COMPAQ

SCO UNIX IP Routing Over X.25 Networks

Compaq TechNote

Includes information on:

- Compaq ProSignia PC Server as an IP Router
- Installation and configuration procedures

NOTICE

SCO UNIX IP Routing Over X.25 Networks

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Chapter 1
Introduction

This TechNote describes a COMPAQ ProSignia PC Server running SCO UNIX functioning as an IP Router. This configuration provides for transparent connectivity between different TCP/IP LANs or workstations over X.25 packet-switched networks. Throughout this TechNote, we refer to this configuration as the "IP Router Platform." This TechNote provides the installation and configuration procedures and operational characteristics to build and configure the IP Router Platform.

TechNote Chapter Summary

Use the following table to locate the information you want.

Table 1-1
TechNote Chapter Summary

Chapter 1 INTRODUCTION	Contains a brief explanation of the TechNote purpose and contents.
Chapter 2 TECHNICAL OVERVIEW	Discusses the integrated functional subsystems that form the IP Router Platform and details on X.25 packet-switched networks and TCP/IP networks.
Chapter 3 COMMUNICATION PRODUCTS	Discusses the products used in the IP Router Platform. Presents a technical product overview and product highlights.
Chapter 4 BUILDING THE IP ROUTER PLATFORM	Provides detailed procedures for installing and configuring IP Router Platform components.
Chapter 5 CONFIGURING AND USING THE IP ROUTER PLATFORM	Provides detailed procedures for configuring each node of the topology, to verify status, and to start and stop the IP Router Platform components.
Chapter 6 REMOVING THE IP ROUTER COMPONENTS	Describes the removal procedures for the software and hardware components of the IP Router Platform.
Appendix A ACRONYMS	Lists acronyms used in this TechNote and their meanings.
Appendix B VENDOR CONTACT INFORMATION	Lists mailing address and telephone information for the vendors referred to in this TechNote.

IP Router Platform and TCP/IP

In this IP Router Platform, we configured a COMPAQ ProSignia as a UNIX host system with TCP/IP network support. This TechNote presumes you installed the SCO UNIX Operating System on a COMPAQ ProSignia.

You can easily implement the IP Router Platform into an X.25 packet-switched Wide Area Network (WAN) that interconnects remote TCP/IP networks and/or workstation sites, as the following figure illustrates.

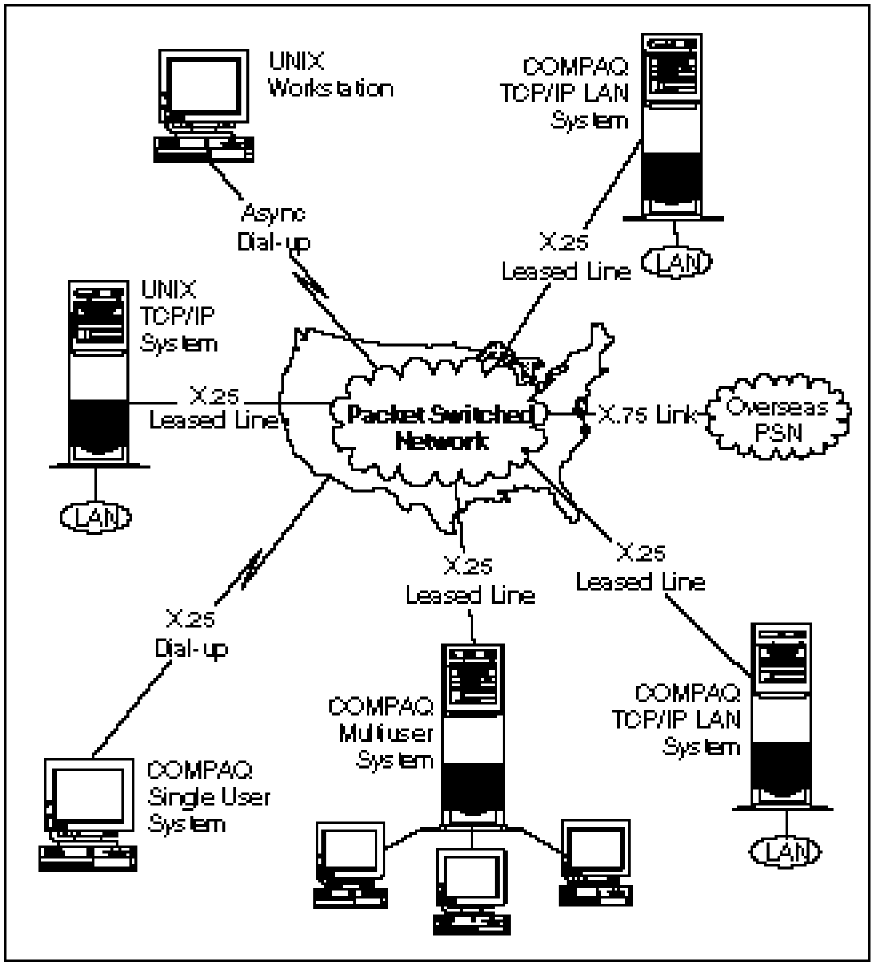

Figure 1-1. X.25 WANs Interconnecting Remote Sites

Chapter 2
Technical Overview

This chapter provides an overview of the communication standards integrated to form the IP Router Platform. Specifically, this chapter discusses the following topics:

- X.25 packet-switched networks
- TCP/IP networks

X.25 Packet-Switched Networks

In its simplest form, the X.25 is a protocol for interfacing to a wide-area, packet-switched network. X.25 handles the connection between the nodes and the network. Therefore, the internal workings of the network are usually not important to X.25 end-nodes.

X.25 networks and dedicated point-to-point links (leased lines) are the most common means to establish wide-area links. X.25 packet-switched networks are best for light-to-moderate network traffic requirements such as multiuser host interfaces and many transaction processing applications. Leased lines are best for continuous moderate-to-heavy network traffic requirements such as the bridging of remote file-server to file-server connections. Leased lines might or might not use X.25.

In X.25 packet-switched networks, the X.25 protocol standard provides the interface. Worldwide, there are many suppliers of publicly accessible X.25 networks. These suppliers are commonly referred to as Public Data Network (PDN) providers. Many private X.25 networks also exist. These networks use leased lines, satellite links, microwave, and so on, and are referred to as private data networks.

Your decision to use PDNs or to create your own private network depends on your requirements. Consider such issues as cost and up-time. PDNs typically base their costs on line use, which results in cost fluctuations. Leased lines charge a fixed fee regardless of the traffic volume. As a result, the leased line resource is wasted during idle times. PDNs also perform dynamic routing which permits packet rerouting if a network node fails. The lack of alternate routing capability in leased lines might or might not be acceptable for your requirements.

X.25 Standard

The X.25 standard specifies a Data Terminal Equipment (DTE) to Data Circuit-Terminating Equipment (DCE) interface. A COMPAQ ProSignia that is running the Eicon IP Router product functions as a DTE. The DCE provides access to the packet-switched network. The X.25 standard defines three levels, as shown in the following figure.

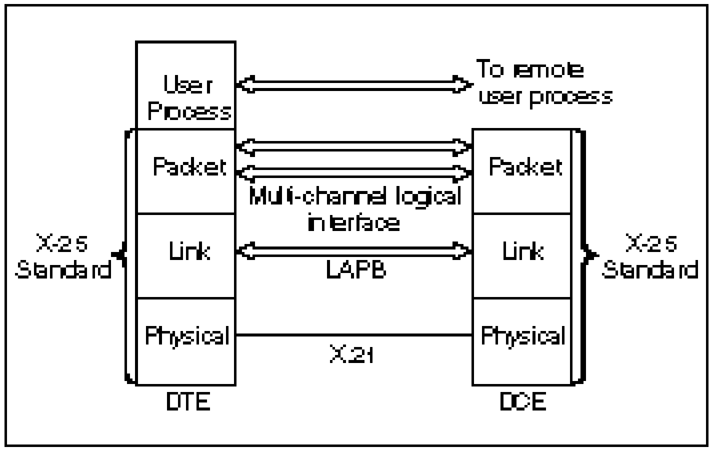

Figure 2-1. X.25 Interface

- *Packet Level* - X.25 specifies a "virtual circuit service." Two types of virtual circuits exist: "switched" and "permanent." A switched virtual circuit is dynamically established. A permanent virtual circuit is a network-assigned virtual circuit. A DCE can establish up to 4095 simultaneous virtual circuits with DTEs over a single DTE-DCE link. Individual virtual circuits could correspond to applications, processes, terminals, and so on. The DTE-DCE link provides full duplex multiplexing.
- *Link Level* - X.25 defines both a Single Link Procedure (SLP) and a Multi-Link procedure (MLP) that allows the interface to operate over multiple lines. The SLP uses Link Access Procedure Balanced (LAPB) which is based on the High Level Data Link Control (HDLC) synchronous protocol. When multiple links exist, each link uses SLP LAPB.
- *Physical Level* - The X.21 standard is specified. However, the RS-232-C or V.35 standard is common.

Packet-Switched Network Internals

Packet-switched networks are complex in their internal workings and employ routing services using one of two techniques. However, the following table describes the key functional elements found in all packet-switched networks:

Table 2-1
Key Functional Elements of Packet-Switched Networks

Routing	The network must route each packet from node-to-node. The source and destination nodes are not directly connected.
Traffic Control	The network must provide traffic flow and congestion control to provide efficient, stable, and predictable performance.
Error Control	The network must handle "lost" packets, as well as link, node, and station failures.

Packet-switched networks use one of two techniques to provide these key functional elements. Internally, and sometimes externally, the network provides either a virtual circuit service or a datagram service.

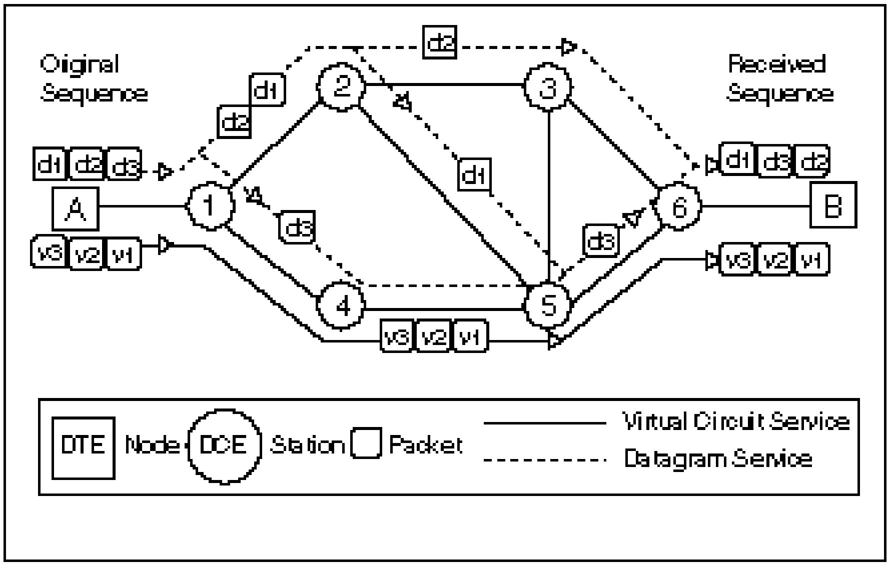

Figure 2-2. Packet-Switched Network

Virtual Circuit Service

With a virtual circuit service, the network delivers the data packets in the sequence received. There are two types of virtual circuit services, permanent and switched. With a switched virtual circuit, the node and station must exchange call-setup and call-clearing information to create and remove the virtual circuit.

Virtual circuit service minimizes per-packet overhead because routing decisions are made only once per virtual circuit. A virtual circuit also ensures that the packets arrive in the proper sequence at the station closest to the destination node.

Datagram Service

With a datagram service, the network handles packets independently and does not ensure the delivery sequence. When a node requests a station to send packets to another node, the station treats each packet independently and determines the routing sequence on a per-packet basis. As a result, the packets can traverse different routes even though they are part of the same transmission group.

The datagram service does not ensure that the packets are received by the station closest to the destination node in the original sequence. The receiving station usually performs buffering and sorting of the packets prior to transmitting them to the destination node.

Many packet-switched networks employ an internal datagram service. This service is robust, has dynamic routing flexibility, and provides an external virtual circuit service by performing buffering and sorting of the packets at the receiving station.

Connecting to Public Packet-Switched Networks

There are many suppliers of PDNs available today. The most popular PDNs (focusing primarily on transport services) are Telenet, Tymnet, and Infonet. These PDNs provide global connections to over 70 countries. You can access these networks using any of the following:

- Asynchronous dial up – Uses standard asynchronous modems with connections at 300, 1200, 2400, and 9600 Kilobits per second using V.32.
- Leased lines using either asynchronous or synchronous protocols
    - Asynchronous – Analog lines operate at 1.2 to 19.2 Kilobits per second and digital at 9.6 to 56 Kilobits per second. Depending on the line type, a modem or Digital Signaling Unit (DSU) is required.
    - Synchronous – This is the most popular means for high-volume, multi-session support. Lines speeds of 1.2, 2.4, 4.8, 9.6, 14.4, 19.2 and 56 Kilobits per second are available. Depending on the line type, a modem or DSU is required. Tymnet advises that a single 4.8 Kilobits per second line can typically support 16 simultaneous users, and a 14.4 Kilobits per second line can handle 48. We used a synchronous connection method in the IP Router Platform.
- X.25 dial up (X.32) – X.32 provides basically the same functionality as synchronous leased lines without the cost of a leased line. When using V.32 synchronous modems operating at 9.6 Kilobits per second, throughput is essentially the same as low-to-medium range synchronous leased lines.

Summary

X.25 networks ensure reliable data delivery by detecting and correcting packet errors at every location where the data traverses a node (a "hop"). In addition, X.25 networks provide the ability to establish up to 4095 simultaneous virtual circuits over a single physical link. As a result, you can easily perform global internetting of remote sites.

Internally, X.25 networks are slower than traditional 10-Megabits per second Ethernet networks. Internal network speeds are typically between 64 Kilobits per second and 2 Megabits per second. External connections operate even slower. Modem connections between X.25 DTE-DCEs typically operate at 2400 bytes per second to 19.2 Kilobits per second. Leased lines typically operate at 56 Kilobits per second to 1.544 Megabits per second (T1 service).

X.25 networks provide a means to connect geographically dispersed sites in a cost-effective manner. Worldwide, there are many suppliers of commercial X.25 PDNs who also provide a range of value-added services such as email, store-and-forward (EDI), dial-out, and network management.

TCP/IP Networks

The Transmission Control Protocol / Internet Protocol (TCP/IP) was developed in the 1970s by the Defense Advanced Research Projects Agency (DARPA) with funding by the US Government. TCP/IP was originally developed as a means to interconnect and share information between major research institutions and government labs regardless of the underlying network technologies. Today TCP/IP is the defacto standard for open systems networking.

TCP/IP Protocol Model

The TCP/IP protocol model comprises four distinct functional layers as shown in the following figure.

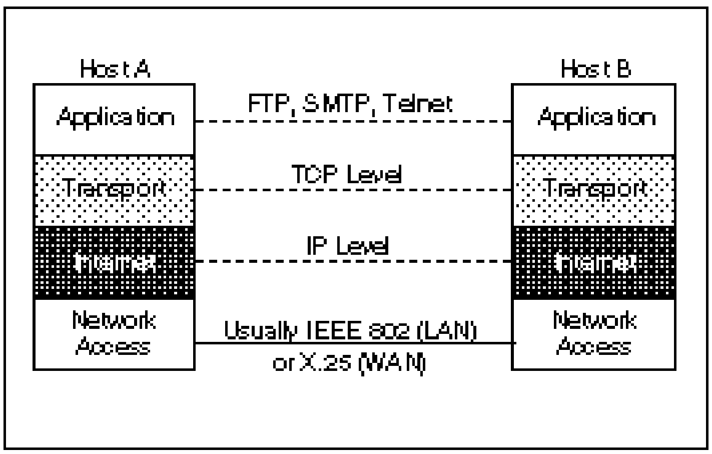

Figure 2-3. TCP/IP Protocol

- *Application* - Uses the services of the TCP layer to communicate with distant host processes. Example application protocols include File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), and Telnet protocol used in terminal emulation.
- *Transport (TCP Level)* - Provides for reliable, full duplexed, stream-oriented communications between processes on different hosts and networks.
- *Internet (IP Level)* - Provides the functionality for moving packets between different hosts on a network or between network segments. The IP level uses a datagram service that requires routing at each routing device (for example, a router or gateway).
- *Network Access* - Includes the logical link and medium-access control as well as the physical characteristics of the medium. Example standards include IEEE 802.3 and X.25.

Although we show TCP/IP as a hierarchical structure, the standard does not require this. For example, a process at a given layer can use the services of a process at the same layer, the next layer, or even a non-adjacent layer.

Addresses

On a given internetwork, all nodes that communicate via TCP/IP must have a unique IP address. IP addresses consist of four bytes (32 bits). Each byte is further subdivided and grouped to form a network class identifier, a network identifier, and a host identifier as shown in the following figure:

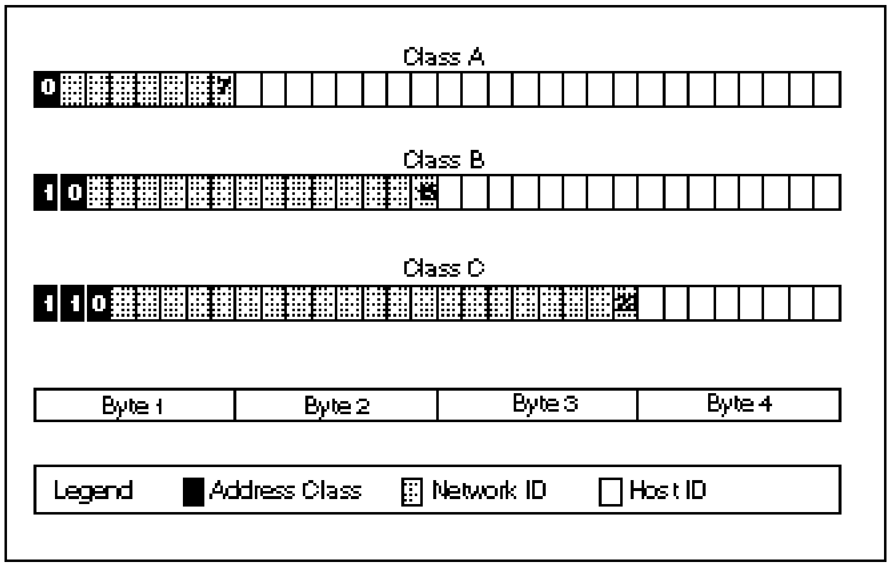

Figure 2-4. IP Address Classes

Address Classes

IP addresses are categorized into address classes A, B, C, and D (multicast) using bits 1-3 to identify the class. Each class specifies a certain quantity of bits for the Network ID and Host ID fields. Also, IP prohibits the use of all zeros or ones to identify either a network or host. Therefore, the total number of unique IP addresses is always two less than the mathematical maximum. The following table summarizes the number of total networks and unique hosts that can be specified with each address class:

Table 1-2
Address Classes

Class A	2^{7}-2 (126) total networks, each with 2^{24}-2 (16777214) unique hosts
Class B	2^{14}-2 (16382) total networks, each with 2^{16}-2 (65534) unique hosts
Class C	2^{21}-2 (2097150) total networks, each with 2^{8}-2 (254) unique hosts

Subnet Addresses

There are a large number of potential Host IDs that you can define within Class A and B networks. Because of this large Host ID definition potential, and the manageability and contention issues associated with it, you can use a portion of the Host ID to specify a subnetwork. Subnetting allows a single network identifier for multiple, connected physical networks. Part of the host identifier is used to specify different subnet addresses. The network uses a "network mask" to extract the subnetwork ID from the IP address.

A network mask consists of a mask bit corresponding to each IP address bit. The mask extracts the network ID from the IP address. For each bit in the IP address that you treat as a network ID, its corresponding network mask bit is set to 1. Alternately, for each bit in the IP address that you treat as a host ID, its corresponding network mask bit is set to 0. For example, a Class A network has a mask of 255.0.0.0, a Class B mask is 255.255.0.0 and a Class C mask is 255.255.255.0. To extract the network ID, the IP address and the mask are "logically anded" together, causing the network ID portion to "pass through."

To create a subnet in a Class B network we can change the mask to 255.255.255.0 and assign a value between 1 and 254 to the subnet and place that value in byte 3 of the IP address. You can further complicate it by applying it to a Class C network where a portion, say 2 bits, of the 8-bit host ID field identifies the subnet. In this case, our mask would be 255.255.255.192.

Routing

The term "routing" refers to the way a packet moves from one network or subnet to another. Multiple TCP/IP networks can interconnect if each host's IP address is unique. Most hosts on TCP/IP networks possess one IP address. Other hosts, such as the IP Router defined in this TechNote, interconnect networks. A host that interconnects two or more IP networks is referred to as a "router" or "gateway router" and possesses two or more IP addresses, one for each network attachment.

Routing Table

Each host must possess information that defines the way it routes packets. The "IP route table," which is part of the IP package, contains this information.

Each route table entry tells the host how to reach a particular network by identifying the destination network, gateway router, and hop count. For example, using the topology and IP addresses specified in this TechNote, the route table entry for the COMPAQ ProSignia (132.149.0.0 132.149.0.1 1) instructs the router to send all packets containing the network ID 132.149 to host 132.149.0.1 and that the trip has 1 hop. In our topology, the host 132.149.0.1 is the LAN address for the COMPAQ ProSignia.

Routing over X.25

Many systems route IP packets over X.25 because X.25 provides an easy, economical way to interconnect several sites. Routing over X.25 involves the use of a second routing table called the "X.25 route table" in conjunction with the IP route table described previously.

The following figure illustrates the protocol flow used to provide IP routing over X.25 and resembles the topology used in this TechNote:

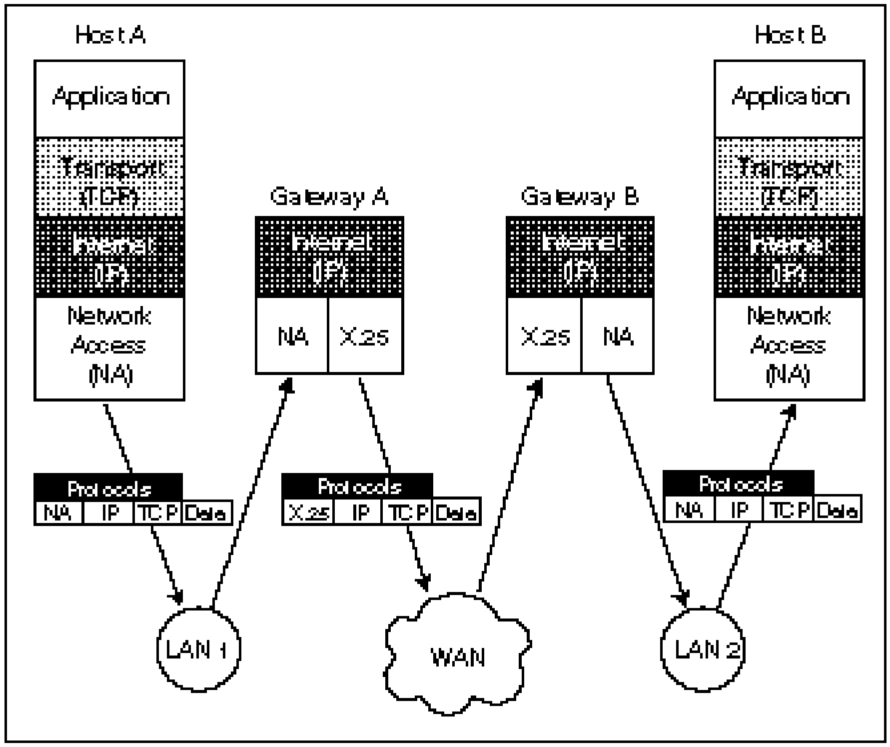

Figure 2-5. Protocol Flow

When Host A sends a packet to Host B, the following steps occur:

- Host A generates the data at the Application level and forwards it to the Transport (TCP) level. TCP encapsulates the data in its protocol and forwards the packet to the Internet (IP) level. At the IP level, Host B's IP address is determined and compared against the route table. An entry is found that routes the packet to Gateway A's IP address. IP encapsulates the packet with its protocol and forwards the packet to the Network Access (NA) level. NA encapsulates the packet with its protocol and writes it to LAN 1.

- Gateway A receives the packet, NA removes its protocol and forwards the packet to the IP layer. IP compares the destination IP address against the route table and finds an entry that routes it to Gateway B's IP address. IP updates the packet and forwards it to the X.25 layer. The X.25 layer compares the destination IP address against the X.25 route table and an entry is found that routes it to Gateway B's X.25 address. X.25 encapsulates the packet and writes it to the WAN.
- Gateway B receives the packet, X.25 removes its protocol and forwards the packet to the IP layer. IP compares the destination IP address against the route table and finds an entry that routes it to LAN 2. IP updates the packet and forwards it to the NA layer. NA encapsulates the packet and writes it to LAN 2.
- Host B receives the packet, NA removes its protocol and forwards the packet to the IP layer. IP accepts the packet, removes its protocol and forwards it to the TCP layer. TCP accepts the packet, removes its protocol and forwards the data to the destination process.

Summary

TCP/IP is the defacto standard for open systems networking. TCP is a connection-oriented protocol that ensures reliable data delivery regardless of the underlying network media. IP employs a connectionless datagram service that provides for robust communications and dynamic routing. IP can run over multiple network media and link control protocols. For example, for this TechNote IP runs over IEEE 802.3 (Ethernet) and X.25.

IP addresses are divided into classes A, B, C, and D. Each address contains a class ID, network ID, and a host ID. Class A addresses support large linear networks with a large number of hosts. Class B addresses support fewer hosts than A but more than C. Class C addresses support the fewest hosts. Class D is for multicasting, where a group of units can all receive the same data packet.

Networks with a large number of hosts can be difficult to manage and susceptible to network congestion. By using network masks and borrowing bits from the host ID field, you can divide a single network into a set of smaller, more manageable networks.

IP performs routing by determining the routing sequence on a per-packet basis. Packets are routed through the network by each node they encounter until they reach their final destination. IP performs routing based on entries contained in its route table. When routing over X.25, IP uses a second table called the X.25 route table to route packets across X.25 stations.

Chapter 3
Communication Products

This chapter presents a technical overview of the Eicon Technology products used in the IP Router Platform.

EiconCard HSI/PC Communications Adapter

The EiconCard HSI/PC from Eicon Technology (EiconCard adapter board) is a communications adapter with 1-megabyte of RAM. We use it in the IP Router Platform to enable the COMPAQ ProSignia to interface to the X.25 packet-switched network.

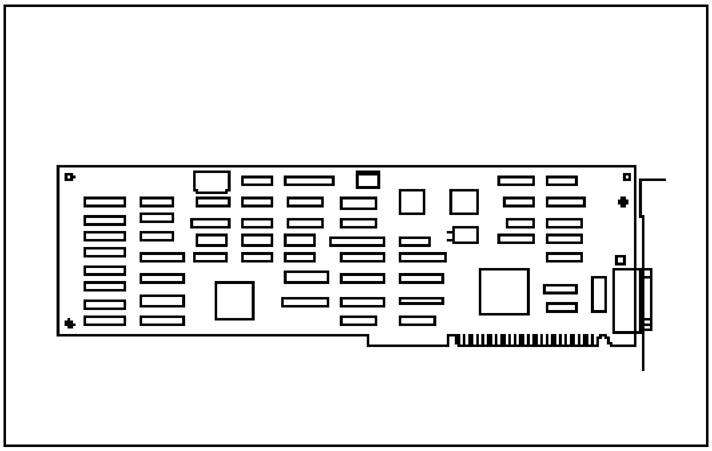

Figure 3-1. EiconCard Adapter Board

The EiconCard adapter board has a 32-bit, 16-MHz Motorola 68000 microprocessor with one megabyte of memory. This adapter board has a single High Speed Interface (HSI) communications port supporting speeds of up to 384 Kilobits per second and is configured to interface with V.24, X.35, or X.21 synchronous modems.

The V.24 interface is compatible with CCITT V.24, V.28, X.21*bis*, and EIA RS-232-C, which is used in this TechNote. Optionally, you can use a null-modem cable provided by Eicon Technology to create a direct connection between two systems containing EiconCard adapter boards.

The EiconCard adapter board is an intelligent communications card that performs all protocol processing on-board. The protocol software loads onto the EiconCard adapter board at boot time. For this TechNote, the Eicon Technology IP Router for UNIX software downloads the High-level Data Link Control (HDLC), X.25, and IP protocols at boot-time. The protocol software runs under its own real-time operating system, thereby providing the functionality required for simultaneous access to multiple hosts.

IP Router for UNIX Software

The IP Router for UNIX is the Eicon Technology software product we use in the IP Router Platform. The product contains the EiconCard adapter driver, communication protocols such as HDLC, X.25, and the IP Router module that interfaces with the system's TCP/IP runtime system.

Other highlights of the IP Router for UNIX product are:

- Supports X.25 and Leased Line communications methods
- Operates in a non-dedicated PC
- Complies with RFC 877 ensuring interoperability with IP/X.25 routers from other vendors
- Supports Broadcast/Multicast
- Supports up to 254 simultaneous sessions per EiconCard adapter board
- Supports SNMP MIB II
- Simultaneously shares the EiconCard with Eicon Technology's communications products SNA and OSI Gateways

Putting It All Together

Organizations with a need to interconnect remote TCP/IP sites can integrate high performance and cost-effective IP routing solutions using the COMPAQ ProSignia and the Eicon Technology IP Router for UNIX product. Industry-standard X.25 packet-switched network services are available worldwide and provide a reliable and flexible communications vehicle for interconnecting geographically dispersed sites.

In this TechNote, industry standards such as COMPAQ products, SCO UNIX, TCP/IP, and X.25 are integrated together to form a powerful and flexible base solution for many wide-area connectivity requirements. Most major network protocols, including TCP/IP, OSI, and SNA, are supported by this base platform.

The IP Router Platform configuration presented in this TechNote connects with remote TCP/IP sites over an X.25 packet-switched network. We connect the platform to the X.25 DCE using the HDLC synchronous protocol over a 56 Kilobits per second leased line via a Digital Signaling Unit (DSU).

Components

The base platform consists of a COMPAQ ProSignia running SCO UNIX. This TechNote presumes that the base platform already has the SCO UNIX operating system installed and running. To provide network access to the platform, we used the COMPAQ 32-Bit NetFlex Controller (a standard component on the COMPAQ ProSignia) and the SCO TCP/IP Runtime System and configured the platform as a network node. To provide X.25 and IP routing connectivity, we added the Eicon Technology products and configured them as described in this TechNote.

The following table lists the IP Router Platform components. For a description of the minimum system configuration required for the Eicon Technology IP Router for UNIX product, refer to the Eicon Technology document: *Eicon Technology IP Router for UNIX Administrator's Guide.*

Table 3-1
IP Router Platform Components

COMPAQ Hardware
COMPAQ ProSignia PC Server Model 486DX2/66-550 with:
1 additional 4-Megabyte Single Inline Memory Module (SIMM), for a total of 12 Megabytes of system memory COMPAQ 320-/525-Megabyte Tape Drive COMPAQ 32-Bit NetFlex Controller (standard in this ProSignia Model)
Operating System Software
SCO UNIX System V/386 Release 3.2.4 Operating System
SCO TCP/IP Runtime System 1.2
SCO UNIX Maintenance Supplement 4.2
COMPAQ EFS for SCO UNIX Systems V/386 Release 3.2.4, Version 1.6
IP Router Communications Hardware and Software
Eicon Technology EiconCard HSI/PC Communications Adapter hardware
Eicon Technology IP Router for SCO UNIX software

Topology

The tested topology for the IP Router Platform includes various network and node attachments. We created two TCP/IP Class B networks and interconnected them by X.25 over a 56 Kilobits per second leased line connected to a private packet-switched network. Each network contained two nodes: a router configured with the Eicon Technology products and a UNIX workstation node.

To validate the topology, we used the following connection schemes:

- terminal sessions using the **telnet** and **rlogin** commands
- Execution on remote systems using the **rcmd** command
- File transfers using the **ftp** commands

The following figure illustrates the topology we used to validate the functionality of the IP Router Platform:

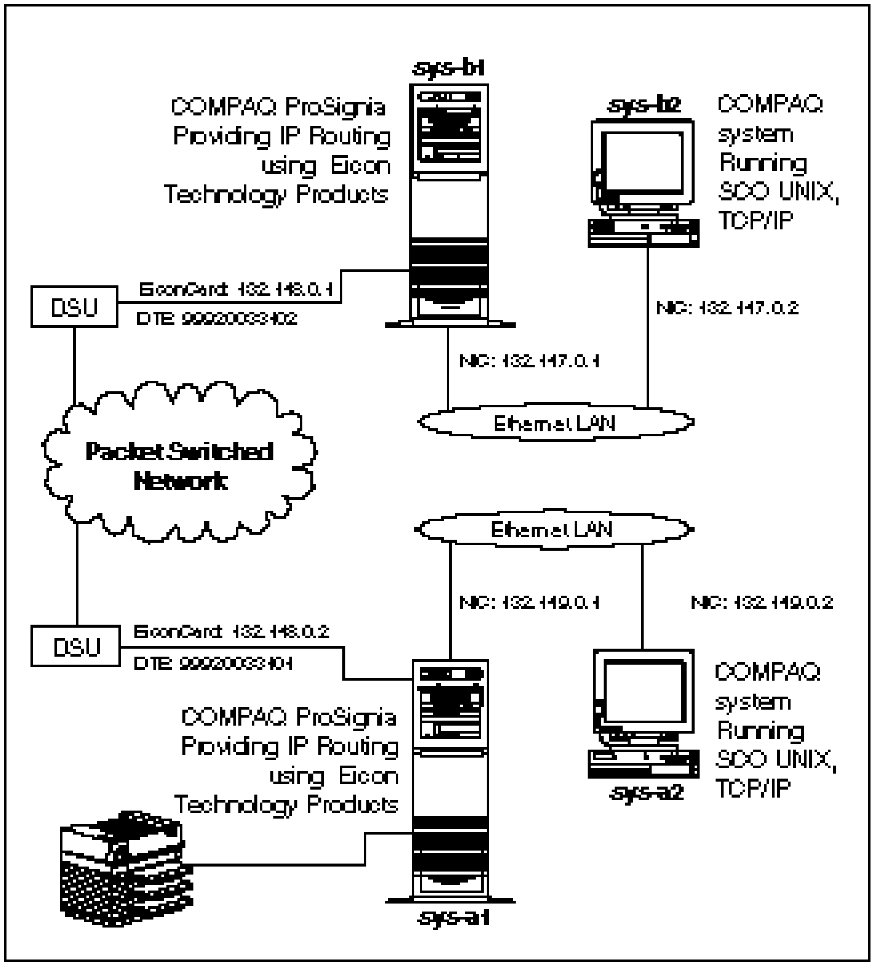

Figure 3-2. IP Router Platform Tested Internetwork Topology

Eicon Technology Certification Compliance

The Eicon Technology product is certified as compliant in the following countries:

Argentina	Australia	Austria	Bahamas	United Kingdom
Bahrain	Belgium	Brazil	Canada	United States
Chile	Colombia	Costa Rica	Denmark	Venezuela
Egypt	Finland	France	Germany	
Greece	Honduras	Hong Kong	Iceland	
India	Indonesia	Ireland	Israel	
Italy	Korea	Kuwait	Luxembourg	
Malaysia	Mexico	Netherlands	New Zealand	
Norway	Peru	Portugal	Puerto Rico	
Saudi Arabia	Singapore	Spain	Sweden	
Switzerland	Taiwan	Thailand	Turkey	

Chapter 4
Building the IP Router Platform

This chapter provides detailed procedures for adding and configuring the TCP/IP, X.25, and IP Router components.

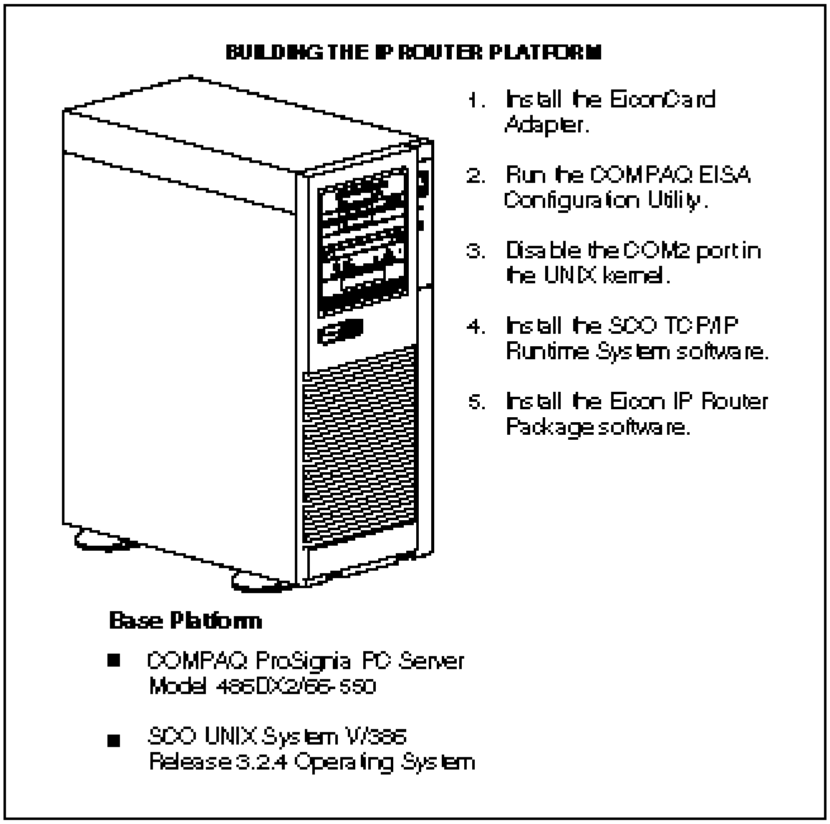

Figure 4-1. Building the IP Router Platform

Installing the EiconCard Adapter Board

Perform the following steps:

1. Turn off the COMPAQ ProSignia. Disconnect the AC power cord.

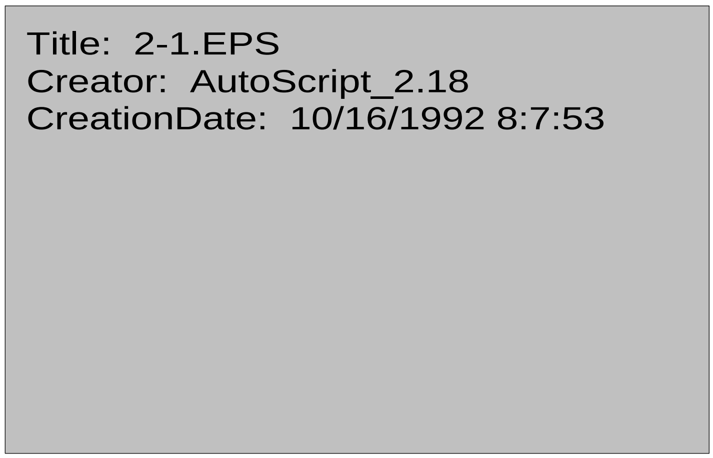

Figure 4-2. Removing the Side Cover

2. Loosen the thumbscrews on the rear panel, and remove the side cover.
3. Remove the retaining screw and option slot cover from an available slot.

4. Ensure that the EiconCard adapter board is configured with the default dip switch settings (1=off, 2=off, 3=on, 4=on) which represents an I/O address of 380h.

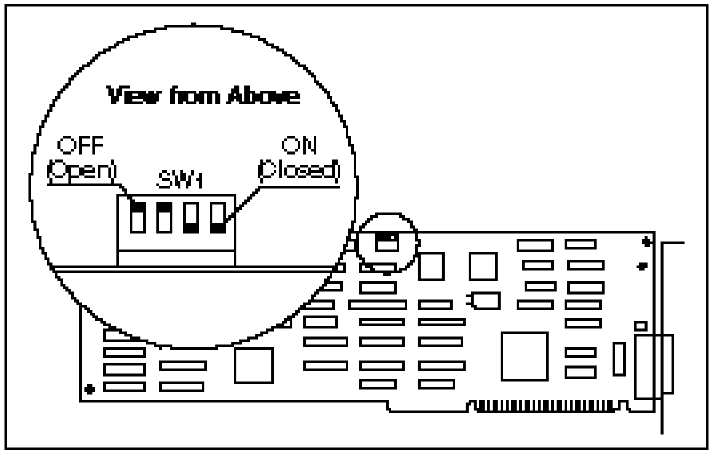

Figure 4-3. EiconCard Adapter Board I/O Switch Settings

5. Insert the EiconCard adapter board into the slot and record the slot number.

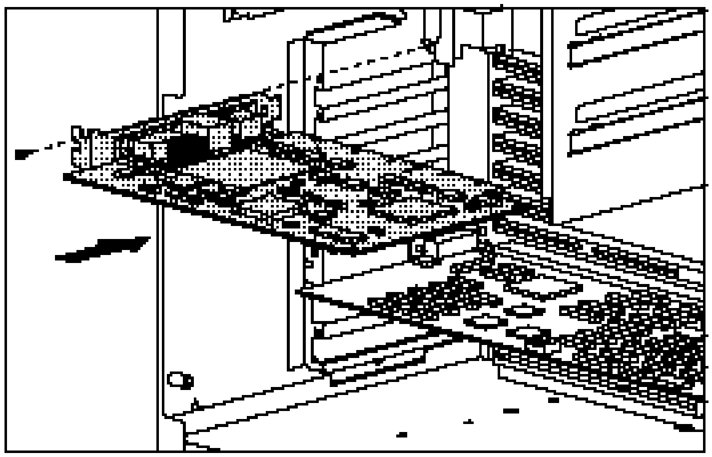

Figure 4-4. Installing the EiconCard Adapter Board

6. Secure the adapter in place with the retaining screw.

Running the COMPAQ EISA Configuration Utility

This section provides the configuration procedures for the EiconCard adapter board and the NetFlex Controller. For these procedures, you need the COMPAQ System Configuration diskette that came with the COMPAQ ProSignia.

NOTE: The following instructions are specific to Version 2.11 of the COMPAQ EISA Configuration Utility and might not apply to previous or future versions.

Complete the following steps:

1. Insert the COMPAQ System Configuration diskette into the diskette drive and turn on the system.
2. When the COMPAQ logo screen appears, press **ENTER**.
3. When the Auto Config screen appears, select *Yes*.

   The configuration utility detects the NetFlex Controller and automatically configures it.
4. When the Configuration Changes screen appears, press **ENTER**.
5. The board name and the slot where it is located displays on the screen.
6. When the Information screen appears, select *View or modify configuration*.
7. From the Steps in configuring your computer menu, select *Step 3: View or edit details*.

Verifying the NetFlex Controller Configuration

To configure the NetFlex Controller, perform the following steps:

1. From the list displayed, locate the slot containing the NetFlex Controller.
2. Configure the NetFlex Controller according to your requirements. For this TechNote, we use the following values:

Network Type: Ethernet

Interrupt: IRQ11, Level triggered

Interrupt Sharing: Disabled

Network Speed: 10 Mb/s

Network Media Connector: AUI (DB-15)

Disabling the COM2 Serial Port

You must now disable the COM2 serial port. Perform the following steps:

1. Position the cursor on "COM2" under the category "Integrated Interfaces" and press **ENTER**.
2. Select *Disabled* from the pop-up menu.

Configuring the EiconCard Adapter Board

To configure the EiconCard adapter board, perform the following steps:

1. Press **F7** to invoke the Advanced menu.
2. Select *View additional system information menu* from the Advanced menu.
3. Select *Available resources* from the View Additional System Information menu.

4. From the Available Resources screen, verify that the following values are available:

I/O Ports	380
IRQ	3
Memory	
Address	0C8000h
Amount	8k (minimum)

NOTE: The EiconCard adapter board supports the use of other values. However, we use the values shown above in this TechNote. Make a note of the values you use; you will need them in the next section.

5. Once the options are set, press **F10**.
6. To exit, press **F10** again.
7. Select *Step 5: Save and exit* from the main menu.
8. Select *Save the configuration and restart the computer*.

NOTE: Be sure to remove the COMPAQ System Configuration diskette from the diskette drive before the system reboots.

Disabling the COM2 Serial Port

In the configuration used in this TechNote, we set the EiconCard adapter board to the default factory settings. The default setting for the COM2 serial port is IRQ 3. Therefore, you must disable the COM2 serial port in the UNIX kernel.

1. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure. The following prompt displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

2. Enter the root password.

   This procedure brings up the system in single-user mode.

3. At the "#" prompt, enter

   `sysadmsh`

4. Select, in sequence, *System* *Hardware* *Card_Serial* from the menus hierarchy.

5. If an entry displays containing the string, "interrupt = COM2," enter

   `r`

   otherwise, enter

   `q`

6. If you entered **q** in the previous step, go to the section titled, "Installing the SCO TCP/IP Runtime System Software."

   If you entered **r** in the previous step, enter the number of the line containing the string, "interrupt = COM2."

7. Enter **y** after each of the following prompts appear:

```
Do you wish to create a new kernel now?

Do you want this kernel to boot by default?

Do you want the kernel environment rebuilt?
```

8. Reboot the SCO UNIX operating system before proceeding to the next section by entering the following at the "#" prompt:

   ```
   shutdown -g0 -y
   ```

Installing the SCO TCP/IP Runtime System Software

This section provides instructions for installing the SCO TCP/IP Runtime System software. Topics include:

- Installing the NetFlex Controller driver software
- Installing the SCO UNIX Maintenance Supplement
- Installing the SCO TCP/IP software
- Configuring TCP/IP and the NetFlex Controller driver
- Verifying the installation and configuration

To complete the sections in this chapter, you need the following items:

- COMPAQ EFS for SCO UNIX diskettes
- SCO UNIX Maintenance Supplement diskettes
- SCO TCP/IP Runtime System diskettes

Installing the NetFlex Controller Driver

This section provides instructions for installing the NetFlex Controller driver from the COMPAQ EFS for SCO UNIX diskettes. To install the driver, complete the following steps:

1. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure. The following prompt displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

2. the root password.

   This procedure brings up the system in single-user mode.

3. At the "#" prompt, enter

   ```
   custom
   ```

4. At the custom menu, select *Install A New Product Packages.*
5. At the prompt, "Insert: COMPAQ Supplement Floppy Volume 1," insert the COMPAQ EFS for SCO UNIX Volume 1 diskette and select *Continue*.
6. Select the entry *Compaq Ethernet/Token Ring driver* from the menu.
7. At the prompt, "Insert COMPAQ Supplement Floppy Volume 1," select *Continue.*
8. Insert the remaining diskettes as prompted, then select *Continue*.

   The files are extracted and the Compaq Ethernet/Token Ring driver Initialization script executes.

9. At the prompt, "Add the board in slot n to the cet driver configuration," enter

   ```
   y
   ```

   (**n** refers to the slot where you installed the NetFlex Controller)

10. At the prompt, "Do you wish to relink the kernel at this time?" enter

    ```
    n
    ```

11. To return to the main menu, press **ENTER**.

Installing the SCO UNIX Maintenance Supplement

This section provides instructions for installing the SCO UNIX Maintenance Supplement v4.2. While in single-user mode, perform the following steps:

1. At the custom menu, select *Install* *A New Product* *Entire Product.*
2. At the prompt, "Insert Distribution Floppy Volume 1," insert the SCO UNIX Maintenance Supplement diskette 1 and select *Continue*.
3. At the prompt, "Insert: SCO UNIX Maintenance Supplement v4.2 Floppy Volume UB1" (diskette 1), select *Continue*.
4. Insert the remaining diskettes as prompted and press **ENTER**.
5. When you are prompted, enter the serial number and activation key included with your SCO UNIX Operating System distribution.
6. At the prompt, "Do you wish to archive the saved files?" enter

   ```
   n
   ```

   You can archive these files at a later time from the directory: usr/lib/custom/prev-4.1

7. At the prompt concerning the parallel port device driver, "Do you wish to configure it now?" enter

   ```
   n
   ```

8. Enter **y** after each of the following prompts:

```
Do you wish to create a new kernel now?

Do you want this kernel to boot by default?

Do you want the kernel environment rebuilt?
```

9. To exit, from the Custom menu select *Quit →Yes.*
10. You must now reboot the system to invoke the newly created kernel containing the SCO UNIX Maintenance Supplement. Enter the following:

    ```
    shutdown -g0 -y
    ```

Installing the SCO TCP/IP Runtime System Software

This section provides instructions for installing the SCO TCP/IP Runtime System version 1.2 software. Complete the following steps:

1. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure. The following prompt displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

2. Enter the root password.

   This procedure brings up the system in single-user mode.
3. At the "#" prompt, enter

    ```
    custom
    ```
4. the Custom menu, select *Install* *A New Product* *Entire Product.*

5. At the prompt, "Insert: Distribution Floppy Volume 1," insert the SCO TCP/IP for UNIX Runtime System diskette 1, and select *Continue*.

   The custom data files are installed and the product Install script executes.

6. At the prompt, "Insert: SCO TCP/IP Runtime System Floppy Volume 1," select *Continue*.
7. Insert the remaining diskettes as prompted and select *Continue*.
8. When prompted, enter the serial number and activation key included with the SCO TCP/IP for UNIX Runtime System distribution.
9. When prompted to enter the system node name, enter

   ```
   sys-a1
   ```

   Then press **ENTER**.

   NOTE: The node name *sys-a1* was used in this TechNote. However, it might not be appropriate for your configuration. If you are configuring for any of the other nodes presented in this TechNote, respond appropriately (for example, *sys-a2*, *sys-b1*, and *sys-b2*).

10. When prompted to enter the "DOMAIN" name, accept the default by pressing **ENTER**.
11. At the prompt, "Do you want to relink the kernel now?" enter

    ```
    n
    ```

    NOTE: To save time, do not relink the kernel now. In the next section, we configure TCP/IP and the NetFlex Controller Driver and then relink the kernel.

Configuring TCP/IP and the NetFlex Controller Driver

This section provides instructions for configuring TCP/IP and the NetFlex Controller driver. Obtain the following network connection information from your TCP/IP Network Administrator:

Table 4-1
TCP/IP Parameters

Parameter	Description
Internet Address	IP address of this node. Values used: sys-a1: 132.149.0.1 sys-a2: 132.149.0.2 sys-b1: 132.147.0.1 sys-b2: 132.147.0.2
Network Mask	Value that masks the Internet portion of an Internet address, leaving only the host portion. Values used: 255.255.0.0
Broadcast Address	Broadcast address that TCP/IP uses to broadcast packets to the entire network, rather than to a specific destination. Values used: sys-a1: 132.149.255.255 sys-a2 132.149.255.255 sys-b1: 132.147.255.255 sys-b2: 132.147.255.255

While in single-user mode, perform the following steps:

1. At the "#" prompt, enter

   netconfig

2. From the Available options menu, select *1. Add a chain.*
3. Select *1. sco_tcp.*
4. Select *cet0*.

   NOTE: This driver is for the COMPAQ 32-Bit NetFlex Controller. If you are using another network controller, respond appropriately.

5. At the prompt, "Add chain sco_tcp->cet0," enter

   y

6. At the prompt, "Enter the internet address of this interface," enter

   132.149.0.1.

   NOTE: The above internet address is for node *sys-a1*. If you are configuring for node *sys-a2*, *sys-b1*, or *sys-b2*, use the appropriate address shown in Table 4-1 at the beginning of this section.

7. At the prompt, "Enter the netmask for this interface ..." enter

   255.255.0.0

   The netmask is a value that masks the Internet portion of your Internet address, leaving only the host portion.

8. At the prompt, "Does the interface use a broadcast address ..." enter

   y

   This is the broadcast address that TCP/IP uses to broadcast packets to the entire network, rather than to a specific destination.

9. At the prompt, "Enter the broadcast address for this interface ..." enter

   132.149.255.255

   NOTE: The above IP address is for node *sys-a1*. If you are configuring for node *sys-a2*, *sys-b1*, or *sys-b2*, use the appropriate address shown in Table 4-1 at the beginning of this section.

1. When prompted, verify the values presented by the system against those shown below:

Interface Address:	132.149.0.1
Netmask	255.255.0.0
Broadcast Address	132.149.255.255

   If correct, enter

   y

   NOTE: The above IP values are for node *sys-a1*. If you are configuring for node *sys-a2*, *sys-b1*, or *sys-b2*, use the appropriate value shown in Table 4-1 at the beginning of this section.

11. At the prompt, "0 Pseudo ttys are currently configured ..." select *1. Add Pseudo ttys*.

    Pseudo ttys are ttys allocated to network programs, such as **telnet** and **rlogin** which permit remote sessions.

12. At the prompt, "How many pseudo ttys you want ..." enter

    16

    NOTE: If you require more than 16 concurrent remote sessions, increase your response accordingly. SCO TCP/IP requires a minimum of 16 pseudo ttys.

13. From the Available options menu, enter **q** to quit.

14. At the "#" prompt, enter:

    /etc/conf/cf.d/link_unix

15. Enter **y** after each of the following prompts:

```
Do you want this kernel to boot by default?

Do you want the kernel environment rebuilt?
```

You must reboot the kernel to invoke the new configuration. In the next section, we reboot the kernel and test the configuration.

Verifying the Installation and Configuration

This section provides instructions for verifying that TCP/IP and the Network Controller are installed, configured properly, and recognized by the UNIX kernel.

Invoke the newly configured UNIX kernel by rebooting it.

1. At the "#" prompt, enter:

   ```
   shutdown -g0 -y
   ```

2. At the prompt, "Safe to Power Off or Press Any Key to Reboot," press **ENTER**.

Next, verify that the NetFlex Controller is successfully installed and is recognized by the UNIX kernel.

1. When the system reboots, you should see the following entry in the hardware listing:

```
%cet  0x7000-0x7FFF  5 - unit=0 Compaq Ethernet, 10Mbps, AUI
```

2. If you need to make modifications, run **netconfig** from the single-user mode and reconfigure TCP/IP and/or the NetFlex Controller driver. Refer to the section titled, "Configuring TCP/IP and the NetFlex Controller Driver."

Verify that TCP/IP is successfully installed and operational.

1. Enter multiuser mode by pressing **CTRL + D** when the following displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

2. Log into the system.
3. At the "#" prompt, enter

   ping 132.149.0.1

   Repeating messages resembling the following should appear, and the "icmp_seq" value should increase incrementally:

   These messages indicate that TCP/IP is configured and working correctly.

   NOTE: The above IP address used in the ping command is for node *sys-a1*. If you are configuring for node *sys-a2*, *sys-b1*, or *sys-b2*, refer to the table at the beginning of the previous section to obtain their IP addresses.

4. To stop the test, press the **DEL** key.
5. Bring the system into single-user mode by first entering the following at the "#" prompt:

   sync;sync;init 1

6. Enter the root password to bring the system into single-user mode when the following message displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

Installing the Eicon IP Router for UNIX Software

The Eicon IP Router for UNIX software includes the EiconCard Base Package and the EiconIP/X.25 Router software. The EiconCard Base Package software communicates and controls the EiconCard. The EiconIP/X.25 Router software performs the routings. The following figure illustrates the package contents and purpose:

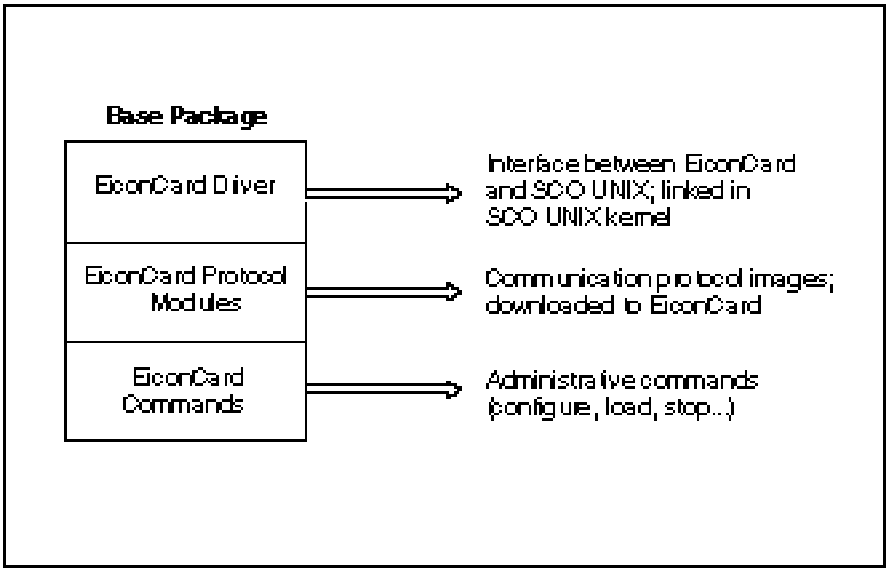

Figure 4-5. EiconCard Base Package Contents

Perform the installation and configuration procedures in the following sequence:

1. Configure the IRQ, Base I/O, and Memory Segment addresses for the EiconCard adapter board.
2. Specify the communications protocols to download the EiconCard adapter board.
3. Specify the EiconCard adapter board HSI port configuration for the X.25 link.

Pre-installation Considerations

Prior to installing the IP Router Package software, you need:

- The TCP/IP Runtime System installed and configured.
- IRQ, Base I/O, and Memory Segment addresses you specified in a previous section of this chapter titled "Running the COMPAQ EISA Configuration Utility."
- X.25 and TCP/IP network information. Obtain the following network connection information from your X.25 network provider:

Table 4-2
X.25 Parameters

Parameter	Description
Baud Rate	The baud rate between the EiconCard and the X.25 network. Valid range 2.4-384 Kb/s Values used: sys-a1: 56 Kb/s sys-b1: 56 Kb/s
Line Type	Switched or Non-switched Values used: sys-a1: Non-switched sys-b1: Non-switched
Modem Interface	X.21, V.35 or RS232 Values used: sys-a1: RS232 sys-b1: RS232

Continued

Table 4-2 *Continued*

Maximum Frame Size (N1)	HDLC frame size (5 bytes larger than X.25 packet size). Values used: sys-a1: 261 sys-b1: 261
Maximum Window Size	Packets sent before acknowledgment received. Values used: sys-a1: 007 sys-b1: 007
Maximum Packet Size	X.25 packet size (5 bytes less than HDLC frame size). Values used: sys-a1: 256 sys-b1: 256
Number of Virtual Circuits	Virtual circuit quantity and types that you have been assigned (Permanent Virtual Circuits (PVC), Incoming Virtual Circuits (IVC), Two-way Virtual Circuits (TVC), Out-going Virtual Circuits (OVC)). Values used: sys-a1: PVC=0, IVC=0, TVC=8, OVC=0 sys-b1: PVC=0, IVC=0, TVC=8, OVC=0

The EiconCard interface to the X.25 network must have an IP address assigned to it. This is a different IP address than the one specified during installation of the TCP/IP Runtime System. This address is mapped later to the actual X.25 DTE address using the Eicon **xipix25** command to add the entry to the Eicon IP Router table. This address is used to route IP packets across the X.25 network.

We used the following addresses for this TechNote. These addresses might not be appropriate for your network. Check with your TCP/IP Network Administrator to determine which addresses to use:

Table 4-3
X.25/IP Parameters

Parameter	Description
Internet Address	IP/X.25 address to assign the EiconCard interface. Values used: sys-a1: 132.148.0.1 sys-b1: 132.148.0.2
Network Mask	Value that masks the Internet portion of an Internet address, leaving only the host portion. Values used: sys-a1: 255.255.0.0 sys-b1: 255.255.0.0

Installation Procedures

This section describes the installation procedures for the IP Router for UNIX. To perform the procedures, you need the Eicon IP Router for UNIX diskette.

Perform the following steps on both IP Router nodes *sys-a1* and *sys-b1* to install the IP Router for UNIX Package software:

1. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure. The following prompt displays on the screen:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

2. Enter the root password.

   This brings the system up in single-user mode.

3. At the "#" prompt, enter

   ```
   custom
   ```

4. At the Custom menu, select *Install* → *A New Product* → *Entire Product.*

5. At the prompt, "Insert: Distribution Floppy Volume 1," insert the Eicon IP/X.25 Router diskette and select *Continue*.

   The custom data files are installed and the product Installation script executes.

6. At the prompt, "Insert: Eicon IP/X.25 Router Floppy Volume 1," select *Continue.*

7. At the prompt, "Are you installing the EiconCard Base Package on a micro-channel system?" enter

   ```
   n
   ```

8. The prompt, "Which of the following Eicon cards are you installing?" displays on the screen. For the EiconCard HSI, enter

   ```
   2
   ```

9. At the prompt, "Enter interrupt vector number:" enter

   ```
   3
   ```

10. At the prompt, "Enter I/O address in hex:" enter

    ```
    380
    ```

11. At the prompt, "Enter window address in hex:" enter

    ```
    c800
    ```

12. At the prompt, "Autoload of EiconCard:" enter

    ```
    y
    ```

13. The EiconCard driver software configuration portion of the installation script displays the following values:

```
EiconCard Driver cards configuration:

Card                1    2    3    4

Card type           HSI
Interrupt           3
I/O Address         380
Window Address      C800
Autoload            yes
```

14. At the "Is this information correct?" prompt, review your entries and if they are correct, enter

    y

    The Install script checks the consistency of the values you entered.

15. The installation script displays the following values:

```
EiconCard Driver software configuration:

Number of concurrent request          : 128
Number of data buffers                : 128
Watchdog wake up period (in sec)      : 30
Load/Self-test timeout period         : 5
```

16. At the "Is this information correct?" prompt, review your entries and if they are correct, enter

    y

    The Installation script updates the system configuration files.

17. At the prompt, "IP address of IP Router Interface [192.1.100.1]:" enter

    132.148.0.1

    NOTE: The above IP/X.25 address is for node *sys-a1*. If you are configuring for node *sys-b1*, enter 132.148.0.2.

18. At the prompt, "Network mask of interface:" enter

    255.255.0.0

19. At the prompt, "Maximum Transmission Unit (MTU):" enter

    576

20. At the prompt, "Maximum Number of routing table entries:" enter

    16

21. The Eicon IP Router driver configuration portion of the Install script displays the following values:

```
EiconIP Router Driver Configuration:

IP address of IP Router interface              : 132.148.0.1
Network mask of interface                      : 255.255.0.0
Maximum Transmission Unit (MTU)                : 576
Maximum number of routing table entries        : 16
```

22. At the prompt, "Is this information correct?" review your entries and if they are correct, enter

    y

    The Install script updates TCP/IP and system configuration files.

    NOTE: The above IP address is for node *sys-a1*. If you are configuring for node *sys-b1*, it should display 132.148.0.2.

23. The following prompt displays twice. Enter **n** for each display:

```
Do you wish to create a new kernel now?
```

> **NOTE:** We relink the kernel at the end of this section, after we perform additional configuration procedures.

24. To exit from the Custom menu, select *Quit* →*Yes*.

Manual Enabling of Kernel Parameters

You must enable two kernel parameters before IP routing can occur. In the current release of the Eicon IP Router software, the installation script does not automatically update these parameters. Therefore, you must manually enable them. (Eicon Technologies has indicated they will incorporate the following functionality into later releases of their software installation script.)

1. At the "#" prompt, enter

```
/etc/conf/bin/idtune -f IPFORWARDING 1
/etc/conf/bin/idtune -f IPSENDREDIRECTS 1
```

2. To invoke the Eicon IP Router driver and the modified kernel parameters, you must relink the kernel. At the "#" prompt, enter

```
/etc/conf/cf.d/link_unix
```

3. Enter **y** after each of the following prompts:

```
Do you want this kernel to boot by default?

Do you want the kernel environment rebuilt?
```

Configuring the Software

After you successfully install the Eicon IP/X.25 Router Package software, you must configure it. While in single-user mode, perform the following steps on both IP Router nodes *sys-a1* and *sys-b1*:

1. At the "#" prompt, enter the following commands:

```
cd /usr/lib/eicon
./eccfg
```

2. When the first screen displays, the following message displays on the last line: "New EC.CFG file: default values will be used. Press any key to continue." Press **ENTER**.

3. The first in a series of EiconCard Configuration screens appears. These screens configure the EiconCard protocols to download to the EiconCard and X.25 link information. The following seven screen images show the configuration used for this TechNote. After you complete filling in the information requested in each screen, press **F4** to view the next screen.

```
+++++++++++++++ EiconCard Configuration +++++++++++++++++++
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+         Number of Cards ......................1          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
+                                                          +
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
+++++++++++++++++++++++ EiconCard Configuration +++++++++++++++++++
+                                                                 +
+                                                                 +
+                                                                 +
+         Card Type .................................HSI/PC       +
+                                                                 +
+                                                                 +
+                                                                 +
+         Input/Output Port Address ....................380 (*)    +
+                                                                 +
+         Interrupt Request Level .......................03        +
+                                                                 +
+         Memory Segment Address ......................C800        +
+                                                                 +
+         Number of Ports ...............................1         +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                   (*)  Must Match Hardware Setup.               +
+                                                                 +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
++++++++++++++++++ EiconCard Configuration ++++++++++++++++++++++++
+                                                                 +
+                                                                 +
+                                                                 +
+         Base Protocol Module ....................HDLC           +
+                                                  X25            +
+                                                  SNDCF          +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+                                                                 +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

NOTE: For the previous screen, the protocol stack is initially shown empty. To build the protocol stack, use the space bar (toggle) and the up-down arrow keys.

```
+++++++++++++++++++ EiconCard Configuration ++++++++++++++++++
+                                                            +
+         Port Name ............................             +
+         Port Number .............................FF        +
+                                                            +
+         Line Type: Switched/Non-Switched ..........N        +
```

```
+         Duplex : Full/Half ........................F         +
+         Point-to-point/Multi-point ................P         +
+         Modem Interface ......................RS232         +
+         Clocking : External/Internal ..............E         +
+         NRZI Encoding : Yes/No ....................N         +
+         Line speed (bps) ......................56000         +
+                                                             +
+         RI  (on)  -> DTR (on) delay (msec) .....0000        +
+         DSR (on)  -> RTS (on) delay (msec) .....0000        +
+         DCD (off) -> RTS (on) delay (msec) .....0000        +
+         CTS (on)  -> Tx  (on) delay (msec) .....0000        +
+         Tx Idle timeout (msec) .................0000        +
+         RTS (on)  -> RTS (off) maximum (msec) . 0000        +
+         RTS (off) -> DCD (on) timeout (msec) ...0000        +
+         DCD (on)  -> DCD (off) maximum (msec) ..0000        +
+                                                             +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
++++++++++++++++++++ EiconCard Configuration +++++++++++++++++++
+                                                             +
+                                                             +
+                                                             +
+         DTE/DCE Addressing ........................T        +
+         Active/Passive Link Setup .................A        +
+         FRMR to RRC/RNRC/REJC with P=0 ............Y        +
+                                                             +
+         Check-Point-Timer T1 (msec) ............2900        +
+         Ack-Delay-Timer T2 (msec) ..............0200        +
+         Idle-Probe-Timer T3 (msec) ............15000        +
+         Maximum-Frame-Size N1 (octets) .........0261        +
+         Maximum-Retry-Count N2 ...................10        +
+         Normal/Extended Sequence ..................N        +
+         Maximum-Window-Size K ...................007        +
+         X.32 Dial-out from Network.................N        +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
+++++++++++++++++++++ EiconCard Configuration ++++++++++++++++
+                                                             +
+         Node-Type .........................DTE              +
+         Node-Address ...................                    +
+         Basic/Extended Format Packets ...........E          +
+         Sequential Assignment of Virtual Circuits .Y        +
+                                                             +
+         Maximum Window Size..007 Maximum Packet Size..0256 +
+         Default Window Size..002 Default Packet Size..0256 +
+                                                             +
+         Starting PVC Number.0001 Number of PVCs ...000      +
+         Starting IVC Number.0001 Number of IVCs ...000      +
+         Starting TVC Number.0001 Number of TVCs ...008      +
+         Starting OVC Number.0009 Number of OVCs ...000      +
+                                                             +
+         Timer T20 (sec) .......................060          +
+         Timer T21 (sec) .......................060          +
+         Timer T22 (sec) .......................060          +
+         Timer T23 (sec) .......................060          +
+         Idle Timer (sec) ......................000          +
+         Maximum Retry Count N3 .................03          +
+                                                             +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

```
+++++++++++++++++++ EiconCard Configuration ++++++++++++++++++
+                                                             +
+                                                             +
+                                                             +
+         Maximum Number of Call Directory Entries ....004    +
+                                                             +
+         Maximum Number of Users .....................001    +
+                                                             +
+         Maximum Number of Subnetwork Circuits .......004    +
+                                                             +
+         Maximum Datagram Size (bytes) ..............0578    +
+                                                             +
+         Maximum Number of Pending Data                      +
+                      Transmission Requests ....007          +
+                                                             +
+         Minimum Connection Time (sec) .......0000004        +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+                                                             +
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
```

4. To save the configuration, press **F1**.
5. To exit the configuration program, press **F10**.
6. Press **F1**.
7. You must reboot the system to invoke the new kernel containing the Eicon IP Router Package drivers, and modified kernel parameters linked in the previous section. Enter the following at the "#" prompt:

```
shutdown -g0 -y
```

Verifying the Installation and Configuration

To verify that the Eicon IP Router software was successfully installed and configured, perform the following steps:

1. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure.

   The EiconCard driver recognizes the EiconCard if the hardware configuration display includes the following line:

```
%EtECard      - - -  v1.4 Eicon Technology Corp.
```

1. When the following prompt displays on the screen, press **CTRL + D** to start the system in multiuser mode.

```
Type CONTROL-D to proceed with normal startup,
(or give root password for system maintenance):
```

3. The IP Router software was successfully installed if the following line displays on the screen just prior to TCP/IP starting:

```
Configuring EiconIP/X.25 Driver ... Done
```

4. The Eicon IP Router package was successfully installed if the following lines display on the screen just prior to the login prompt:

```
Loading Eicon Card 0 ... Done
```

Chapter 5
Configuring and Using the IP Router Platform

The following sections describe the steps to configure each node of the topology presented in this TechNote. IP Router nodes *sys-a1* and *sys-b1* are configured with appropriate X.25 and IP Route table entries. Network nodes *sys-a2* and *sys-b2* are configured with appropriate IP Route table entries.

The following diagram illustrates the internetwork addressing scheme configured in this section. The two TCP/IP networks and one X.25 network along with their respective IP and X.25 DTE addresses are shown:

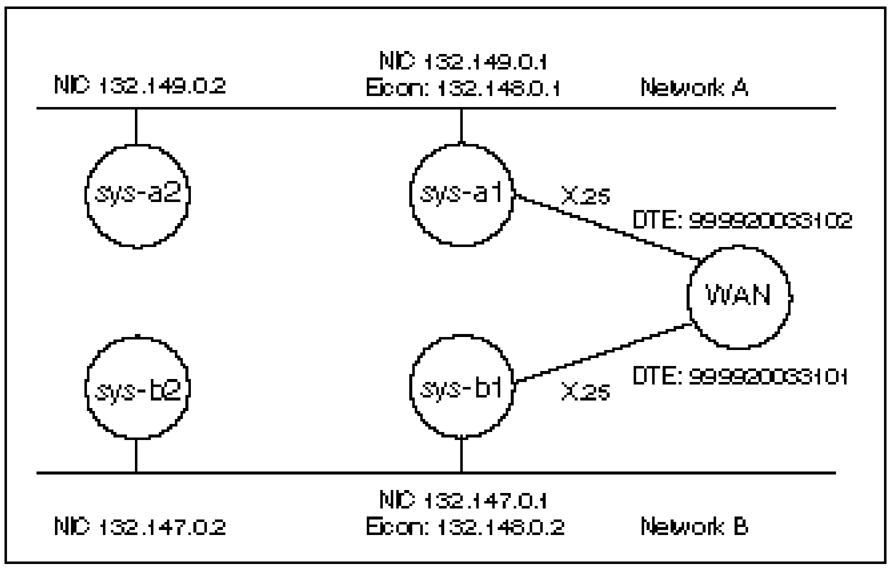

Figure 5-1. Addressing Scheme

Node *sys-a1*

While in multiuser mode, you must associate all nodes by their names rather than IP address and configure appropriate route entries into their respective TCP/IP and X.25 route tables.

Associate Node *sys-a1* with IP Address

To associate node *sys-a1* with an IP address, perform the following steps:

1. Edit the host control file */etc/hosts* using a text editor, such as **vi**. For example:

```
vi /etc/hosts
```

2. Append the following lines to the file:

```
132.149.0.1        sys-a1
132.149.0.2        sys-a2
132.147.0.1        sys-b1
132.147.0.2        sys-b2
```

For example, the */etc/hosts* file located on *sys-a1* now looks like the following:

```
# cat /etc/hosts
127.0.0.1      localhost
132.149.0.1    cet0
132.148.0.1    EtX0
132.149.0.1    sys-a1
132.149.0.2    sys-a2
132.147.0.1    sys-b1
132.147.0.2    sys-b2
```

Add Entry to IP Route Table

You must add an entry to the IP Route table that corresponds to the network where nodes *sys-b1* and *sys-b2* reside (132.147). The following steps display the current IP Route table, add the entry to the Route table, and again display the Route table.

1. To display the current IP Route table, enter the command:

   ```
   netstat -rn
   ```

   The following displays.

```
# netstat -rn
Routing tables
Destination     Gateway           Flags    Refs   Use      Interface
127.0.0.1        127.0.0.1        UH       1        0      lo0
132.148          132.148.0.1      U        1        0      EtX0
132.149          132.149.0.1      U        0        0      cet0
```

NOTE: There is no entry for destination IP address 132.147. This is the remote network where *sys-b1* and *sys-b2* reside.

2. Add the entry to the IP Route table. The following command adds an entry that routes all packets containing a destination IP address of 132.147 to node 132.148.0.2 with two hops (traverses two nodes before it reaches its destination).

3. At the "#" prompt enter:

   ```
   route add 132.147.0.0 132.148.0.2 2
   ```

4. Again display the IP Route table to verify that the route entry was successful. Enter:

   netstat -rn

5. The following table displays. Notice the added entry for destination IP address 132.147:

```
# netstat -rn
Routing tables
Destination    Gateway           Flags     Refs     Use  Interface
127.0.0.1      127.0.0.1         UH        1        0lo0
132.147        132.148.0.2       UG        0        0EtX0
132.148        132.148.0.1       U         1        0EtX0
132.149        132.149.0.1       U         0        0cet0
```

Add Route Entry Information to the TCP Control File

The route entry information from the previous steps is not retained during UNIX boots. You must add the information to the TCP control file to execute it automatically during TCP/IP startup. Perform the following steps:

1. Edit the TCP control file */etc/tcp* using a text editor, such as **vi**. For example:

   vi /etc/tcp

2. Locate the section containing the following header:

```
#
#  Interface configuration -- edit as appropriate
#
```

3. Append the following command line to the end of this section:

```
route add 132.147.0.0 132.148.0.2 2
```

4. For example, within the */etc/tcp* file located on *sys-a1*, the section now looks like the following. Note the last entry:

```
#
# Interface configuration -- edit as appropriate.
#
ifconfig lo0 localhost
ifconfig EtX0 132.148.0.1 -arp metric 1 netmask 255.255.0.0
ifconfig cet0 132.149.0.1 -trailers netmask 255.255.0.0 broadcast 132.149.255.255
#    ifconfig en0 `uname -n` $NETMASK -trailers $BROADCAST
route add 132.147.0.0 132.148.0.2 2
```

Add X.25 Interface and IP Route Entries to IP Route Table

Now, add the X.25 Interface and IP route entries to the Eicon IP Route table. The entries match the IP address of the first gateway along the route to the destination with its X.25 address.

1. At the "#" prompt, enter the following command to make the directory containing the Eicon commands your current directory:

```
cd /usr/lib/eicon
```

2. Display the current X.25 Interface table. Enter:

```
./xipstat -in
```

   The following X.25 Interface table displays on the screen. Note that there are no entries:

```
# ./xipstat -in
Gateway            Remote DTE        Ipkts   Ierrs Opkts   Oerrs
```

3. Now display the Eicon IP Route table. Enter:

   ```
   ./xipstat -rn
   ```

   The following Eicon IP Route table displays on the screen. Note that there are no entries:

```
# ./xipstat -rn
Destination      Gateway          Flags       Use      Port
```

4. Add the following line to the X.25 Interface table. An entry is generated automatically for the Eicon IP Route table:

   ```
   ./xipix25 -a 999920033101 -I 999920033102 132.148.0.2
   ```

5. Display the X.25 Interface table to verify successful entries. Enter:

   ```
   ./xipstat -in
   ```

   The following X.25 Interface table displays on the screen. Note the added entry containing the IP address (132.148.0.2) of the remote DTE (999920033101).

```
# ./xipstat -in
Gateway            Remote DTE       Ipkts  Ierrs   Opkts  Oerrs
132.148.0.2        999920033101     0      0       0      0
```

6. Now display the Eicon IP Route table to verify successful entries. Enter:

   ```
   ./xipstat -rn
   ```

7. The following Eicon IP Route table displays on the screen. Note the added entry with the network address portion (132.148) of the remote DTE (132.148.0.2).

```
# ./xipstat -rn
Destination      Gateway              Flags    Use     Port
132.148           132.148.0.2         IOB      0       0xFF
```

Node *sys-a2*

Associate Node *sys-a2* with IP Address

To associate node *sys-a2* with an IP address, perform the following steps:

1. Edit the host control file */etc/hosts* using a text editor, such as **vi**. For example:

   ```
   vi /etc/hosts
   ```

2. Append the following lines to the file:

   ```
   132.149.0.1     sys-a1
   132.149.0.2     sys-a2
   132.147.0.1     sys-b1
   132.147.0.2     sys-b2
   ```

3. For example, the */etc/hosts* file located on *sys-a2* now looks like the following:

```
# cat /etc/hosts
127.0.0.1       localhost
132.149.0.1     sys-a1
132.149.0.2     sys-a2
132.147.0.1     sys-b1
132.147.0.2     sys-b2
```

Add Route Entry Information to the TCP Control File

This part of the configuration process involves adding an entry to the IP Route table that routes all packets containing an IP address different than 132.147 to a default gateway (*sys-a1*). You must add the information to the TCP control file to execute it automatically during TCP/IP startup. Perform the following steps:

1. Edit the TCP control file */etc/tcp* using a text editor, such as **vi**. For example:

   ```
   vi /etc/tcp
   ```

2. Locate the section containing the following header:

   ```
   #
   #  Interface configuration -- edit as appropriate
   #
   ```

3. Append the following command to the end of this section:

   ```
   route add default 132.149.0.1 2
   ```

   For example, within the */etc/tcp* file located on *sys-a1*, the section now looks like the following. Note the last entry:

```
#
# Interface configuration -- edit as appropriate.
#
ifconfig lo0 localhost
ifconfig wdn0 132.149.0.2 -trailers netmask 255.255.0.0 broadcast 132.149.255.25
#    ifconfig en0 `uname -n` $NETMASK -trailers $BROADCAST
route add default 132.149.0.1 2
```

Node *sys-b1*

Associate Node *sys-b1* with IP Address

To associate node *sys-b1* with an IP address, perform the following steps:

1. Edit the host control file */etc/hosts* using a text editor, such as **vi**. For example:

   ```
   vi /etc/hosts
   ```

2. Append the following lines to the file:

   ```
   132.149.0.1    sys-a1
   132.149.0.2    sys-a2
   132.147.0.1    sys-b1
   132.147.0.2    sys-b2
   ```

   For example, the */etc/hosts* file located on *sys-a1* now looks like the following:

```
# cat /etc/hosts
127.0.0.1      localhost
132.149.0.1    cet0
132.148.0.1    EtX0
132.149.0.1    sys-a1
132.149.0.2    sys-a2
132.147.0.1    sys-b1
132.147.0.2    sys-b2
```

Add Entry to IP Route Table

This part of the configuration process involves adding an entry to the IP Route table that corresponds to the network where nodes *sys-a1* and *sys-a2* reside (132.149). The following steps display the current IP Route table, add the entry to the table, and again display the IP Route table to verify that the entry was successful.

1. Display the current IP Route table. Enter:

    ```
    netstat -rn
    ```

    The following displays on the screen:

```
# netstat -rn
Routing tables
Destination    Gateway      Flags   Refs    Use     Interface
127.0.0.1      127.0.0.1    UH      1       0       lo0
132.147        132.147.0.1          U       1       0        cet0
132.148        132.148.0.2          U       1       0        EtX0
```

NOTE: There is no entry for destination IP address 132.149. This is the remote network where *sys-a1* and *sys-a2* reside.

2. Add the entry to the IP Route table. The following adds an entry that routes all packets containing a destination IP address of 132.149 to node 132.148.0.1 with two hops (traverses two nodes before it reaches its destination).

    At the "#" prompt, enter:

    ```
    route add 132.147.0.0 132.148.0.1 2
    ```

3. Again display the IP Route table to verify that the route entry was successful. Enter:

```
netstat -rn
```

The following table displays. Notice the added entry for destination IP address 132.149:

```
# netstat -rn
Routing tables
Destination    Gateway      Flags   Refs        Use       Interface
127.0.0.1      127.0.0.1            UH          1         0          lo0
132.147        132.148.0.1          U           1         0          cet0
132.148        132.148.0.2 U        1           0         EtX0
132.149        132.148.0.1 UG       0           0         EtX0
```

Add Route Entry Information to the TCP Control File

The route entry information from the previous step is not retained during UNIX boots. You must add it to the TCP control file to execute it automatically during TCP/IP startup. Perform the following steps:

1. Edit the TCP control file */etc/tcp* using a text editor, such as **vi**. For example:

```
vi /etc/tcp
```

2. Locate the section containing the following header:

```
#
#  Interface configuration -- edit as appropriate
#
```

3. Append the following command line to the end of this section:

```
route add 132.149.0.0 132.148.0.1 2
```

For example, within the */etc/tcp* file located on *sys-b1*, the section now looks like the following. Note the last entry:

```
#
# Interface configuration -- edit as appropriate.
#
ifconfig lo0 localhost
ifconfig EtX0 132.148.0.2 -arp metric 1 netmask 255.255.0.0
ifconfig cet0 132.147.0.1 -trailers netmask 255.255.0.0 broadcast 132.147.255.255
#    ifconfig en0 `uname -n` $NETMASK -trailers $BROADCAST
route add 132.149.0.0 132.148.0.1 2
```

Add X.25 Interface and IP Route Entries to IP Route Table

Now, add the X.25 Interface and IP route entries to the Eicon IP Route table. The entries match the IP address of the first gateway along the route to the destination with its X.25 address.

1. At the "#" prompt, enter the following command to make the directory containing the Eicon commands your current directory:

```
cd /usr/lib/eicon
```

2. Display the current X.25 Interface table. Enter:

```
./xipstat -in
```

The following X.25 Interface table displays on the screen. Note that there are no entries:

```
# ./xipstat -in
Gateway          Remote DTE       Ipkts   Ierrs     Opkts   Oerrs
```

3. Now display the Eicon IP Route table. Enter:

    ./xipstat -rn

    The following Eicon IP Route table displays on the screen. Note that there are no entries:

```
# ./xipstat -rn
Destination     Gateway        Flags     Use    Port
```

4. Add the entry to the X.25 Interface table. An entry is generated automatically for the Eicon IP Route table:

    ./xipix25 -a 999920033102 -l 999920033101 132.148.0.1

5. Display the X.25 Interface table and verify that the entries were successful. Enter:

    ./xipstat -in

    The following X.25 Interface table displays on the screen. Note the added entry with the IP address (132.148.0.1) of the remote DTE (999920033102):

```
# ./xipstat -in
Gateway          Remote DTE     Ipkts   Ierrs    Opkts   Oerrs
132.148.0.1      999920033102   0       0        0       0
```

6. Now display the Eicon IP Route table. Enter:

    ./xipstat -rn

    The following IP Route table displays on the screen. Note the added entry with the network address portion (132.148) of the remote DTE (132.148.0.1):

```
# ./xipstat -rn
Destination     Gateway      Flags   Use      Port
132.148          132.148.0.1  IOB     0        0xFF
```

Node *sys-b2*

Associate Node *sys-b2* with IP Address

1. Edit the host control file */etc/hosts* using a text editor, such as **vi**. For example:

```
vi /etc/hosts
```

2. Append the following lines to the file:

```
132.149.0.1        sys-a1
132.149.0.2        sys-a2
132.147.0.1        sys-b1
132.147.0.2        sys-b2
```

For example, the */etc/hosts* file located on *sys-b2* now looks like the following:

```
# cat /etc/hosts
127.0.0.1        localhost
132.149.0.1     sys-a1
132.149.0.2     sys-a2
132.147.0.1     sys-b1
132.147.0.2     sys-b2
```

Add Route Entry Information to the TCP Control File

This part of the configuration process involves adding an entry to the IP Route table which routes all packets containing an IP address different than 132.149 to a default gateway (*sys-b1*). You must add the information to the TCP control file to execute it automatically during TCP/IP startup. Perform the following steps:

1. Edit the TCP control file */etc/tcp* using a text editor, such as **vi**.
   For example:

   ```
   vi /etc/tcp
   ```

2. Locate the section containing the following header:

   ```
   #
   #  Interface configuration -- edit as appropriate
   #
   ```

3. Append the following command to the end of this section:

   ```
   route add default 132.147.0.1 2
   ```

   For example, within the */etc/tcp* file located on *sys-b2*, the section now looks like the following. Note the last entry:

```
#
# Interface configuration -- edit as appropriate.
#
ifconfig lo0 localhost
ifconfig wdn0 132.147.0.2 -trailers netmask 255.255.0.0 broadcast 132.147.255.25
#    ifconfig en0 `uname -n` $NETMASK -trailers $BROADCAST
route add default 132.147.0.1 2
```

Testing Connectivity to Each Node

This section describes the procedures required to verify routing by the IP router nodes and the internetwork connectivity of all nodes.

Reboot the Nodes

First, reboot all nodes so that they are started up in a "known" state. Repeat Steps 1, 2, and 3 for each node (*sys-a1*, *sys-a2*, *sys-b1*, and *sys-b2*):

1. Shut down the system by entering the following at the "#" prompt:

   ```
   shutdown -g0 -y
   ```

2. When the following prompt appears, press **ENTER** to restart the system:

```
**      Safe to Power Off      **
                -or-
** Press Any Key to Reboot **
```

3. Start up the COMPAQ ProSignia using the usual UNIX-boot procedure.
4. When the following prompt displays on the screen, press **CTRL + D** to start the system in multiuser mode:

```
Type CONTROL-d to proceed with normal startup,
(or give root password for system maintenance):
```

Verify Connectivity and Routing

Next, verify that all nodes recognize one another and that each IP Router node is routing properly. For each node listed below, perform the commands contained in the display and verify the results. You will probably generate different time values (*time=0 ms*) than those shown in the display. Ignore these time differences. To stop the **ping** command, press the **DEL** key.

sys-a1: In the following display, the connectivity to local node *sys-a2* and remote nodes *sys-b1* and *sys-b2* is successful. Also, routing by nodes *sys-a1* and *sys-b1* is successful. Notice that when accessing the remote nodes, reponse time has increased significantly. This is due to the X.25 connection operating at 56 Kilobits per second and the WAN operating internally at 64 Kilobits per second versus the local Ethernet operating at 10 Megabits per second.

```
# ping sys-a2
PING sys-a2 (132.149.0.2): 56 data bytes



--- sys-a2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms

# ping sys-b1
PING sys-b1 (132.147.0.1): 56 data bytes



--- sys-b1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 150/150/150 ms

# ping sys-b2
PING sys-b2 (132.147.0.2): 56 data bytes



--- sys-b2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 160/170/180 ms
```

sys-a2: In the following display, the connectivity to local node *sys-a1* and remote nodes *sys-b1* and *sys-b2* is successful:

```
# ping sys-a1
PING sys-a1 (132.149.0.1): 56 data bytes



--- sys-a1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms

# ping sys-b1
PING sys-b1 (132.147.0.1): 56 data bytes



--- sys-b1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 150/160/170 ms

# ping sys-b2
PING sys-b2 (132.147.0.2): 56 data bytes



--- sys-b2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 180/180/180 ms
```

sys-b1: In the following display, the connectivity to local node *sys-b2* and remote nodes *sys-a1* and *sys-a2* is successful. Also, routing by nodes *sys-b1* and *sys-a1* is successful:

```
# ping sys-b2
PING sys-b2 (132.147.0.2): 56 data bytes



--- sys-b2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms

# ping sys-a1
PING sys-a1 (132.149.0.1): 56 data bytes



--- sys-a1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 150/150/150 ms

# ping sys-a2
PING sys-a2 (132.149.0.2): 56 data bytes



--- sys-a2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 180/180/180 ms
```

sys-b2: In the following display, the connectivity to local node *sys-b1* and remote nodes *sys-a1* and *sys-a2* is successful:

```
# ping sys-b1
PING sys-b1 (132.147.0.1): 56 data bytes



--- sys-b1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 0/0/0 ms

# ping sys-a1
PING sys-a1 (132.149.0.1): 56 data bytes



--- sys-a1 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 160/165/170 ms

# ping sys-a2
PING sys-a2 (132.149.0.2): 56 data bytes



--- sys-a2 ping statistics ---
2 packets transmitted, 2 packets received, 0% packet loss
round-trip min/avg/max = 180/180/180 ms
```

Using the IP Router

This section describes using, checking the status, testing, and resolving issues associated with the IP Router Platform components.

IP Router Driver Maintenance

You can modify, display, and remove the IP router driver using the Eicon **xipstat** command. If you are going to modify or remove the driver, first be sure to stop the X.25 connection as described in the section of this chapter titled "Starting/Stopping the X.25 Connection."

To invoke the IP router driver maintenance routine, enter the following at the "#" prompt:

```
/usr/lib/eicon/xipdrvcfg
```

For example, the following screen displays the current driver configuration for node *sys-a1*:

```
# /usr/lib/eicon/xipdrvcfg

    Eicon IP Router for Unix Driver Configuration

      1. Install and/or configure driver
      2. Remove driver
      3. Display driver configuration

    Select an option or enter q to quit : 3

    IP address of IP Router interface              : 132.148.0.1
    Network mask of interface                      : 255.255.0.0
    Maximum Transmission Unit (MTU)                : 576
    Maximum number of routing table entries        : 16
```

NOTE: If you modify any of the driver parameters, you must relink and reboot the kernel for the changes to take effect.

Maintaining X.25 IP Router Tables

This section describes the commands used to maintain and display the Eicon IP Router table. There are two types of entries in this table. They are X.25 Interface and IP Route entries. The IP Router for UNIX software provides two commands for maintaining the table and one command for displaying the table. All three commands accept multiple parameters. The three commands associated with the Eicon IP Router table are:

- **xipix25**: Adds and deletes X.25 Interface entries.
- **xiproute**: Adds and deletes IP Route entries. Similar to the TCP/IP **route** command.
- **xipstat**: Displays the table entries. Similar to the TCP/IP **netstat** command. To display the X.25 Interface entries append the **-in** parameter string. To display the IP Route entries, append the **-rn** parameter string. To obtain a verbose listing, append **-v** to your parameter string.

NOTE: When using the **xipix25** command to add an X.25 Interface entry, the command automatically generates and adds a corresponding Eicon IP Route entry (via **xiproute**). When using the **xipix25** command to remove an X.25 Interface entry, it *does not* automatically remove the corresponding Eicon IP Router entry. Use the **xiproute** command to manually delete and/or add Eicon IP Route entries.

The following example (using node *sys-a1*) shows the following:

- Displays an empty IP Router table.
- Adds an X.25 Interface entry that automatically generates a corresponding Eicon IP Route entry.
- Displays the updated table.
- Displays the table using the verbose (**-v**) parameter.
- Deletes the X.25 Interface entry and the Eicon IP Route entry.
- Displays the now-empty table.

```
# cd /usr/lib/eicon

# ./xipstat -in
Gateway          Remote DTE       Ipkts   Ierrs Opkts   Oerrs
# ./xipstat -rn
Destination      Gateway          Flags         Use       Port

# ./xipix25 -a 999920033101 -l 999920033102 132.148.0.2

# ./xipstat -in
Gateway            Remote DTE       Ipkts   Ierrs Opkts   Oerrs
132.148.0.2        999920033101    0        0       0         0
# ./xipstat -rn
Destination      Gateway          Flags         Use       Port
132.148            132.148.0.2     IOB           0           0xFF
# ./xipstat -inv
132.148.0.2:
       Type             : X.25
       Connection    : in/out, on-demand, bound
       Inact.timer     : 240
       Port/PVC        : 0xFF/0
       DTE Rem/Loc: 999920033101/999920033102
       Facilities        :
       User data       : 204
# ./xipstat -rnv
132.148:
       Type               : IP
       Gateway          : 132.148.0.2
       Net mask         : 255.255.0.0 (0xffff0000)
       Metric              : 1

# ./xipix25 -r  132.148.0.2
# ./xiproute delete 132.148.0.0 132.148.0.2

# ./xipstat -in
Gateway          Remote DTE       Ipkts   Ierrs Opkts   Oerrs
# ./xipstat -rn
Destination      Gateway          Flags         Use       Port
```

Checking the Status of the EiconCard Adapter Board

You can determine the status of the EiconCard adapter board at anytime. Specifically, you can determine the port and memory segment addresses, the IRQ used, and if the communication protocols were downloaded.

To view the status of the EiconCard adapter board, enter the following at the "#" prompt:

```
/usr/lib/eicon/ecaddr
```

For example, the following display shows that there is one EiconCard adapter board and that the communications protocols were downloaded to it:

```
# /usr/lib/eicon/ecaddr
Card 0: HSI/PC       set        loaded    port 0380 segment c800 interrupt 03
Card 1: UNKNOWN not set  not loaded  port 0000  segment 0000  interrupt 00
Card 2: UNKNOWN not set  not loaded  port 0000  segment 0000  interrupt 00
Card 3: UNKNOWN not set  not loaded  port 0000  segment 0000  interrupt 00
```

Checking the Status of the X.25 Connection

This section describes how to determine the status of the X.25 connection. To view the status of the HDLC link-level connection, enter the following command at the "#" prompt:

```
/usr/lib/eicon/ecstats -hdlc
```

A successful connection occurs when both the *Line State* and *Protocol State* fields display "Connected."

To view the status of the X.25 packet-level connection, enter the following command at the "#" prompt:

```
/usr/lib/eicon/ecstats -x25
```

A successful connection occurs when the *Packet Level State* fields displays "Ready."

The commands presented above produce a "snapshot" of the current status. Therefore, continually repeating these commands provides you with an ongoing status. You can create a continuously looping script named *ecstats.sh* containing the following:

```
cd /usr/lib/eicon
while [ 1 ]
    do
        clear
        ./ecstats $1
        sleep 3
    done
```

Invoke this script by entering the following at the "#" prompt:

```
ecstats.sh [-hdlc,-x25]
```

To obtain a complete listing (a "trace") of all packets transmitted and received, along with other important X.25 link information, perform the following:

1. At the "#" prompt, enter the command:

   ```
   /usr/lib/eicon/ectrace -x25 -start -b 64000
   ```

   The command initializes a trace buffer on the EiconCard adapter board. A trace of the X.25 packets is stored into a 64-Kbyte buffer on the EiconCard adapter board. Note that the X.25 and 64000 parameters might contain different values. Once you enter this command, allow enough time for some data to be placed into the buffer.

2. To view the buffer, enter the following command at the "#" prompt:

   ```
   /usr/lib/eicon/ectrace -x25 | more
   ```

   The listing contains detailed information concerning the X.25 line traffic.

   To turn off the trace facility, enter the following at the "#" prompt:

   ```
   /usr/lib/eicon/ectrace -x25 -stop
   ```

Starting/Stopping the X.25 Connection

You can start and stop the X.25 connection either automatically or manually.

Automatic Method

When the IP Router for UNIX software was installed, it created startup and shutdown scripts and placed them in the appropriate directories. The following scripts automatically execute during normal UNIX multiuser startup (*init 2*) and shutdown:

- For startup: */etc/idrc.d/EtEC*
- For shutdown: */etc/idsd.d/EtEC*

Manual Method

You can also manually start and stop the X.25 link by using the following commands. You usually use these commands following an EiconCard or X.25 link reconfiguration using the command **/usr/lib/eicon/eccfg**.

- For shutdown, enter the following at the "#" prompt:
  /usr/lib/eicon/echalt -d 0
- For startup, enter the following at the "#" prompt:
  /usr/lib/eicon/ecload -v -d 0

After successful startup, the following messages display on the screen:

```
Self-test ok
Loading sndcf.img: 174
Card 0 port 0 status: ok
```

If the last message displays "Card 0 port 0 status: Modem not ready (no DSR)," check your modem cable connections.

Tuning TCP/IP Streams Configuration

The configuration for the streams portion of the TCP/IP Runtime System is not updated automatically during the installation of the IP Router software. Depending on the applications you use, the parameters associated with the stream buffers might require modification.

The streams configuration for the IP Router platform presented in this TechNote did not require modifications. To determine if your configuration requires modifications, perform the following steps:

1. Run the network applications that you will normally run. The longer you run these applications, the greater the amount of data you gather and the more accurate your sample data will be. Three days of data were gathered for the IP Router presented in this TechNote.

   The following displayed scenario was performed on the IP Router platform:

```
# crash
dumpfile = /dev/mem, namelist = /unix, outfile = stdout
> strstat
```

ITEM	CONFIG	ALLOC	FREE	TOTAL	MAX	FAIL
streams	160	42	118	949766	45	0
queues	864	196	668	1899546	208	0
message blocks	1845	101	1744	80031384	412	0
data block totals	1476	107	1374	51686443	410	0
data block size 4	296	14	282	45	15	0
data block size 16	296	1	295	2489713	2	0
data block size 64	296	16	280	41445011	242	0
data block size 128	264	63	207	7211419	161	0
data block size 256	136	13	123	1937	14	0
data block size 512	72	0	71	538317	1	0
data block size 1024	52	0	52	1	1	0
data block size 2048	52	0	52	0	0	0
data block size 4096	12	0	12	0	0	0

2. If no entries in the "Fail" column exceed zero, the configuration needs no modification and you can skip the rest of this section. However, if values greater than 0 are present, proceed to the next step.

3. For each entry in the "FAIL" column containing a value greater than zero, you must modify the stream buffers kernel parameter. While in the single-user mode, modify the parameter by entering the following at the "#" prompt:

   /etc/conf/cf.d/configure

4. From the main menu, select 11. *Streams Data*
5. Modify only the parameter(s) identified in Step 3 by incrementing the current value. Leave the remaining entries the same.
6. You must relink the kernel and restart it before the changes can take effect.
7. Repeat Steps 1 through 6 until the "FAIL" column contains only zero values.

Chapter 6
Removing the IP Router Components

This chapter describes the removal procedures associated with TCP/IP, COMPAQ 32-Bit NetFlex Controller and Driver, and the Eicon IP Router for UNIX software.

Removing the Eicon IP Router for UNIX Software

While in single-user mode, perform the following:

1. At the "#" prompt, enter

    ```
    custom
    ```

2. Select *Remove* from the menu.
3. Select *Eicon IP/X.25 Router*.
4. Select *Entire Eicon IP/X.25 Router Set.*
5. At the prompt, "Do you wish to continue?" select *Yes*.
6. At the prompt, "Do you want to remove the IP Router now?" enter

    ```
    y
    ```

    The remove script executes and the product is removed from the system.

7. At the prompt, "Do you wish to create a new kernel now?" enter

    ```
    n
    ```

8. Again, at the prompt, "Do you wish to create a new kernel now?" enter

   n

   NOTES: You must rebuild and reboot the kernel for the changes to take effect. To save time, we rebuild and reboot the kernel in a later section.

9. From the Custom menu, select *Quit* → *Yes*.

Removing the SCO TCP/IP Software

While in single-user mode, perform the following:

1. At the "#" prompt, enter

   custom

2. Select *Remove* from the menu.
3. Select *SCO UNIX System V Operating System* from the menu.
4. Select *Services*.
5. Select *SCO UNIX TCP/IP Runtime Services*.
6. At the prompt, "Do you wish to continue?" select *Yes*.

   The product remove script executes and the product is removed.

7. From the Custom menu, select *Quit* → *Yes*.

Removing the NetFlex Controller Driver

While in single-user mode, perform the following:

1. At the "#" prompt, enter

   ```
   custom
   ```

2. Select *Remove* from the menu.
3. Select *SCO UNIX System V Operating System* from the menu.
4. Select *Service Components*.
5. Select *COMPAQ Supplement*.
6. Select *CUCET*.
7. At the prompt, "Do you wish to continue?" select *Yes*.

   The product remove script executes and the product is removed.

8. At the prompt, "Do you wish to relink the Kernel at this time?" enter

   ```
   y
   ```

9. From the Custom menu, select *Quit* → *Yes*.

   NOTE: You must reboot the kernel for the changes to take effect. This occurs in the next section.

Removing the EiconCard Adapter Board

To remove the EiconCard adapter board, perform the following:

1. Shutdown UNIX by entering the following at the "#" prompt:

   ```
   shutdown -g0 -y
   ```

2. When the message "Save to Power Off" appears, turn off the COMPAQ ProSignia, and disconnect the AC power cord.
3. Loosen the thumbscrews on the rear panel, and remove the system side cover.
4. Remove the retaining screw securing the EiconCard adapter board in the slot.
5. Remove the EiconCard adapter board from the slot.
6. Replace the slot cover and secure it using the retaining screw.
7. Replace the cover on the COMPAQ ProSignia.
8. Reconnect the COMPAQ ProSignia AC power cord.

You may now reboot the system.

Appendix A
Acronyms

DCE	Data Circuit-Terminating Equipment
DSU	Digital Signaling Unit
DTE	Data Terminal Equipment
FTP	File Transfer Protocol
HDLC	High-level Data Link Control
HSI	High Speed Interface
LAPB	Link Access Procedure Balanced
MLP	Multi-Link Procedure
NA	Network Access
NIC	Network Interface Card
OSI	Open Systems Interconnection
PDN	Public Data Network
SDLC	Synchronous Data Link Control
SIMM	Single Inline Memory Module
SLP	Single Link Procedure
SMTP	Simple Mail Transfer Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol

Appendix B
Vendor Contact Information

Use the following information to contact the vendors referred to in this TechNote:

Eicon Technology Corporation
In the US:
14755 Preston Road
Suite 620
Dallas, TX 75240
Telephone: (214) 239-3270
Fax: (214) 239-3304

In Canada:
2196 - 32nd Avenue (Lachine)
Montreal, Quebec, Canada
H8T 3H7
Telephone (514) 631-2592
Fax: (514) 631-3092

In Europe:
Kingsway Business Park
Oldfield Road, Hampton
Middlesex TW12 2HD
United Kingdom
Telephone: 44(81) 941-7122
Fax: 44(81) 941-0548

SCO
400 Encinal Street
P. O. Box 1900
Santa Cruz, CA 95061-1900
Telephone: (408) 425-7222
(800) 726-8649

Compaq Computer Corporation
20555 SH 249
P. O. Box 692000 MC 13 01 02
Houston, TX 77269-2000
Telephone: (800) 345-1518

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