

Enter the X.25 address in one of the following formats:

- *link number.x121 address* (for example `0.23433140831`)
- *link number.MAC address* (for example `1.1234567890AB7E`)

Editing the `Permissions` File

Add lines like the following to this file:

```
MACHINE=hostname1:hostname2 \
 REQUEST=yes \
 SENDFILES=yes \
 READ=/ WRITE=/ \
 COMMANDS=ALL
 LOGNAME=nuucp \
 REQUEST=yes \
 SENDFILES=yes \
 READ=/ WRITE=/ \
```

(Continuation)

```
COMMANDS=ALL
```

It is standard practice to use `nuucp` as the `LOGNAME`, but this is not mandatory.

Note - You may want to set more restrictive permissions than those shown above. For more detail, refer to the *SunOS 5.x Administering TCP/IP and PPP*.

Editing the `Dialers` File

You need to tell `uucp` the command to issue to the PAD to allow outgoing calls. Add the following line to this file:

```
pad   ''''   '''' P_ZERO   '''' CALL\040\T
```

Editing the `Systems` File

You need to add lines like this to the `Systems` file:

```
systemname Any Pad Any hostname  in:--in: logname word: password
```

The *hostname* is the hostname you mapped to an address in the `Dialcodes` file. Alternatively, enter the X.25 address here.

Use the `LOGNAME` that you set in the `Permissions` file. In most cases this is `nuucp`.

Configuring `tip`

To configure `tip`, add the name of the remote node you want to reach to your `/etc/remote` file. The entry must include the device type and also specify the `pad` command needed to reach the remote device. If the remote destination is in the hosts database, you can give the hostname you entered there. The entry looks like this:

```
hostname:\
          :dv=/dev/xtydevice:cm=CALL x25.address:
```

Use the `xty` device you set using `x25tool`.
Enter the X.25 address in one of the following formats:

- *link number.x121 address* (for example `0.23433140831`)
- *link number.MAC address* (for example `1.1234567890AB7E`)

CHAPTER 11

Troubleshooting

This chapter contains information for troubleshooting possible problems with Solstice X.25. Problems are generally related to one of the following areas:

- Cabling
- Modem problems
- Logical Channel Ranges
- Other Configuration problems

“Resolving Common Problems” on page 158 offers suggestions for dealing with these problems. Check this section first to see if the procedures solve the problem.

Otherwise, follow the complete troubleshooting procedure. In general it is best to take a “bottom up” approach to troubleshooting. The tests in this chapter are described in that order.

In summary, check:

- The Physical layer:
  - Hardware
  - Line status
- The Datalink layer
  - Packet and link-level traces
  - Protocol statistics
  - Trace information
  - Streams error messages
- The Network Layer:
  - Protocol status

- Connectivity
- Network addresses
- Local routing tables
- Permissions
- Remote operations
- NIS operations (if applicable)

Resolving Common Problems

This section provides information for resolving common problems. These problems are most likely to appear when you bring up Solstice X.25 for the first time. If you cannot resolve the problem using the procedures given here, carry out the full set of tests described in the remainder of this chapter.

Cabling Problems

The following may be symptoms of cabling problems:

- Network does not come up
- X.25 link layer does not come up, or does not stay up
- The message `xmit hung` appears in the console
- No data is being sent or received

Check the following:

1. Make sure you are using the correct type of cable. Refer to Appendix A for cabling diagrams.
2. Make sure all cables are properly seated.
3. If you are operating over an LAPB link, make sure that you are using a cable that is designed for synchronous use. If you have a spare cable, replace your existing cable and retry the connection.

Modem Problems

The following may be symptoms of modem problems:

- Network does not come up
- X.25 link layer does not come up, or does not stay up
- The message `xmit hung` appears in the console
- No data is being sent and or received

Check the following:

1. Make sure your modem is correctly configured. Check your modem's documentation.
2. If you still have a connection, check the Transmit and Receive Data lights on your modem: with LAPB transmission, these should always be on.
3. If you have a connection, use a breakout box at the Sun (not the modem) end of the connection to check that RS-232-C pins 2, 3, 4, 5, 6, 7, 8, 15, 17, and 20 are functioning. Pay particular attention to the Transmit Clocking and Receive Clocking pins, 15 and 17. If the lights corresponding to these pins are not lit, it indicates that the local and/or remote modems are not supplying clocking. Notify the remote end and use your modem's documentation to perform troubleshooting.
4. If you are using a null modem connection, one side should be a DTE, the other a DCE and one or both sides must supply clocking. See "Building the Null Modem Cable" on page 176 for instructions on setting up a null modem connection.

Logical Channel Ranges

Logical channel number mismatches can be difficult to diagnose, especially if you are viewing output from `x25trace`. You see a Call Request packet going out, but no response at the X.25 Packet Layer. In a facilities mismatch, for example, you receive a Clear Indication from the remote end. The Clear Indication contains an error code that is occasionally helpful in pinpointing the problem. The following symptoms may mean that the logical channel ranges are incorrectly configured:

- Inability to establish a packet level connection—for example PAD calls fail
- Traffic can be sent in one direction only
- PAD calls are cleared with the error `Call Cleared - Out of Order (0900)`
- Calls are cleared with an error code of 0x00 24

Check that the logical channel ranges you configured match those used on the X.25 network. If this is a PSDN, contact your service provider to find out what these should be. Refer to "Configuring a Single WAN Link" on page 35 for information on how to use `x25tool` to set the logical channel ranges.

Other Configuration Problems

The following symptoms may indicate that there may be a mistake in the configuration:

- Network does not come up
- X.25 link layer does not come up, or does not stay up
- Inability to establish a packet level connection—for example PAD calls fail
- Link is up but not responding correctly
- Repeated Resets are being received

Check the following:

1. Make sure you specified the correct serial port when you ran x25tool or edited the configuration file. Refer to “Configuring a Single WAN Link” on page 35 for how to configure this using `x25tool`.
2. For LAPB links, check that the link is configured as a DTE if communicating over a PSDN.
3. Facilities and other parameter mismatches, between your machine and the PSDN, can prevent the establishment of virtual circuits. Check the Negotiate Toward Defaults item in the Link Editor, Throughput window. For the majority of PSDNs this should be set to No.
4. Check where calls are being cleared from. If you receive an error code of the form 00 nn, the leading zeroes indicate the call-clearing request originated with the remote host. If the first two digits are not 00,the call-clearing request originated in the PSDN.
5. If you receive an error code of 0x00 43, check that your X.121 address is specified correctly. If it is, check to see whether there is a process listening for an incoming call.
6. If you receive error code 0x00 42, it is likely that your maximum I-frame size, an LAPB-layer parameter, is set incorrectly for your link. The maximum I-frame size is a subscription option to the PSDN. When LAPB is in extended mode, set this parameter eight bytes larger than the default packet size parameter at the packet level.When LAPB is in normal mode, set it five bytes larger. If Solstice X.25 receives a Call Request with a packet size that is within eight bytes (or five bytes) of the maximum I-frame size parameter, the X.25 software clears the call with the 0x00 42 diagnostic. Modify your LAPB parameters as necessary.
7. If you receive error code 0x00 70, check your console to see if you have a licensing problem.
8. If you can find out about the remote host, check that it is still up.
9. If you are running IP over X.25, run ifconfig commands to check on your `ixe` device (for example, `zsh0`). Use of ifconfig is described in “Checking the Protocol Status ” on page 169. If the response from ifconfig is UP, POINTOPOINT, and RUNNING, check with your PSDN to see if there is a problem at the network end.
10. Run x25trace to trace the exchange of X.25 packets across the link. People who are familiar with the X.25 Packet Layer Protocol can interpret the output from x25trace to determine where errors are occurring. The x25trace command is described in “Obtaining Packet and Link-Level Traces” on page 163.
11. If you receive a message from PAD such as, `i/o error, open /dev/x25 failed`, it might indicate that the X.25 network daemon is down. Check the status of the daemon in `x25tool`. This message may also indicate that there are two many simultaneous PAD calls for the software to cope with. Wait a moment, then try again.

12. If you experience intermittent disconnections or resets, check for configuration errors in your link configuration file. At the packet level, make sure that the window and packet size parameters agree, between your machine and the PSDN.
13. If you receive repeated RESETS with error code `0x0092`, there may be a window size mismatch.
14. Perform a loopback test, to check your local configuration down to the link layer.
15. Perform a back-to-back test, to test your configuration against that of another machine.

Note - For error code descriptions, refer to Appendix C.

Checking the Physical Layer

First of all make sure that all of your modem and power cables are in good working order, and that they are all plugged-in, switched on, and tightly seated. Then carry out loopback tests. Finally, check the line status.

If you are using the onboard serial port of a SPARCstation, the most thorough hardware test you can do is to use `syncloop`. If you are using the SUN HSI card, the most thorough hardware test you can do is to use `hsi_loop`. If you are using another manufacturer's card, refer to their documentation.

To check the line status, use the `syncstat` or `hsi_stat` command to observe the line over periods of ten seconds.

Checking a High Speed Interface

If you are using a high speed interface, use the `hsi_loop` command to perform a loopback test to check the following components of your communications link:

- Software configuration
- CPU-to-card communication
- Correct operation of the serial port
- EIA-449 or EIA-232 ports and cables
- Local and remote modems
- Transmission line

If you see errors in the output, contact your local technical support for help in interpreting them.

Checking the Serial Port Line Status

The `syncstat` command monitors traffic that uses the onboard serial port or the serial port on the SCiiExpress-X card.

If you see output packets but no input packets, then either the remote system is not initialized or the line is not properly connected to the remote system. If you see input packets with CRC errors, the transmission medium is causing errors. If you see neither input nor output packets, then the Solstice X.25 protocol module was not successfully initialized. Try restarting the device.

Checking High Speed Interface Line Status

The `hsi_stat` command monitors traffic over a high speed interface. You must log in as `root`, or become `superuser`, to run `hsi_stat`.

If you see output packets but no input packets, then either the remote system is not initialized or the line is not properly connected to the remote system. If you see input packets with CRC errors, the transmission medium is causing errors. If you see neither input nor output packets, then the Solstice X.25 protocol module was not successfully initialized. Try restarting the device.

Checking the Datalink Layer

If the problem is not at the physical layer, the next thing to check is the Solstice X.25 software and configuration. The most important thing is to try and work out in which layer—X.25, LAPB, LLC2, or WAN—the problem originates. In general, you should check the following:

- Check the link and packet layers are up—use x25stat.
- Observe connection attempts and obtain clearing causes and diagnostic codes—use x25trace.
- Log protocol activity—use the `strace` command and the `strerr` daemon.
- Obtain an ASCII record of the values of the parameters for all of the layers in your X.25 configuration— use the `x25info` utility, in `/opt/SUNWconn/bin`. This is particularly useful when you need to send a description of your configuration to your support provider.

Using one or more of these diagnostic tools, you can usually obtain sufficient information to diagnose and correct your communications problem.

Obtaining Packet and Link-Level Traces

Use /opt/SUNWconn/bin/x25trace command to capture information about each packet and/or frame sent and received by Solstice X.25.

You can specify the layer you want to trace, the interface you want to trace, and the destination you want to trace. This lets you narrow down the information you receive.

The x25trace command takes the form shown below:

```
# /opt/SUNWconn/bin/x25trace [options] [-i interface] filter_expression
```

You must run it as `root`, in the foreground. If you want to capture its output in a file, use standard Unix redirection to do so. (This is useful if you intend to contact your local technical support representative for help.) x25trace runs until you enter a Ctrl-C.

You can use specific MAC addresses as filters. For example, you can enter a command that has the effect of saying, “Trace all packets that travel over interface A between address 1 and address 2.” Such commands can extend beyond the width of a command line. In this case, use the backslash (\) continuation character to go beyond a single line.

Table 11–1 lists the devices x25trace supports:

TABLE 11–1 Devices Supported by `x25trace`

Device Name	Description
`/dev/llc2`	Supports LLC2 interfaces.
`/dev/lapb`	Supports synchronous point-to-point interfaces.
`/dev/x25`	Supports the X.25 Packet Layer interface

The following options are available. They are supported by all of the devices.

`-a` By default, x25trace displays the user data in hexadecimal for the highest protocol specified. This option tells x25trace to only display the number of bytes of user data and not display the data in hexadecimal. For example, if you enter:

```
hostname# x25trace -a -i /dev/llc2 x25
```

	x25trace displays only the number of bytes in X.25 packets sent and received over the llc0 interface.
`-l` ***number***	Specifies the link on which `x25trace` is to trace packets. By default, `x25trace` traces on all links and prints the link number in the traced information. (This option is useful only in the situation in which you have multiple links.)
`-u`	This option causes x25trace to buffer display output line-by-line, instead of the default operation of packet-by-packet.
`-x`	This option causes x25trace to display entire packets in hexadecimal, in addition to its default operation of decoding the packet. This option is useful in troubleshooting malformed packets. With such packets, you often see an error message starting with two asterisks (**).

You can use the following filter expressions in an x25trace command line:

`betweenmac`	Trace only the packets or frames passing between the 802.*x* MAC addresses you specify.
`dstmac`	Trace only the packets or frames that have a destination address that is the MAC address you specify.
`lapb` **(or** `hdlc`**)**	Trace only LAPB frames.
`mac`	Trace packets and frames to/from the MAC address you specify. Use only when tracing on a LAN interface.
`multicast`	Trace only LLC2 packets that have multicast addresses.
`pdu_in`	Trace only incoming Protocol Data Units (PDUs).
`pdu_out`	Trace only outgoing Protocol Data Units (PDUs).
`srcmac`	Trace only the packets or frames that have a source address that is the MAC address you specify.
`x25`	Trace only X.25 Packet Layer Protocol packets.

`x25lcn [+|num>]`	Used with a plus sign (+), this expression means trace only the packets that travel on the next logical channel set up. Used with a number, it means trace only the packets that travel on the logical channel identified by *num*.

`x25trace` Examples

Below are some examples of using x25trace for tracing incoming and outgoing packets.

Tracing LAPB and X.25 on `/dev/lapb`*:*

To trace LAPB frames and X.25 packets as they are sent or received by LAPB, enter:

```
hostname# x25trace -i /dev/lapb
```

To trace X.25 packets as they are seen by the X25 driver, type one of the two following commands:

```
hostname# x25trace -i /dev/x25 x25
hostname# x25trace
```

Tracing LLC2 and X.25 on `/dev/llc2`*:*

```
hostname# x25trace -i /dev/llc2
```

The command above captures all LLC frames, including Unnumbered Information frames used to carry CLNP and ES-IS PDUs. When tracing at the X.25 level on an LLC2 link, MAC addresses are displayed as `0:0:0:0:0:0`. Tracing at the LLC2 level on the same link returns the correct MAC addresses.

Tracing a single X.25 connection (logical channel number):

```
hostname# x25trace -i /dev/lapb x25lcn  lcn_num x25
```

Tracing only the next X.25 connection being set up:

```
hostname# x25trace -i /dev/lapb x25lcn + x25
```

Tracing LLC2 frames on `/dev/llc2`*:*

```
hostname# x25trace -i /dev/llc2 llc
```

Tracing X.25 packets to/from specific MAC addresses on `/dev/llc2`*:*

```
hostname# x25trace -i /dev/llc2 srcmac 8:20:0:1:2:3 x25
hostname# x25trace -i /dev/llc2 dstmac 8:20:0:1:2:3 x25
hostname# x25trace -i /dev/llc2 betweenmac 8:20:0:1:2:3 9:0:2b:18:21:5 x25
```

Trace outgoing LLC2 frames that are not multicast:

```
hostname# x25trace -i /dev/llc2 pdu_out not multicast
```

Redirecting trace of X.25 packets over an LAPB link to a file:

```
hostname# x25trace -a -i /dev/lapb x25 > /var/adm/x25/packets.record
```

Displaying Protocol Statistics

Displaying protocol statistics lets you track what is going on a link or links. You can display statistics on a per-protocol basis, or display statistics for all protocols.

To display statistics, start `x25tool`, then pull down the Network menu. Choose the Statistics X.25 menu item. The Network Statistics window appears. Choose the protocol you would like statistics for by clicking on the box to the left of the protocol name. You can select more than one protocol; for example, you can select X.25 and MLP.

Once you have select a protocol or protocols, specify a Link Number or All. Specify the Interval (in seconds) that Statistics should be collected for, and the level of detail you require. For example, you may want to isolate the statistics for a particular VC, if you suspect that is where the problem is. Click on Display to display the statistics—Clear resets them to zero. Once you are happy with your settings, click on Apply.

To collect and display statistics, click on the Display button in the Network Statistics window. Statistics appear in the window and are updated every time the Interval elapses. If you do not have `x25tool` running on your system, you can access the same information by running the command `x25stat`.

Logging Trace Information

The SunOS 5.x streams `strace (1M)` command lets you log trace information. See the `strace` man page for details on the command's use.

The `strace` command must be followed by three arguments:

module id

Table 11–2 lists the possible values:

TABLE 11–2 `strace` module id values

Value	Meaning
200	PLP driver
201	LAPB driver
202	LLC2 driver
203	XXX
208	IXE (IP over X.25)
210	WAN
218	X25SECU (call filtering)
219	XTP (PAD printer)

link number

The number of the link over which the driver you are tracing is running, or all to specify all links.

level

The tracing level that allows you to receive more or fewer packets or frames. Table 11–3 lists the available `strace` tracing levels for the X.25, LAPB, and LLC2 drivers.

TABLE 11–3 `strace` Tracing Levels

Level	X.25 driver module ID 200	LAPB driver module ID 201	LLC2 driver module ID 202
1	call setup	link up/down	link up/down
2	call clearing	link reset	link reset
3	call reset	error activity	error activity
4	restart activity	link busy	link busy
5	interrupt packets	*not available*	Type 1 activity
6	data packets	*not available*	*not available*

Specify all to trace all available levels. For example, to trace X.25 PLP packets on all links at all tracing levels, type:

```
# /usr/sbin/strace 200 all all
```

Note that `strace` is owned by root and is executable only by root.

The tracing of an *incoming* event does not mean that the packet or frame has been accepted by the driver at the layer you are tracing. This is because, for a given layer, the tracing of incoming events is triggered on receiving data from the layer below. At this point, the packet or frame is not yet verified. If the packet or frame is subsequently found to be in error, it might be discarded or cause some further protocol action.

The successful completion of a trace of an *outgoing* event at the X.25 layer does not necessarily mean that the packet has been sent to the link layer. Following tracing, various consistency checks are performed on the link-level database. If these checks fail, the packet will be discarded. At the LAPB and LLC2 layers, successful tracing *does* mean that the frame was sent to the WAN or LAN driver. However, it does not mean that the frame will be transmitted on the line.

Capturing Streams Error Messages

In Solstice X.25, the X.25, LAPB, and LLC2 drivers can generate streams error messages. The SunOS 5.x streams `strerr (1M)` daemon captures streams error messages. This daemon receives error messages and appends them to log files in

`/var/adm/streams`. Log file names take the form `error.`*mm*`-`*dd*, where *mm* and *dd* indicate the month and day the messages were written to the file.

If you are experiencing problems with Solstice X.25 and are uncertain of the source, run `strerr`. If you receive a streams error message, contact your local Sun customer service representative.

You must be `root` to run the `strerr` daemon. Start it like this:

```
hostname# /usr/sbin/strerr &
```

The daemon runs until you kill it.

See the `strerr` man page for a description of the syntax of the messages in the streams error message file.

Checking the Network Layer

Once you are sure that the physical and datalink layers are both working correctly, check to see whether the problem is at the network layer. Check the following:

- the state of the line, using `ifconfig`
- connectivity, using `ping`
- the network address, using `netstat -i`
- the routing tables, using `netstat -r`
- permissions in the `/etc/hosts.equiv` file
- remote operation, using `rlogin`
- NIS operation, using `ypmatch`

Checking the Protocol Status

When Solstice X.25 is running, you can use ifconfig to monitor the current state of the line. Give the X.25 interface name as an argument. For example,

```
hostname# ifconfig ixe
ixe: 192.9.200.2 flags=51<UP,RUNNING,PRIVATE>
```

If the words `UP` and `RUNNING` are displayed, then the connection is potentially intact.

If `ifconfig` does not display `UP` and `RUNNING`, then either you did not configure the X.25 module correctly or the remote system cannot be contacted.

The PRIVATE flag, shown in the display above, is associated with Solstice X.25 and SunLink X.25 devices. The flag means that the routing daemon does not broadcast the host route for the X.25 device to the local network.

Note - Wait 30 seconds after bringing the X.25 link up to check these statistics, as these flags can be up to 30 seconds out of date.

Checking Connectivity

Use `ping` to check that the connection is up:

```
hostname# ping -r gateway_a
gateway_a is alive
```

The `-r`option tells `ping` that the remote host is on a directly-connected interface, such as a X.25 link. If the remote host does not respond, a routing problem exists at some point between the local and remote hosts.

Checking the Network Addresses

Use the `netstat -i`command to check that the correct local and remote addresses are assigned to the Solstice X.25 interface:

```
hostname# netstat -i
```

Make sure that the IP addresses for the local and remote X.25 interfaces are the same in the `/etc/hosts` files or NIS host maps for the machines on both ends of the X.25 link.

Checking the Local Routing Tables

Use the `netstat -r` command to display the local routing tables:

```
hostname# netstat -r
```

The routing table looks like this:

```
Routing tables
 Destination     Gateway     Flags     Refcnt     Use      Interface
 host_a          sun-bb      UGH       0          0        ie1
 host_b          sun-bb      UGH       0          0        ie1
 gateway_b       gateway_a   UGH       1          12897    ixe0
 route7          route7      UGH       0          0        ie0
 eastgate        route71     UGH       0          158      ie0
 backbone        alpha-bb    U         1          16087    ie1
 dresdenpc       route1      UG        0          0        ie1
 loopback        localhost   U         2          113436   lo0
 beta-bb         alpha       U         4063       146044   ie0
 dallas2         route7      UG        0          0        ie0
 trainingpc      route62     UG        0          0        ie1
```

Make sure there is a routing table entry for each possible destination network. In particular, Solstice X.25 devices, listed under `Interface`, should be matched with the appropriate host names listed under Gateway. The `Gateway` entry should, in turn, be matched with the correct entry under Destination.

If there is not a routing table entry for each possible destination network, and you are using *static routing*, add the appropriate static routes. If you are using *dynamic routing* with `in.routed`, do the following:

1. **Check that** `in.routed` **is running by typing**:

```
# ps -ef | grep route
  root  process_id 1 80 Feb 22  1:55 /usr/sbin/in.routed -q
```

   If the routing tables still are not correct, become superuser, and continue with the next steps.

2. **Kill** `in.routed` **and flush the routing tables**:

```
#kill -9 process_id
#/usr/sbin route -f
```

   where *process_ID* is the process ID displayed by the `ps -ef` command.

3. **Restart** `in.routed` **as follows**:

```
#/usr/sbin/in.routed
```

Checking Permissions

If you attempt to use `rsh` or `rlogin` and receive the message `Permission denied`, it is because the remote system's `/etc/hosts.equiv` or `/.rhosts` does not contain the sending system's host name or does not contain the line '+'. For example, if `gateway_a` is to have permissions for `gateway_b`, then `gateway_a` should appear in the `/etc/hosts.equiv` file of `gateway_b`.

Checking Remote Operations

Check that remote operations are working correctly by using `rlogin` or `rsh` to reach the remote host over the X.25 link. If this fails, it probably indicates that the machines on each end of the link have different MTU sizes.

Checking NIS Operations

If your network or the network at the opposite side of the X.25 link run NIS, you should ensure that NIS operation is working correctly. Type `ypwhich` at the command line. You should receive the name of an NIS server on the internetwork as a response. If you don't, this indicates problems with NIS over the X.25 link.

On devices where the interface running Solstice X.25 is the only network interface, you need to perform a few extra steps if you want to get NIS service from across the link. You can do either of the following:

1. Make the remote machine the NIS server.
2. Assign an NIS server for the local machine.

If you choose the second option, do the following:

1. **Become superuser.**

2. **Run** `ypbind` **as follows**:

```
# ypbind -ypsetme
```

3. **Assign a known NIS server to the local X.25 routing gateway, as follows**:

```
# /usr/sbin/ypset server_addr
```

where `server_addr` is the IP address of an NIS server on the local network.

Licensing Problems

Solstice X.25 only runs when a license is available. If you are using Solstice X.25, and its license ceases to be available, the following message is printed to the console:

```
Solstice X.25, waiting to get license
```

If, after three attempts, the license is still unavailable, Solstice X.25 prints the following message to the console and closes down:

```
Unable to regain license, X.25 closing down
```

The most likely cause is a network problem between the device running Solstice X.25 and the license server.

APPENDIX **A**

Cabling

This appendix explains how to build:

- a synchronous null modem cable, for both RS-232-C and RS-449 interfaces
- an X.21-to-RS-449 converter
- an X.25 adapter cable that allows you to run Solstice X.25 over a serial interface on a SPARCstation IPC or IPX
- a cable that lets you use the X.25 port on the SCiiExpress-X card as if it were an HSI port

Note - The CPU serial port on a SPARCstation IPC or IPX can be jumpered for RS-423. References here to RS-232-C apply to IPC/IPX RS-423 ports as well.

Null Modem Requirements

A synchronous null modem is a specially configured cable that simulates two back-to-back modems. When the distance between two hosts is not great, you might be able to use a null modem cable instead of more expensive synchronous modems or synchronous modem eliminators. The use of the null modem cable described here allows you to connect your Sun machine to another Sun or non-Sun machine, for synchronous communication over a short distance.

The maximum distance at which a null modem cable can work is determined by the specification for your serial port interface and depends greatly on the quality of the cable you use.

You must perform the following steps to use a null modem cable for machine-supplied clocking:

- Build the null modem cable, according to the pin-outs provided here.
- In the `x25tool` Link Editor, set the Interface parameter so that one side is DTE and the other side is DCE.
- In the `x25tool` Link Editor, set the Tx Clock parameter to the bit rate you want.

You can use a null modem cable with any of the Sun RS-232-C or RS-449 serial port options, except the EXPX device, which cannot supply a clock.

Configuring Internal or External Clocking

Solstice X.25 supports the following clocking alternatives:

- Transmit clock and receive clock are both external. This is the situation in which clocking is provided by a synchronous modem or modem eliminator.
- Transmit clock is internal; receive clock is external. On the machine that is to supply clocking, set the Tx Clock parameter to the bit rate you want in the Link Editor in `x25tool`.

Note - You can only use an IPC/IPX in situations where clocking is external, that is, where the remote (non-IPC/IPX side) supplies both the transmit and receive clocks.

Building the Null Modem Cable

The following subsections provide four null-modem-cable schematic diagrams. The first pair of diagrams are RS-232-C null modems; the second pair are RS-449 null modems. Within each pair, one diagram illustrates a null modem cable to connect two Sun machines in which both Sun machines supply the clocking. The other diagram illustrates a null modem cable to connect a Sun machine to another Sun or non-Sun machine, in which only one Sun machine supplies clocking for both sides.

To build a null modem cable, you can configure your own cable or use a standard cable with an adapter box. If you decide to use an adapter box, be sure to obtain an adapter that allows you to change pin configurations. Pre-configured adapters generally do not work with synchronous protocols because they do not handle clock signals correctly.

For an RS-232-C cable, use a good quality, shielded wire. For an RS-449 cable, it is best to use shielded, twisted-pair wire.

RS-232-C Null Modem Cables

The following diagram illustrates a synchronous null modem that allows you to connect two Sun machines that each supply clocking, using the RS-232-C interface. Each Sun machine supplies clocking on pin 24. The null modem routes this clocking to pin 17 on the opposite side to provide receive clocking.

In `x25tool` Link Editor window, set the Tx Clock parameter to the bit rate you want (not External) on both machines.

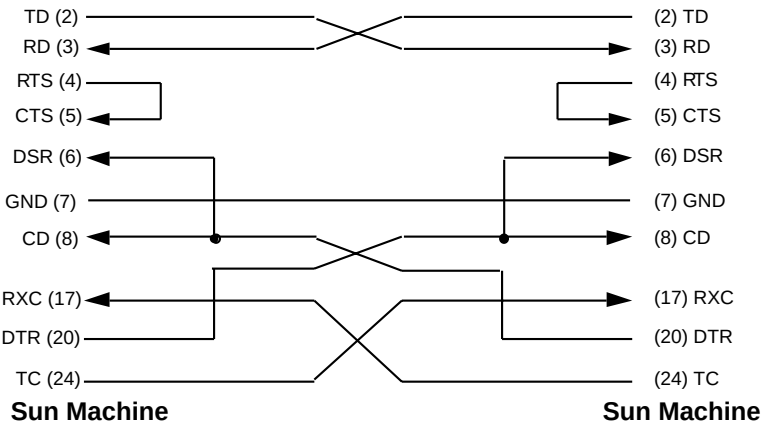

Figure A–1 RS-232-C Null Modem: Both Sun Machines Supply Clocking

The following diagram illustrates a synchronous null modem that allows you to connect a Sun machine to another Sun or non-Sun machine, using the RS-232-C interface. The Sun machine supplies both the transmit and receive clocks for the other machine. Note that this null modem is not symmetrical.

In `x25tool` Link Editor, set the Tx Clock parameter to the bit rate you want (not External) on the Sun machine that is to supply clocking.

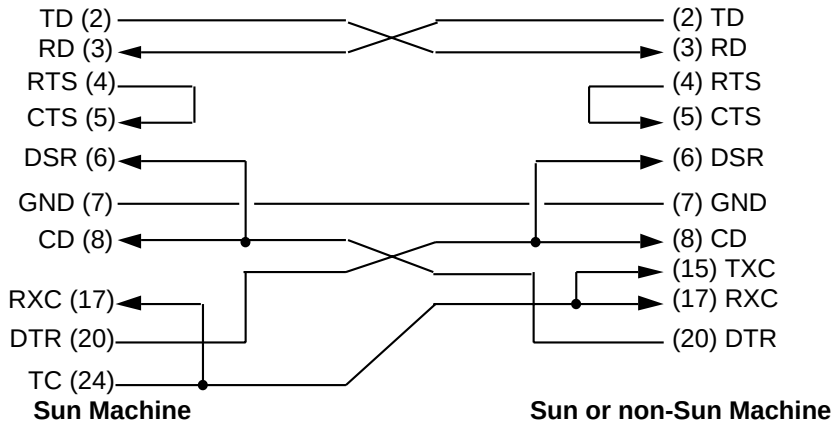

Figure A–2 RS-232-C Null Modem: Sun Machine Supplies Clocking for Both Sides

RS-449 Null Modem Cables

The following diagram illustrates a synchronous null modem cable that allows you to connect two Sun machines that each supply clocking, using the RS-449 interface. Each Sun machine supplies clocking on pins 17 and 35. The null modem cable routes this clocking to pins 8 and 26 on the opposite side to provide receive clocking.

Because the RS-449 interface is balanced, there are two pins for each signal. For example, in the diagram below, Send Data (SD), pins 4 and 22, is connected to Receive Data (RD), pins 6 and 24. This means that pin 4 is connected to pin 6 and pin 22 is connected to pin 24.

In `x25tool` Link Editor window, set the Tx Clock parameter to the bit rate you want (not External) on both machines.

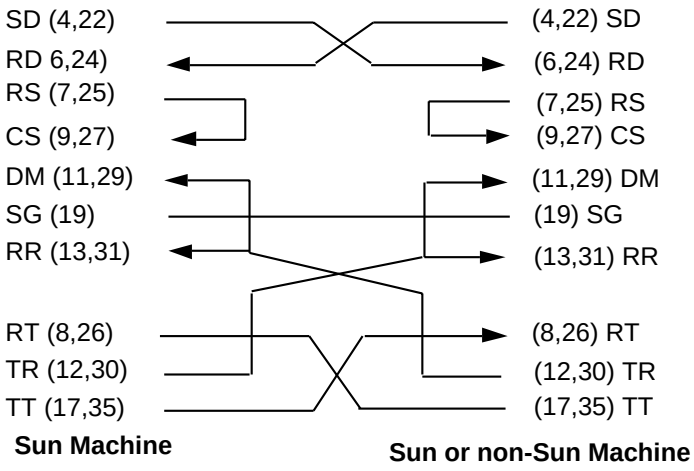

Figure A–3 RS-449 Null Modem Cable: Both Machines Supply Clocking

The following diagram illustrates a synchronous null modem cable that allows you to connect a Sun machine to another Sun or non-Sun machine, using the RS-449 interface. The Sun machine supplies both the transmit and receive clocks for the other machine. Note that this null modem cable is not symmetrical.

Because the RS-449 interface is balanced, there are two pins for each signal. For example, in the diagram below, Send Data (SD), pins 4 and 22, is connected to Receive Data (RD), pins 6 and 24. This means that pin 4 is connected to pin 6 and pin 22 is connected to pin 24.

In `x25tool` Link Editor, set the Tx Clock parameter to the bit rate you want (not External) on the Sun machine that is to supply clocking.

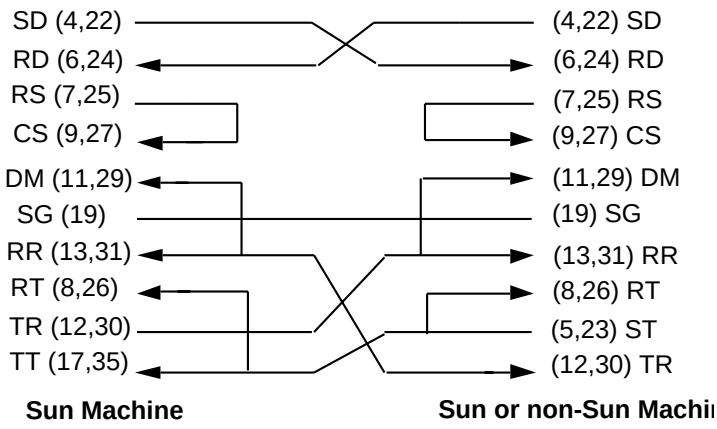

Figure A–4 RS-449 Null Modem Cable: Sun Machine Supplies Clocking

X.21-to-RS-449 Converter

Tables A-1 and A-2 list the signals and names for RS-449 and X.21 circuits.

TABLE A–1 RS-449 Signals

Circuit	Name	Direction
SD	Send Data	To DCE
RD	Receive Data	From DCE
TT	Terminal Timing	To DCE
ST	Send Timing	From DCE
RT	Receive Timing	From DCE
RS	Request to Send	To DCE
CS	Clear to Send	From DCE
RR	Receiver Ready	From DCE
TR	Terminal Ready	To DCE

TABLE A–1 RS-449 Signals *(continued)*

Circuit	Name	Direction
DM	Data Mode	From DCE
SG	Signal Ground	

TABLE A–2 X.21 Signals

Circuit	Name	Direction
G	Signal Ground	
T	Transmit	To DCE
R	Receive	From DCE
C	Control	To DCE
I	Indication	From DCE
S	Signal Element Timing	From DCE
B	Byte Timing	From DCE

The diagram below illustrates the pin connections required for an X.21-to-RS-449 converter.

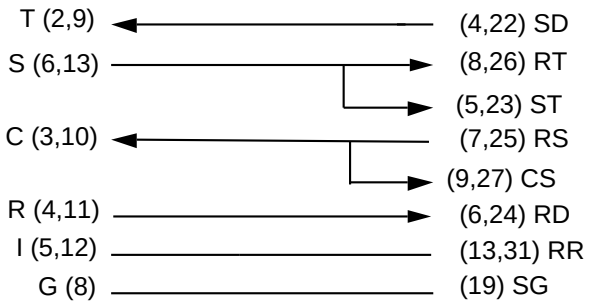

Figure A–5 X.21-to-RS-449 Converter

Using the X.21 interface as an HSI

Note - The information in this section applies only to the x86 version of the product.

If you want to use the X.21 interface provided by the SCii Express-X card in the same way as an HSI interface, make up a cable as below:

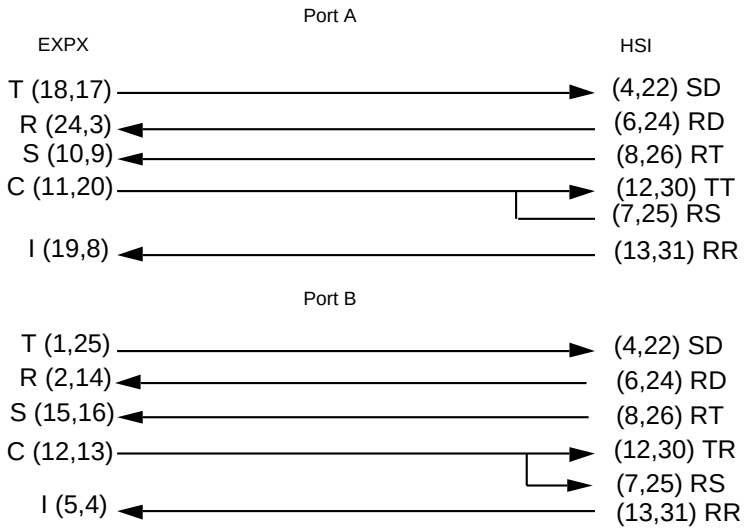

Figure A–6 X.21 Interface Configured as an HSI

IPC/IPX X.25 Adapter Cable

You can build an adapter cable to run Solstice X.25 over the 8-pin serial port on a SPARCstation IPC or IPX.

Table A–3 lists the pin-outs in the X.25 Adapter Cable.

TABLE A–3 Pin-outs for IPC/IPX Adapter Cable

Signal Name	Female DB-25 Pin Number	DIN-8 Pin Number
TD	2	3
RD	3	5
RTS	4	6
TC	15	2
GND	7	4
DCD	8	7
RC	17	8
DTR	20	1

Note - Pin-15-to-pin-2 is the only difference from the asynchronous DIN-8-to-DB-25 cable, which has DB-25 pin 5 pinned to DIN-8 pin 2.

APPENDIX **B**

Parameter Values Quick Reference

This appendix summarizes the parameters stored in the X.25 configuration files, their format and valid parameter values. The configuration files are contained in the `/etc/opt/SUNWconn/x25/config` directory.

File `link_config_0000.cfg` configures link 0. In the default configuration, this is a WAN link. File `link_config_0001.cfg` configures link 1. In the default configuration, this is a LAN link.

There is a separate configuration file for each link. The filename is of the format `link_config_`*n*`.cfg`, where *n* is the link number. These are the files that will be read when the Solstice X.25 is next started. Editing them is equivalent to editing the configuration while using `x25tool` in *static* mode. Use a different naming convention if you want to save changes without using them on the next restart.

To create a new non-MLP WAN link use file `link_config_0000.cfg` as a template. Copy it and giving the new file the correct name for the link you want it to apply to. For example, to configure port 3 as a WAN link, call the file `link_config_0003.cfg`.

To create a new MLP WAN link, use the sample file `/etc/opt/SUNWconn/x25/Samples/def_mlp_config.cfg` as a template.

To create a new LAN link, copy and rename the file `link_config_0001.cfg`. Then edit the new file to use the values you want.

Each configuration file is composed of a series of sections, one for each part of the configuration. In the case of an MLP configuration file, the LAPB and WAN sections become sub-sections of the MLP section. Refer to the `/etc/opt/SUNWconn/x25/Samples/def_mlp_config.cfg` file to see how this works.

Table B–1 summarizes the available sections, keywords and parameters. Refer to Chapter 7 for a discussion of the meaning and use of the available parameters.

Note - All timer values are given in seconds.

TABLE B–1 Configuration File Content

Section	Keyword	Valid Parameter Values	Parameter Value Default
IDENTIFICATION	PRODUCT_NAME	Solstice X.25	
	PRODUCT VERSION	9.2	
	FILE_TYPE	x25link	
	MODIFIED_BY	*user_id*	
	FILE_DATE	*date*	
LINK	device	/dev/*devicenamen*	
	local_address	A valid X.121 or MAC address	
	full_address	*linkno.address*	
	type	WAN, LAN	
	version	1980, 1984, 1988	
	mode	DTE, DCE	
	protocol	LAP, LAPB, LLC2, MLAPB	
	description	32 character string	
MLP	mlp_window	Numerical value between 0 and 4095	10
	mlp_guard	Numerical value between 1 and 4095	10
	mt1_val	Timer value in seconds, between 1.0 and 300.0	2.0

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	mt2_val	Timer value in seconds, between 1.0 and 300.0	2.0
	mt3_val	Timer value in seconds, between 1.0 and 300.0	2.0
	mn1_val	Numerical value between 1 and 255	10
LAPB	n2_count	Numerical value between 1 and 255	10
	t1_timer	Numerical value between 1 and 300	9.0
	pf_timer	Numerical value between 1.0 and 300	0.7
	reject_timer	Numerical value between 1.0 and 1000	2.5
	busy_timer	Numerical value between 1.0 and 3000	10.0
	idle_timer	Numerical value between 0 and 3200	25.0
	rr_ack_delay	Numerical value between 0 and 300	0.4
	unack_max	Numerical value between 0 and 127	3
	local_win	For modulo 8 networks, a numerical value between 1 and 7. For modulo 128 networks, a numerical value between 1 and 127.	
	local_probe	For modulo 8 networks, a numerical value between 1 and 7. For modulo 128 networks, a numerical value between 1 and 127.	
	ign_ua_error	Y(es) or N(o)	
	frmr_frmr_error	Y(es) or N(o)	
	frmr_invrsp_error	Y(es) or N(o)	

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	sframe_pbit	Y(es) or N(o)	
	no_dm_adm	Y(es) or N(o)	
	iso8882	Y(es) or N(o)	
	sabm_in_x32	Y(es) or N(o)	
	initial_down	Y(es) or N(o)	
	mlp_priority	Numerical value between 1 and 12	1
WAN	line_speed	EXTERNAL, 110, 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 48000, 56000, 64000, 128000, 256000, 512000, 1.024M, 1.536M, 2.048M	
	max_frame	max_iframe_len plus 1	
	connect_proc	NONE or V25	
	v25_callreq	Numerical value between 6.0 and 30	
LLC2	n2_count	Timer value between 1 and 255	10
	t1_timer	Timer value between 1.0 and 300.0	9.0
	pf_timer	Timer value between 1 and 300.0	0.7
	reject_timer	Timer value between 1 and 1000.0	2.5
	busy_timer	Timer value between 1 and 3000.0	10.0
	idle_timer	Timer value between 0 and 3200.0	25.0
	rr_ack_delay	Timer value between 0 and 300	0.4

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	unack_max	Numerical value between 0 and 127	3
	local_probe	Numerical value between 0 and 127	0
	xid_window	Numerical value between 1 and 127	7
	xid_ndup	Numerical value between 0 and 255	2
	xid_tdup	Numerical value between 0 and 300	5
X25	network	X25_80, X25_84, X25_88, X25_LLC, X25_CIRCUIT	
	plpmode	Normal or Auto	
	pvc_range	Pair of numerical values	0-0
	inc_range	Pair of numerical values	0-0
	out_range	Pair of numerical values	0-0
	two_range	Pair of numerical values	512-575
	modulo	8 or 128	8
	use_negotiation	Y(es) or N(o)	
	bar_negotiation	Y(es) or N(o)	
	src_addr_control		0
	accept_revchg	Y(es) or N(o)	
	prev_chg	Y(es) or N(o)	
	fast_select	Y(es) or N(o)	

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	fs_r_response	Y(es) or N(o)	
	bar_nonpriv_listen	Y(es) or N(o)	
	locmaxpktsize	7,8,9,10,11,12	
	remmaxpktsize	7,8,9,10,11,12	
	locdefpktsize	7,8,9,10,11,12	
	remdefpktsize	7,8,9,10,11,12	
	locmaxwinsize	Numerical value between 1 and 127	7
	remmaxwinsize	Numerical value between 1 and 127	7
	locdefwinsize	Numerical value between 1 and 127	2
	remdefwinsize	Numerical value between 1 and 127	2
	maxnsdulength	Numerical value between 1 and 32000	256
	ackdelay	Numerical value between 1 and 3200.0	5
	t20value	Timer value between 0 and 3200.0	180.0
	t21value	Timer value between 0 and 3200.0	200.0
	t22value	Timer value between 0 and 3200.0	180.0
	t23value	Timer value between 0 and 3200.0	180.0
	t24value	Timer value between 0 and 3200.0	75.0
	t25value	Timer value between 0 and 3200.0	180.0

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	t26value	Timer value between 0 and 3200.0	180.0
	t28value	Timer value between 0 and 3200.0	0.0
	idlevalue	Timer value between 0 and 3200.0	0.0
	connectvalue	Numerical value between 0 and 3200.0	200.0
	ack_delay	Numerical value between 0 and 3200	
	r20value	Numerical value between 1 and 255	1
	r22value	Numerical value between 1 and 255	1
	r23value	Numerical value between 1 and 255	1
	r28value	Numerical value between 1 and 255	1
	localdelay	Numerical value between 0 and 32	0.005
	access_delay	Numerical value between 0 and 32	0.005
	locmaxthclass	Numerical value between 0 and 15	12
	remmaxthclass	Numerical value between 0 and 15	12
	locdefthclass	Numerical value between 0 and 15	12
	remdefthclass	Numerical value between 0 and 15	12
	locminthclass	Numerical value between 0 and 15	4
	remminthclass	Numerical value between 0 and 15	4
	sub_cug	Y(es) or N(o)	

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	sub_pref_cug	Y(es) or N(o)	
	sub_cugia	Y(es) or N(o)	
	cug_format	Basic or Extended	
	bar_cug_in	Y(es) or N(o)	
	bar_incall	Y(es) or N(o)	
	bar_outcall	Y(es) or N(o)	
	sub_toa_npi_fmt	Y(es) or N(o)	
	bar_toa_npi_fmt	Y(es) or N(o)	
	sub_nui_override	Y(es) or N(o)	
	bar_call_x32_reg	Y(es) or N(o)	
	acc_nodiag	Y(es) or N(o)	
	use_diag	Y(es) or N(o)	
	ccitt_clear_len	Y(es) or N(o)	
	bar_diag	Y(es) or N(o)	
	disc_nz_diag	Y(es) or N(o)	
	acc_hex_add	Y(es) or N(o)	
	intl_prioritised	Y(es) or N(o)	
	iso_8882_mode	Y(es) or N(o)	

TABLE B–1 Configuration File Content *(continued)*

Section	Keyword	Valid Parameter Values	Parameter Value Default
	send_x121_to_lan	Y(es) or N(o)	
	insert_x121_from_lan	Y(es) or N(o)	
	datapac_priority	Y(es) or N(o)	
	dnic	Any legal DNIC	0000
	intl_addr_recogn	0, 1, 2, 3	
	prty_encode_control	0, 1, 2	
	prty_pkt_forced_val	0,4,5,6,7,8,9,10,11,12	
	dbit_accept_in	clear, leave or zero	
	dbit_accept_out	clear, leave or zero	
	dbit_data_in	clear, leave or zero	
	dbit_data_out	clear, leave or zero	
	thclass_neg_to_def	Y(es) or N(o)	
	thclass_type	Array of 16 integers	
	thclass_wmap	Array of 16 integers	
	thclass_pmap	4,5,6,7,8,9,10,11,12	

APPENDIX **C**

Error Messages and Error Codes

Error Messages are generated by the Solstice X.25 software, and tell you that there may be a mistake in the configuration. Error Codes are generated by your communication service and may indicate a problem with the remote host.

Note - The information given below does not contain an exhaustive list of all the messages that can appear while using Solstice X.25, since many of the messages are self-explanatory. If you receive a message which is not listed here and is not self-explanatory, contact your authorized service provider for assistance.

Error Messages

`Invalid Address Extension`

Check and re-enter the extension.

`Invalid Characters or Invalid Length in Address Extension`

Check and re-enter the extension.

`Missing Address Extension`

Enter the address extension.

`Invalid Character in Called Address or in Calling Address`

Check and re-enter the address.

`Invalid Character in Calling Address`

Check and re-enter the address.

`Invalid Address Local SAP`

Check and re-enter the local SAP.

`Invalid Address Loop SAP`

Check and re-enter the loop SAP.

`Invalid Character in Call User Data`

Check and re-enter the Call User Data.

`Specify the HTML browser before starting Help`

To use on-line help with `x25tool`, you must first specify the browser you want to use (Netscape, Hot Java, Mosaic).

`Invalid DNIC`

Check and re-enter the DNIC

`Cannot allocate memory`

Free up memory and try again.

`Cannot load file <file_name> : <cause>`

The cause displayed with this message should give you some indication of the problem. Correct the problem and try again.

`The file does not exist, or is in the wrong format`

Check that the file exists and is in the right format.

`Error loading file for link# <link id>`

The file may be in the wrong format.

`Cannot open lapb device`

The X.25 network must be up before the lapb device can be opened.

`Cannot open x25 device`

The X.25 network must be up before the x25 device can be opened.

`NO IXE file`

The file is missing.

`Error opening directory %s`

The directory may not exist.

`Error opening file %s`

The file may not exist.

Error Messages Related to Read and Write Permission

The following error messages can occur if you do not have read and write permission. If you receive one of the messages listed below, log in as `root` or become `superuser`, and try again.

`Cannot add dynamically this IP interface`

`Cannot add dynamically this link`

`Cannot load dynamic parameters for link <link>`

`Cannot load dynamic parameters for NUI`

`Cannot load dynamic parameters for Route`

`Cannot remove dynamically this IP interface`

`Cannot remove dynamically this link`

`Cannot reset this link`

`Cannot save dynamically IP Interface Parameters`

`Cannot save dynamically IP Map Parameters`

`Cannot save dynamically LAPB Parameters`

`Cannot save dynamically LLC2 Parameters`

`Cannot save dynamically MLP Parameters`

`Cannot save dynamically NUI Parameters`

`Cannot save dynamically Pad Daemon Parameters`

`Cannot save dynamically PAD Printer Parameters`

`Cannot save dynamically PVC`

```
Cannot save dynamically Routing Parameters

Cannot save dynamically X25 Security Parameters

Cannot save dynamically WAN Parameters

Cannot save dynamically this Link

Cannot get running links list

Error creating backup of boardconf file

Error creating backup of ipconf file

Error creating backup of ixemapconf file

Error creating backup of pvcmapconf file

Error creating backup of nuimapconf file

Error creating backup of paddconf file

Error creating backup of padmapconf file

Error creating backup of routes file

Error creating backup of x25secuconf file

Error creating backup of x25secupid file

Cannot create a symbolic link from <source file> to <destination
file> <causes>

Error creating backup of x29profile file

Error creating backup of xhosts file

Error creating backup of xtpmapconf file

Unable to Execute Command

Unable to Execute Command <command name>

File <filename> is read-only Change the permissions and re-do

Cannot remove symbolic link <symbolic_link>

Error writing boardconf file

Cannot write in Directory <directory_name>
```

```
Error writing ipconf file

Error writing ixemapconf file

Error writing pvcmapconf file

Error writing nuimapconf file

Error writing paddconf file

Error writing padmapconf file

Error writing routes file

Error writing x25secuconf file

Error writing x25secupid file

Error writing x29profile file

Error writing xhosts file

Error writing xtpmapconf file
```

Error Messages Relating to File Format Problems

The following messages indicate a problem with the format of the file. This type of problem can be avoided by using `x25tool` whenever possible, instead of directly editing files.

```
nuimapconf: Bad facility: non-digit locdefpktsize

nuimapconf: Bad facility: overlong locdefpktsize

nuimapconf: Bad facility: non-digit locdefthclass

nuimapconf: Bad facility: overlong locdefthclass

nuimapconf: Bad facility: non-digit locdefwsize

nuimapconf: Bad facility: overlong locdefwsize

nuimapconf: Bad facility: non-digit remdefpktsize

nuimapconf: Bad facility: overlong remdefpktsize

nuimapconf: Bad facility: non-digit remdefthclass
```

```
nuimapconf: Bad facility: overlong remdefthclass

nuimapconf: Bad facility: non-digit remdefwsize

nuimapconf: Bad facility: overlong remdefwsize

nuimapconf: Unexpected character in facility string

xtpmapconf: invalid address <address> for device xtp<device>

xtpmapconf: invalid cud <cud> for device xtp<device>

xtpmapconf: incorrect device

xtpmapconf: incomplete line in config file

xtpmapconf: invalid link number : <link_number> for device
xtp<device>

xtpmapconf: invalid opt <opt> for device xtp<number>

xtpmapconf: invalid printer name <printername> for device
xtp<number>

route file: AEF already set: <aef>

route file: bad type of AEF: <aef>

route file: AEF must be in Hexa : <aef>

route file: source_aef not supported, skipped

route file: too long AEF: <aef>

route file: bad source_aef entry

route file: bad link number

route file: bad right-hand part of aef entry

route file: bad tag <tag> at line <line_number>

route file: Mac address already set <mac_address>

route file: bad 802 address <address>

route file: mismatched quotes at line <line_number>

route file: unknown keyword on line <line_number>
```

```
route file: parse error at line <line_number>, truncated file?

route file: Pid already set <pid>

route file: bad Pid <pid>

route file: Pid must be hexa <pid>

route file: Odd length pid <pid>

route file: Pid too long <pid>

route file: PSTN number already set <PSTN_number>

route file: PSTN missing <PSTN_number>

route file: PSTN number must not exceed 16 digits <PSTN_number>

route file: too many items on line <line_number>

route file: X.121 address already set <x121_address>

route file: bad X.121 <x121_address>

route file: bad X.121 <x121_address>

route file: bad right-hand part of X.121

route file: too long X.121 <x121_address>

x25secuconf, line <line_number> :Bad address

x25secuconf, line <line_number> : No more than 15 digits in X121
address

x25secuconf, line <line_number> : Invalid character in address

x25secuconf, line <line_number> :Bad date

x25secuconf, line <line_number> :Bad day number

x25secuconf, line <line_number> :Bad link id

x25secuconf, line <line_number> :Bad month

x25secuconf, line <line_number> : Invalid repetition period

x25secuconf, line <line_number> :Bad time

x25secuconf, line <line_number> :Bad year number
```

```
x25secupid, line <line_number> : Error in reading pid

x25secuconf, line <line_number> :error in get_service_name

x25secupid, line <line_number> : No * after 128 digits in pid

x25secupid, line <line_number> : pid len must be even

Missing service name <service_name> in x25secuconf file

x25secuconf, line <line_number> :Service name too long

x25secupid, line <line_number> : Invalid Character in pid

x25secupid, line <line_number> :character not authorized in
service name

Unexpected Hold-Down Timer value <timer_value> Assumed to be
X.25 mode from V8 config file

Unexpected 'Unconfigured Host' value on line <line_number>
Assumed to be Reset Action from V8 config file

Unrecognized option at line <line_number>, processing PAD Daemon
file

Invalid Characters or Invalid Length in PID

x25secupid, line <line_number> :error in read_service_name

x25secupid, line <line_number> :Service name too long
```

Error Codes

A problem with an X.25 application might be a result of a problem communicating with the PSDN or a problem with the remote host. When a problem causes your call to be cleared, you receive a diagnostic code in the form of two pairs of digits. The first pair indicates why the call was cleared; the second pair gives additional diagnostic information. The tables on the following pages specify the meanings for these numeric codes. Table C–1 specifies reasons for call-clearing. Table C–2 specifies diagnostic information in addition to the call-clearing cause.

In many instances, if you receive any of these error codes, you will need to contact your service provider. However, in some instances the error code may indicate a configuration problem that you can correct yourself.

A zero (00) call-clearing code indicates that the call-clearing request originated in the remote host. A non-zero call-clearing code indicates the call-clearing request originated in the PSDN.

For example, your call is cleared with a code 03 42. As specified in Table C–1, 03 indicates an invalid facility request. Table C–2 tells you that 42 (hex) means that a facility parameter (that you used) is not allowed. This combination of messages tells you that:

1. The problem was detected by the PSDN, not by the remote host.
2. One or more parameter settings that you made in `x25tool` are unacceptable to the PSDN.

Often, a diagnostic gives only a general clue as to the source of a problem. For example, your call might be cleared with the code 00 42, indicating an invalid facility parameter setting. You might, in fact, have a facility parameter set to a value outside of the range of what you subscribed to. However, you can also receive this message if the maximum I-frame size is set to a size lower than the PSDN expects. Solstice X.25 clears the call rather than allow it to start and possibly fail later.

If you receive error code 00 42 and are not subscribing to any facilities, or are confident that your facilities parameters settings are correct, confirm that you and your PSDN agree on the maximum I-frame size. Remember that any adjustment of the maximum I-frame size, a LAPB parameter, might also require a change to the default packet size parameter, at the X.25 Packet Layer. Use `x25tool` to modify your link configuration as necessary.

In Table C–1 note the four categories of codes, separated by the double horizontal lines:

- The first category, code `00`, indicates that the call-clearing request originated with the remote host. The remaining codes, in all other categories, indicate that the call-clearing request originated within the PSDN.
- Codes in the second category (hexadecimal code `01` through `29`) indicate problems between the PSDN and the remote host.
- Codes in the third category (hexadecimal code `03` through `13`) indicate problems between the local host and the PSDN.

Codes in the fourth category (hexadecimal codes `05` through `15`) indicate problems within the PSDN. Table C–1 lists the fourth category causes for call clearing codes:

TABLE C–1 Causes for Call Clearing

Hexadecimal Code	Decimal Code	Meaning
00	00	Originated by remote DTE
01	01	Number busy
09	09	Out of order
11	17	Remote procedure error
19	25	Reverse charging acceptance not subscribed
21	33	Incompatible destination
29	41	Fast select acceptance not subscribed
03	03	Invalid facility request
0B	0B	Access barred
13	19	Local procedure error
05	05	Network congestion
0D	13	Not obtainable
15	21	RPOA out of order

Table C–2 lists the X.25 diagnostic codes.

TABLE C–2 X.25 Diagnostic Codes

Hexadecimal Code	Decimal Code	Meaning
00	00	No additional information
01	01	Invalid P(S) (send-packet sequence number)
02	02	Invalid P(R) (receive-packet sequence number)
10-1F	16-31	Invalid packet type
20	32	Packet not allowed
21	33	Unidentifiable packet
22	34	Call on one-way logical channel
23	35	Invalid packet type on a permanent virtual circuit
24	36	Packet on an unassigned logical channel
25	37	Reject not subscribed to
26	38	Packet too short
27	39	Packet too long
28	40	Invalid general format identifier
29	41	Restart with nonzero in bits 1-4, 9-16
2A	42	Packet type not compatible with facility
2B	43	Unauthorized interrupt confirmation
2C	44	Unauthorized interrupt
30	48	Timer expired

TABLE C–2 X.25 Diagnostic Codes *(continued)*

Hexadecimal Code	Decimal Code	Meaning
31	49	For incoming call
32	50	For clear indication
33	51	For reset indication
34	52	For restart indication
40	64	Call setup problem
41	65	Facility code not allowed
42	66	Facility parameter not allowed
43	67	Invalid called address
44	68	Invalid calling address

Note in the table above that hexadecimal codes 0, 20, 30, and 40 (decimal 0, 32, 48, and 64) stand for general messages that include the specific conditions indicated by the codes that follow them. Your PSDN might return only the codes that stand for the general messages.

Table C–3 lists X.25 diagnostic codes that you might receive when you are running Solstice X.25 over the Connection-Oriented Network Service (CONS).

TABLE C–3 CONS Diagnostic Codes

Hexadecimal Code	Decimal Code	Meaning
Sent by CONS		
E0	224	Unspecified
E1	225	Disconnect—transient
E2	226	Disconnect—permanent

TABLE C–3 CONS Diagnostic Codes *(continued)*

Hexadecimal Code	Decimal Code	Meaning
E3	227	Reject—transient
E4	228	Reject—permanent
E5	229	QOS not available—transient
E6	230	QOS not available—permanent
E7	231	NSAP unreachable—transient
E8	232	NSAP unreachable—permanent
E9	233	Unspecified Reset
EA	234	Reset due to congestion
EB	235	Unknown NSAP
Sent by CONS user (TP0/TP2)		
F0	240	Unspecified
F1	241	Normal disconnect
F2	242	Abnormal disconnect
F4	244	Reject—transient
F5	245	Reject—permanent
F6	246	No QOS—transient
F7	247	No QOS—permanent

TABLE C–3 CONS Diagnostic Codes *(continued)*

Hexadecimal Code	Decimal Code	Meaning
F8	248	Incompatible NS user data
FA	250	User Reset

Note that you receive the reset codes, hexadecimal numbers E9, EA, and FA, in Reset Request/Indication packets. You receive the remaining codes in Clear Request/Indication packets.

APPENDIX **D**

Installing the Solstice Site/SunNet/ Domain Manager Agent

The Solstice Site/SunNet/Domain Manager agent (hereafter referred to as Domain Manager agent) is included with Solstice X.25 in the `SUNWx25b` package. When Solstice X.25 is installed, the Domain Manager agent and its associated files are copied to the `/opt/SUNWconn/x25/snm` directory.

The Domain Manager agent is designed for use on Solaris 7 and Solaris 8 systems.

Note - The Solstice Site/SunNet/Domain Manager agent was formerly called the SunNet Manager agent.

To install the Domain Manager agent on a system running Solstice X.25, log in as `root` and do the following:

1. **Install the `SUNWsnmag` package on the system where this agent is to run.**

   This package is part of the Solstice Site/SunNet/Domain Manager product. It contains all the standard Domain Manager agents, together with the libraries they need to run.

   Note - If you are installing the Domain Manager agent on an x86 system, you will need to install the `SUNW86nma` and `SUNW86nmc` packages instead.

   ---

2. **Copy the files `na.x25` and `x25.schema` from the `/opt/SUNWconn/x25/snm` directory to the Domain Manager agents directory.**

   This directory is usually named `/opt/SUNWconn/snm/agents`.

3. **Add the following line to include Solstice X.25 in the `inetd.conf` file:**

```
na.x25/10    tli rpc/udp wait root /opt/SUNWconn/snm/agents/na.x25       na.x25
```

4. **Add the following line to either the** `/etc/rpc` **file (if you are not using a naming service such as NIS), or to your** `rpc.bynumber` **map (if you are using a naming service).**

```
x25             100114  na.x25
```

5. **If the Domain Manager console is not running locally, add the following line to the file** `/etc/opt/SUNWconn/snm/snm.conf`

```
na.x25.trap.host hostname
```

where *hostname* is the name of the system where the Domain Manager console is running.

6. **Kill then restart** `inetd`**.**

Use the `ps ---e` command to display the process number of the `inetd` process. Then, as root, enter a `kill -HUP` command to restart the `inetd` daemon. For example:

```
hostname# ps -e | grep inetd | grep -v grep
120 ? 0:02 inetd hostname# kill -HUP 120
```

Repeat steps two to four and step six on the Domain Manager console.

On the Domain Manager console machine, to retrieve information on a Solstice X.25 VC from a target Solstice X.25 machine, use the “quick dump” or “data report” SNM requests. The following is an example of output received from the X.25 agent:

```
Wed Jul 15 05:20:32 1999 [ fullmoon ] : Quick Dump: x25.circuit
pid lcn linkid  in/out  hdlc_state  pkt_lev  state          opkts ipkts address
 0  4095  2      IN      UP          UP       Data Transfer  25    39    222210101
```

The fields in the agent output are explained as follows:

`lcn`

logical channel number of virtual circuit being reported on

`linkid`

link number on which the virtual circuit takes place

`in or out`

direction of virtual circuit (either the initiator or receiver of call)

`hdlc_state`

state of the LAPB link, up or down

`pkt_lev`

state of the X.25 layer, up or down

`state`

state of the X.25 network software, unknown, up, or down

`opkts`

Number of packets sent (valid only if connection is up; reset to zero when connection is up)

`ipkts`

Number of packets received (valid only if connection is up; reset to zero when connection is up)

`address`

X.121 address of remote host

For more information on Domain Manager and the Domain Manager Agent, consult the *Solstice Site/SunNet/Domain Manager Administration Guide.*

APPENDIX **E**

Using the Solstice X.25 SNMP Agent

The Solstice SNMP agent (simple network management protocol) is included with Solstice X.25 9.2. SNMP is a non-proprietary network management protocol that runs over TCP/IP. If you have SNMP installed on a server, you may want to also install the Solstice X.25 SNMP Agent. You can then run the SNMP agent over a network that includes non-Sun machines. You can also use the SNMP agent with the Domain Manager (formerly SunNet Manager).

Solstice X.25 9.2 implements three MIBs (management information bases) which are defined in the IETF standards: RFC1381, RFC1382, RFC1461.

Using the SNMP Agent with SNMP

The `snmpx25d` daemon is the background server process for SNMP requests. To start the daemon, in `x25tool`, select Options ⇒ Start SNMP Agent automatically. The `snmpx25d` daemon will start when X.25 starts as long as the file `/etc/rc3.d/snmpx25.control` exists.

Alternatively, you can link the script `/etc/init.d/snmpx25.control` with `/etc/rc3.d/snmpx25.control` to allow automatic starting of this server process when the system is booted.

To stop the daemon, in `x25tool`, select Options ⇒ Don't Start SNMP Agent automatically

Note that:

- The `snmpx25d` daemon does not implement the SNMP SET commands
- The `snmpx25d` daemon does not implements the SNMP TRAPS
- The `snmpx25d` daemon does not reply to incoming SET request

The SNMP configuration file is `/etc/opt/SUNWconn/x25/snmpx25d.conf`. The `snmpx25d` program logs traces in the file `/var/opt/SUNWconn/snmpx25dlog`.

Using the SNMP Agent with Solstice Site/SunNet/Domain Manager

Note - The Solstice Site/SunNet/Domain Manager was formerly called the SunNet Manager (SNM).

The SNMP agent can also be used with Solstice Site/SunNet/Domain Manager. To install the SNMP agent so that you can run it on a console running Solstice Domain Manager, log on as `root` and do the following:

1. **Copy the files snmp-x25.oid and snmp-x25.schema from the /opt/SUNWconn/x25/snmp directory to the SNM Agent directory.**

   This directory is usually named `/opt/SUNWconn/snm/agents`.

2. **Use the build_oid command to rebuild the SNM OID database.**

   Refer to the *Solstice Site/SunNet/Domain Manager Administration Guide* for more information about this process.

   For more information, consult the *Solstice Site/SunNet/Domain Manager Administration Guide.*

APPENDIX **F**

Compatibility with SunNet X.25 7.0

Solstice X.25 9.2. is compatible with earlier versions of X.25, however, if you are using SunNet X.25 7.0, you need to know about some particular features of Solstice X.25 9.2 that make it backwards compatible with version 7.0. You have no need of these features if you do not use SunNet X.25 7.0. The backwards compatibility features are:

- The sockets programming interface. This is described in the *Solstice X.25 9.2 Programming Guide*.
- The vcstat command. This is described below.
- Direct access to layer two (HDLC) . A number of communications applications use HDLC. It is therefore possible to run layer two as a standalone protocol.

This appendix also contains a section of “Compatibility Tips” on page 223, to help you make the most efficient use of your configuration.

The `vcstat` Command

Note - This command has been included as it is familiar to users of SunNet X.25 7.0. In general, use `x25stat`, see “Checking the Datalink Layer” on page 162.

The vcstat command allows you to monitor link and virtual circuit statistics, on a cumulative or periodic basis. The command has the following syntax

```
% /opt/SUNWconn/bin/vcstat [-L] [-n] [-l interface] [-i interval ] [-p period]
```

The vcstat options are explained as follows:

`-L` Display link-related statistics instead of virtual circuit statistics. By default, vcstat displays

virtual circuit statistics. Examples of displays for each type of statistics are shown below.

`-n` — Display only cumulative (since reboot) statistics, instead of periodically updated display. By default, vcstat displays current statistics at 30-second intervals.

`-l` ***interface*** — Display statistics for the link specified by *interface*. This *interface* corresponds to the number specified for the interface parameter in your link configuration file.

`-i` ***interval*** — Sampling interval for display of cumulative statistics. If you omit this and the -n options, vcstat displays cumulative statistics at 30-second intervals.

`-p` ***period*** — Specifies the length of time, in minutes, vcstat will run when it is displaying current statistics. By default, vcstat displays statistics for 1440 minutes (24 hours).

`-v` ***virtual circuit*** — Specify a virtual circuit or range of virtual circuits.

`-S` ***symbolic address*** — Specify a symbolic address.

Virtual Circuit Statistics

Without the -L option (that is, by default), vcstat displays statistics for all currently active virtual circuits, rather than for links. For example:

```
hostname% /opt/SUNWconn/bin/vcstat -i10
Tue Sep 18 16:24:23 1990
   If LCN    State Substate Sent Recv Remote address MAC address
O 1 0x200 Data 0/0/0/0 130 130 129.144.133.2
O 1 0x201 Data 0/0/0/0 679 5180 10002244
I 2 0x202 Data 0/0/0/0 501 641 20009988       08:00:20:07:11:a1,0e
```

The fields and headings in the above example display are explained as follows:

Column 1 (no heading) — In the first column you see either O, for an outgoing call; I, for an incoming call; or P, for a permanent virtual circuit.

If	Identifies the link over which the call was made. Corresponds to the value of the Link Number parameter in the Link Editor window in `x25tool`.
State	Displays Data when the call is in the data transfer phase of the connection.
Substate	Displays four toggles (1 is true, 0 false). From left to right these are: ■ Sent Receive Not Ready ■ Sent Interrupt ■ Received Interrupt ■ Received Receive Not Ready
Sent and Recv	Displays the number of frames sent and received since the last reboot. (These counts are not reset if you stop and restart your link.)
Remote Address	This field displays the following types of addresses: ■ IP addresses for virtual circuits used for IP connections ■ AEFs. This type of address is accompanied by a string, osi, partial-osi, or non-osi, indicating the type of AEF. ■ X.121 addresses To display a name or partial name from the xhosts table, use the `---s` option.
MAC Address	An LSAP address is present for virtual circuits running over LLC2.

Link Statistics

With the -L option, vcstat displays link-related, rather than virtual-circuit-related, statistics. It displays statistics for all currently active links. For example, to see link-related statistics, updated every 10 seconds, you enter:

```
hostname% /opt/SUNWconn/bin/vcstat -L -i10
 Wed Sep 19 08:56:52 1990
 If Type State SABM   Recv   Sent   Abort Crc Over Under
  0 hdlc UP     3      1112   1141   8     20   13 21
  1 hdlc UP     3      239    268    17    45   4   4
  2 llc UP      1      601    589    4     12   0   0
```

The fields in the vcstat output are explained as follows:

If

Identifies the link number over which the call was made. Corresponds to the value of the Link Number parameter in Link Editor window in `x25tool`.

Type

Can be lapb or llc, identifying the type of connection. The designator lapb indicates a serial-link connection, while llc indicates an LLC2 connection over a LAN.

Note - For LLC2, `vcstat` collects statistics on a per-physical-link basis, not per dynamic LLC2 link.

State

Displays UP when the call is in the data transfer phase of the connection and DOWN when the call is being set up or taken down. Further, displays DOWN-SABM when the link is down and a SABM has been sent; DOWN-FRMR, when a link is down and a Frame Reject has been sent; and DOWN-DISC, when a link is down and a Disconnect has been sent.

SABM

Indicates the number of Set Asynchronous Balanced Mode frames that have been sent. This type of frame is used to establish a frame-layer connection.

Recv and Sent

Displays the number of frames sent and received since the last reboot. (These counts are not reset if you stop and restart your link.)

Abort

Displays the number of aborted received frames. Occurs when the local serial port received a sequence of eight consecutive ones, in violation of LAPB framing rules. Abort errors result from an interruption in the service provided by the

link or from clocking problems. Such errors might also be caused by the software running over Solstice X.25. A small number of abort errors probably indicates a software problem rather than a broken link or a persistent clocking problem.

Crc — Reports the number of received frames with CRC (Cyclical Redundancy Check, an error detection method) errors. A CRC error is recorded when the checksum on a received frame is incorrect. CRC errors occur when there is a clocking problem (different rates on each side) or a noisy line.

Over — Reports the number of receiver overrun errors. Such errors occur when the local system is unable to accept data fast enough and the port hardware buffers overflow. A frame that is not completely received is aborted, triggering error recovery. Underrun errors can occur when the signaling rate in use on a link is too fast for the local system.

Under — Reports the number of transmitter underrun errors. Such errors occur when the local system is too busy to service the serial port hardware. A frame that is not completely sent is aborted, triggering error recovery. Underrun errors can occur when the signaling rate in use on a link is too fast for the local system.

High-Level Data Link Control

Note - The Solstice X.25 9.2 LAPB driver implements an interface that is compatible with SunNet X.25 7.0's HDLC interface. This has been included for backward-compatibility with SunNet X.25 7.0 only. In other situations, use LAPB plus DLPI. This implementation of HDLC does not support `hdlcconf`.

Solstice X.25 9.2 supports the Application Program interface that was available in SunNet X.25 7.0. An application program can open an HDLC device as a file and can control HDLC through SunOS system calls.

Before starting X.25, you need to associate the HDLC driver with the relevant WAN port. To do so, enter:

```
hostname#: iflayer ifdn portname
```

Application Program

You can access HDLC from a program with the same interface used at the user level, the ifnet device. A program can perform all the user-level tasks presented above with standard system calls.

Note - This description assumes that you are familiar with the system calls open(2), close(2), read(2), write(2) and ioctl(2). It also assumes that the ifnet device has been initialized and layered.

All of the contents and structures used are in the following include files:

```
#include <stdio.h>
#include <fcntl.h>
#include <errno.h>
#include <sys/ioctl.h>
#include <sundev/syncstat.h>
#include <nethdlc/hdlc_ioctl.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <net/if.h>
```

Access HDLC by opening the `ifd` device attached to it. In the examples, this is `/dev/ifd0`. For example:

```
fid = open (''/dev/ifd0'', )_RDWR);
```

To configure HDLC, invoke `ioctl(2)` as follows:

```
int fid, error;
struct hdlc_param_req hpr;
struct hdlc_param *hdlc_param

hdlc_param = &hpr.hp:
/* set fields in structure pointed to by hdlc_param */
error = ioctl(fid, HDLC_SET_PARAM, (caddr_t) &hpr);
```

where `fid` is the value returned by open, `HDLC_SET_PARAM` is the call to set the parameters, and `hdlc_param` is a structure defined as follows:

```
struct hdlc_param {
      u_short hp_t1;        /*T1 - P-bit timer (msec) */
      u_short hp_t2;        /*T2 - max delay before ACK (msec) */
      u_short hp_t3;        /*T3 - max idle link time (msec)
      u_short hp_t4;        /*T4 - LLC2 busy timer (msec) */
      u_short hp_t5;        /*T5 - LLC2 reject timer (msec) */
      u_short hp_t6;        /*T6 - Ack timer (msec) */
      u_short hp_tick;      /* resolution of timer (msec/tick) */
      u_short hp_n1;        /*N1 - max frame size - bytes */
      u_char hp_n2;         /*N2 - max retries (used with T1, T4) */
      u_char hp_xcntl;      /* extended control - mod 128 */
      u_char hp_k;          /* K - window size */
      u_char hp_addr;       /* address */
```

The value `hp_t1` corresponds to the `---t1` flag parameter of `hdlcconf` command and the values `hp_t2`, `hp_t3`, `hp_tick`, `hp_n1` and `hp_n2` correspond similarly. The `hp_xcntl` is a boolean value. If it is set, then the implementation will operate in Asynchronous Balanced Mode Extended. Otherwise, it will run in Asynchronous Balanced Mode. The window size is set with `hp_k`. Lastly, set the HDLC address with `hp_addr` and the following values:

```
#define LAPB_ADDR_A   0x03   /* commands to DTE secondary */
                             /* responses from DTE secondary */
#define LAPB_ADDR_B   0x01   /* commands to DCE secondary */
                             /* responses from DCE secondary
```

Setting Parameters

The kernel does not check the parameters, it assumes they are set to reasonable values. Take care when setting them, as wrong parameters can affect the operation of the HDLC link.

Before setting the parameters, it is advisable to *get* them first with the `ioctl` call `HDLC_GET_PARAM`. The `HDLC_SET_PARAM` and `HDLC_GET_PARAM` calls have the same parameter format.

After setting the HDLC parameters, start HDLC by making the following call:

```
int fid;
 error = ioctl (fid, HDLC_INIT, 0);
```

In Solstice X.25 9.2 this is equivalent to executing `hdlcstart` in SunNet X.25 7.0.

Data Transfer

To transfer data to or from HDLC, use `read (2)` and `write (2)`. Each operation corresponds to an HDLC frame, which means that each `read` call will return only

one packet, even if there is more data waiting and room in the buffer. If there is not enough room in the buffer for the current frame, `read` fails, and the frame is discarded. The buffer passed to a `write` call corresponds to a single HDLC frame. Calls to `write` with a length greater than the maximum frame size (`hp_n1`) fail.

Statistics

Note - The command `x25stat` returns more complete statistics than those returned by the procedure shown below.

To get the same statistics as those returned by `hdlcstate` in SunNet X.25 7.0, your program should run the `HDLC_STATS` ioctl call as follows:

```
int fid, error;
 struct hdlc_stats_req hsr;
 struct hdlc_stats *hdlc_stats;

 hdlc_stats = &hsr.he;
 error = ioctl(fid, HDLC_STATS, (caddr_t) &hsr);
 /* results are in structure pointed to by hdlc_stats */
```

The `hdlc_stats` is of type `struct hdlc_stats` shown below:

```
struct hdlc_stats {
       u_short        hs_state;     /* hdlc state */
       u_short        hs_sentsabms; /* sabms sent */
       struct ss_dstats hs_data;    /* data stats */
       struct ss_estats hs_errors;  /* error stats */
```

The value `hs_sentsabmns` is the cumulative total of SABMS that were transmitted, including retry attempts. The field `hs_state` can be any one of the following:

```
#define HDLCLINK_DOWN 0 /* initial state */
#define HDLCLINK_SABM 1 /* SABM outstanding
#define HDLCLINK_FMR 2  /* FRMR outstanding */
#define HDLCLINK_DISC 3 /* DISC outstanding */
#define HDLCLINK_UP   4 /* information transfer state */
```

The structures `ss_dstats` and `ssestats` are defined in the file `<sundev/syncstat.h>` as follows:

```
struct ss_dstats {
      long ssd_spack;    /* input packets */
      long ssd_opack;    /* output packets */
      long ssd_ichar;    /* input bytes */
      long ssd_ochar;    /* output bytes */
 ];

 struct ss_estats {
      long sse_abort;    /* abort received */
      long sse_crc;      /* CRC error */
      long sse_overrun;  /* receiver overrun */
      long sse_underrun; /* xmitter underrun */
```

Their values correspond to the `Total` bytes and `Errors` lines of the `hdlcstate` display.

Shutdown

Normally, HDLC remains up for as long as the remote host is physically connected to the local port. For this reason, `close (2)` does not affect the state of HDLC, and any packets queued for output are transmitted.

To shut down HDLC, execute the following ioctl:

```
int fid;
error = ioctl(fid, HDLC_RESET, 0);
```

This puts the line into the `HDLCLINK_DOWN` state. Calls to `read` and `write` will fail, and `errno` is set to `ENETDOWN`. This is the same call that `hdlcstop` uses.

Compatibility Tips

Follow the tips in the section to make the best possible use of a network that has systems running both SunNet X.25 7.0 and Solstice X.25.

Point-to-Point Configurations

If you configure an IP point-to-point link between a machine running the current release of Solstice X.25 and a machine running SunNet X.25 7.0, configure the 7.0 machine as the “caller”, rather than “called”. This role is determined by the value of the `mode` parameter in the `x25mgr` configuration file. See page 118 of the *SunNet*

X.25 7.0 System Administration Manual for a description of the `mode` parameter. Also, you should set the Disconnection Timer to a high value.

The reason for this is the different treatment of IP point-to-point links by SunNet X.25 7.0 and the current release of Solstice X.25. The 7.0 product keeps switched virtual circuits up all of the time in support of point-to-point links, while the current release drops the virtual circuits after a specified period of inactivity. If a 7.0 machine is configured as “called”, rather than “caller”, it is not able to establish an IP connection with a current-release machine until the latter machine sends a Call Request. This does not occur until the current-release machine has IP packets to send to the 7.0 machine. If the 7.0 machine is configured as “caller” (as it should be), there remains the problem that the current-release machine drops the virtual circuit upon inactivity. When this occurs, the 7.0 machine immediately calls to re-establish the virtual circuit. If your PSDN charges for call setup (as many do), such behavior becomes very expensive. To avoid this, change the Disconnection Timer to a figure that will keep the virtual circuit up long enough to outlast periodic gaps in IP traffic.

Setting the Max. NSDU

If you have an IP/X.25 link between a current-release Solstice X.25 machine and a machine running SunNet X.25 7.0, set Max NSDU to at least 1024. Otherwise IP connections can hang when a high volume of data is sent from the 7.0 machine. If you have two current-release machines on each side of the link, set Max NSDU to be the same on both sides. It can be as high as 8192.

Glossary

agent	A process, usually corresponding to a particular managed object, that carries out request from a manager.
Bits per second (bps)	The number of bits passed per second.
Call	Communication between two DTEs using a virtual circuit.
CCITT	Consultative Committee for International Telephony and Telegraphy. Previous name of the ITU-T.
Closed User Group (CUG)	A PSDN-provided service that permits the DTEs belonging to the group to communicate with each other, but precludes communication with other DTEs. A single DTE can belong to multiple CUGs. The PSDN, not the caller or called parties, enforce the limitation inherent in a CUG.
Data Circuit-terminating Equipment (DCE)	The network side of the user-to-network interface. Commonly corresponds to a modem or other device used to connect to a PSDN.
Data Network Identification Code (DNIC)	A four-digit number that identifies a specific PSDN. The DNIC is the first component of a complete X.121 address and is comparable to the exchange portion of a telephone number used for switched telephone service. In a DNIC, the first three digits make up a data country code, which identify a country, while the remaining digit can be used to distinguish up to 10 different networks within the specified country.
Data Terminal Equipment (DTE)	The device at the user's side of a user-to-network interface. This might be a computer system (packet-mode DTE) or a character-mode terminal (DTE-C), and is both a source and destination for data.

Data Terminal Equipment-Character Mode (DTE-C)	A character-mode (asynchronous) terminal that uses a PAD to connect to a remote host across a PSDN. Part of the Solstice X.25 software plays the role of a DTE-C when you use the PAD application that is shipped with the product.
Defense Data Network (DDN)	A network administered by the US Department of Defense, that uses a form of X.121 to IP address mapping defined in RFC 1236.
Duplex	Circuit or modem that allows for simultaneous two way data transmission.
Facility	An optional service offered by a public network's administration. Usually requested by the user when subscribing.
Flag	A sequence of bits that signifies the beginning and end of a frame.
Frame	The unit of information used at layer 2 of the X.25 Recommendations.
I-Frame	A frame containing data—an Information Frame.
International Telecommunication Union—Telecommunication Standardization Sector (ITU-T)	An international organization of communication carriers, most of which are government telephone and telegraph agencies. The ITU-T develops telecommunication standards through the use of their recommendations. The X.25, X.3, and X.29 standards are ITU-T Recommendations.
LAPB	The datalink layer protocol specified by the X.25 Recommendations.
Logical Channel	An association between two DTEs through which they exchange data.
MLP	MultiLink Procedure. This provides the datalink layer allowing a DTE and a DCE to connect using more than one WAN interface.
MIB	Management information base. A collection of objects that can be accessed through the SNMP agent.
Octet	The ITU-T's term for an 8-bit byte.
Packet	A sequence of bits representing data and associated control information. Is self-contained in that it has routing and packet-sequence information. Commonly used to refer to the structure and format defined by the X.25 recommendation.

Packet switching A data transmission technique in which user information is broken up into discrete, self-contained units called packets. Packet switching has two distinctive characteristics: 1) it allows a communication channel to be shared by many users, each using the circuit only for the time required to transmit a single packet and 2) it allows for the individuals packets that make up a message to be routed over the optimal path of a given moment. See packet.

Packet Assembler/ Disassembler (PAD) A device that resides between one or more character-mode devices, such as asynchronous terminals (or terminal emulation software), and a PSDN. On the terminal side, the PAD accepts asynchronous characters, assembles packets from these characters, and forwards the packets to the PSDN. On the PSDN side, the PAD accepts packets, disassembles the packets into asynchronous characters, and forwards the characters to the terminal(s).

Packet-Switched Data Network (PSDN) A more general term than Public Data Network, refers to any public or private packet-switching network that provides X.25-compliant interfaces to its users.

Permanent virtual circuit (PVC) A permanent, logical association between two physically separate DTEs that does not require call set-up or clearing procedures. Analogous to a leased line in a circuit-switched telephone network.

Public Data Network (PDN) A data communications network whose services are available to any user willing to pay for them. Tymnet and Telnet are examples of PDNs in the United States; the public telephone and telegraph agencies of European and Asian nations are also examples of PDNs. Solstice X.25 product documentation usually uses the term “Packet-Switched Data Networks” in preference to “Public Data Network”, as the former is more general than the latter.

Recognized Private Operating Agency (RPOA) An X.25 user facility that provides for user specification of a particular RPOA transit network through which a call is to be routed internationally when more than one RPOA transit network exists at an international gateway.

SNMP Simple Network Management Protocol, the standard network management protocol used in TCP/IP networks.

SNMP agent The process that carries out requests from SNMP.

Subaddress An optional component of an X.121 address that identifies a specific application on a DTE.

Switched virtual circuit (SVC) — A temporary logical association between two physically separate DTEs that exists only for the duration of the data transfer. Call setup and call clearing procedures are required with a switched virtual circuit. Analogous to an everyday phone call on a circuit-switched telephone network.

Throughput — The rate at which data is passed through a particular system.

V25*bis* — The recommendation that defines dial-up X.25.

Defines the interface between PADs and packet-mode DTEs or other PADs.

X.3 — Describes the functions of the PAD and the various parameters used to specify its mode of operation.

X.21bis — A set of CCITT recommendations that define the physical interface between a DTE and a DCE of a public data network. Access to the DCE is through synchronous modems and voice-band lines. Equivalent to RS-232-C and V.24/V.28.

X.25 client — An application layered above X.25.

X.28 — Defines the format of the terminal user's instructions to the PAD—referred to as PAD command signals—and the format of the PAD's responses to the terminal—referred to as PAD service signals.

X.29 — Defines the interface between PADs and packet-mode DTEs or other PADs.

X.32 — The recommendation that defines the security procedures used for dial-up access to public PSDNs.

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