HN400 Provisioning and Troubleshooting Guide

HN4-TG030NN00

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HN400 Provisioning and Troubleshooting Guide
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Introduction

1

This document provides guidelines for provisioning and troubleshooting the Hatteras Networks™ HN400 family of Ethernet-over-copper delivery systems.

This chapter provides an introduction to the HN400 family of products. The HN400 products utilize the IEEE 802.3ah 2BASE-TL standard for transporting Ethernet over bonded voice-grade copper pairs, and provide an economic, robust method for extending traditionally optical Ethernet services over a copper infrastructure.

The HN400 system software supports the Hatteras Networks™ HN400 family of Ethernet-over-copper delivery systems. The HN400 products utilize the IEEE 802.3ah 2BASE-TL standard for transporting Ethernet over bonded voice-grade copper pairs, and provide an economic, robust method for extending traditionally optical Ethernet services over a copper infrastructure.

1.1. HN400 Family Product Overview

The HN400 products include the following models:

- HN408-CO and HN404-CO — eight- and four-pair devices designed to be installed in the central office (CO) or remote terminal (RT).
- HN408-CP, HN404-CP, HN408-CP-1E-I, and HN404-CP-1E-I — eight- and four-pair devices designed to be installed at customer premise (CP) locations.
- HN408-U and HN404-U — eight- and four-pair universal devices, designed to support universal installation in any CO, RT, or CP location - available with one or two 10/100 Mbps BASE-TX network interfaces
- HN418-U and HN414-U — eight- and four-pair universal devices, designed to support universal installation in any CO, RT, or CP location - provided with one optical 100BASE-X network interface and one 10/100 Mbps BASE-TX network interface

1.1.1 HN40x-CO Products

The *HN40x-CO* series of devices, which are designed for installation in a Central Office (Figure 1), includes the HN404-CP and the HN408-CP. The HN404-CP supports 2BASE-TL connections to a customer premises over one-to-four bonded voice-grade copper pairs; the HN408-CP supports 2BASE-TL over one-to-eight voice-grade bonded copper pairs.

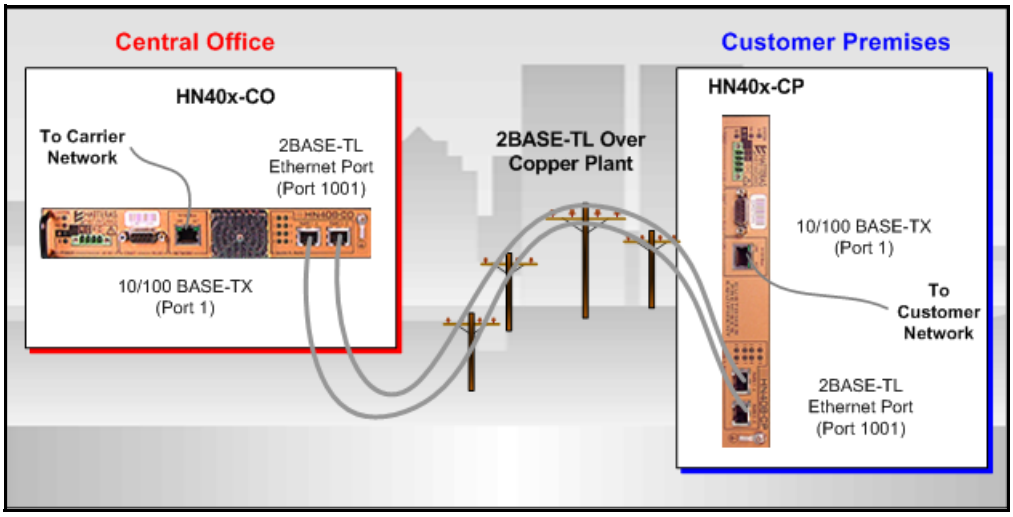

Figure 1 HN40x-CO and HN40x-CP Device Connections

1.1.2 HN40x-CP Products

The *HN40x-CP* series of devices are intelligent network-demarcation devices, designed to be installed at customer premises. The series includes the HN404-CP and HN408-CP in addition to the HN404-CP-1E-I and HN408-CP-1E-I.

The HN404-CP and HN404-CP-1E-I supports 2BASE-TL over one-to-four bonded voice-grade copper pairs; the HN408-CP and HN408-CP-1E-I supports 2BASE-TL over one-to-eight voice-grade bonded copper pairs.

The HN404-CP-1E-I and HN408-CP-1E-I products are functionally equivalent to the HN404-CP and HN408-CP, respectively, but are also compatible with the HN4xx-U. See Table 1-2 on page 1-4 for the product compatibility matrix.

1.1.3 HN4xx-U Products

The HN4xx-U series of universal devices are designed for installation in a CO, RT, or CP environment (Figure 2). These universal devices can be set to operate in either CO or CP mode by using the CLI's **config deviceMode** command.

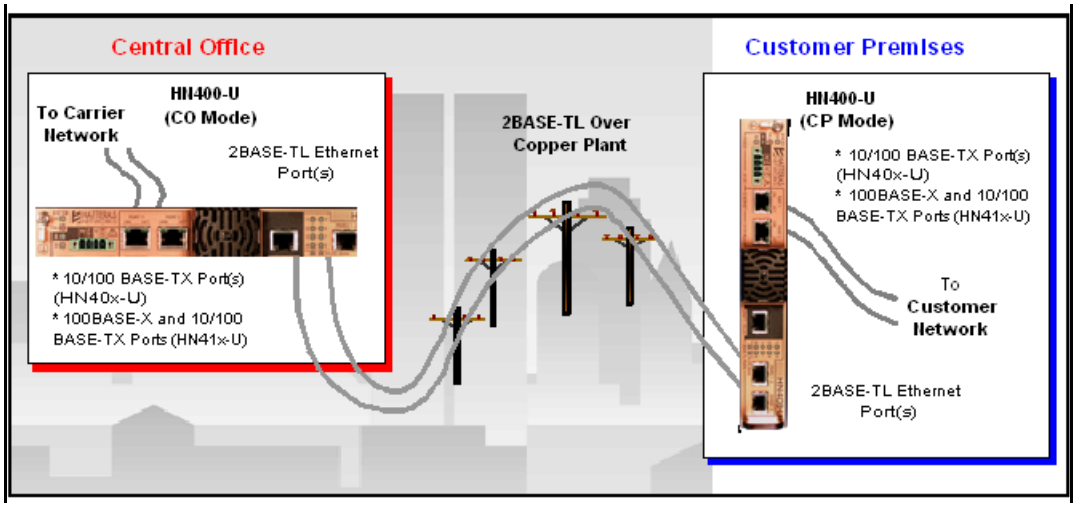

Figure 2 HN4xx-U Device Connections

Table 1-1 lists the HN4xx-U device models with their 2BASE-TL and network interface capabilities.

Table 1-1 HN4xx-U Models

Model	Model Abbreviation	2BASE-TL Connections	Network Interfaces
HN404-U-2E-I	HN404-U	One-to-four	Two 10/100 Mbps BASE-TX
HN408-U-2E-I	HN408-U	One-to-eight	Two 10/100 Mbps BASE-TX
HN414-U-2E-I	HN414-U	One-to-four	One optical 100BASE-X and one 10/100 Mbps BASE-TX
HN418-U-2E-I	HN418-U	One-to-eight	One optical 100BASE-X and one 10/100 Mbps BASE-TX

These HN4xx-U models differ from the HN40x-CO and HN40x-CP models in the following ways:

- An HN4xx-U is software configurable to operate as a CO or CP device — one piece of hardware can serve both roles.
- The HN4xx-U has two 10/100BASE-T ports or one 100BASE-X port and one 10/100BASE-T ports. The HN40x-CO and HN40x-CP each have a single 10/100BASE-T port. In this release, port 2 of HN4xx-U devices can be used only as an out-of-band management port.

- ❒ The HN4xx-U has a RJ-45 serial interface for local configuration and management. The HN40x-CO and HN40x-CP have a DB9 serial interface.

- ❒ The HN4xx-U operates from a -48 VDC power source regardless of operating mode, but has an optional external AC/DC power module for AC powered deployments. The HN40x-CO is -48 VDC powered only, the HN40x-CP is AC powered only.

- ❒ The HN4xx-U supports the enhanced rates (up to 5.7 Mbps per pair) of 2BASE-TL and G.991.2.bis (E-SHDSL), with over 45 Mbps possible on eight bonded pair. The HN40x-CO and HN40x-CP devices do not yet support the E-SHDSL rates.

The HN4xx-U extends the HN400 product family by introducing a single product that can serve either as a CO or CP depending on configuration, and by offering an additional 10/100BASE-T port to serve multiple customers or as an out-of-band management facility. The entire HN400 product family provides a variety of models and capabilities to serve the needs of any customer.

1.1.4 Product Compatibility

Table 1-2 shows the product compatibility matrix for the HN400 and HN4000 products.

Table 1-2 Product Compatibility

A Device Installed at CO...	Connects to These Devices at a CP...
HN404-CO, HN408-CO, HN4000	• HN404-CP • HN408-CP
HN404-U-2E-I, HN408-U-2E-I, HN414-U-2E-I, HN418-U-2E-I, HN4000-I	• HN404-U-2E-I • HN408-U-2E-I • HN414-U-2E-I • HN418-U-2E-I • HN404-CP-1E-I • HN408-CP-1E-I

1.2. The Hatteras Networks Provisioning Utilities

The Hatteras Networks' Access Class Ethernet system includes the following methods to provision and monitor services and network connectivity.

- a Command Line Interface (CLI)
- a Web-browser based Element Management System (EMS)
- a Web-browser based GUI (WebManager)

1.2.1 CLI

The Command Line Interface (CLI) tool enables operators to perform similar provisioning and management functions by using commands that are structured in a familiar CLI format. Operators can use the CLI commands through a telnet session or by making a direct connection to an HN400 platform through a serial port.

Note: This *HN400 Provisioning and Troubleshooting Guide* provides configuration examples that use the CLI interface. For examples of configuring an HN400 platform with the HN EMS, refer to the *HN EMS Installation and User Guide*.

1.2.2 EMS

The Hatteras Networks Element Management System (the HN EMS) is a scalable carrier-class EMS, accessible through a Web browser. The HN EMS enables network operators to provision, operate, and diagnose Hatteras Networks' devices that are in their access network.

1.2.3 WebManager

As part of the Total Management Solution, the Hatteras Networks' WebManager provides an intuitive, easy-to-use Web-accessible GUI for rapid point-and-click provisioning and maintenance. With WebManager, craft personnel can use a Web browser to access the extensive OAM&P capabilities of Hatteras Networks' devices.

The embedded WebManager Web server provides a point-and-click interface that can be accessed from any computer, and provides a fast graphical interface to all management functions. With service wizards and graphical views, even novice personnel can quickly and accurately manage and provision device services.

Provisioning Guidelines

2

This chapter is designed to provide a network installer with the procedures and guidelines that are needed to turn up an HN40x-U, HN40x-CO, or HN40x-CP. These procedures are what the network installer should accomplish after having completed all the steps in the Hatteras Networks hardware installation guides.

The HN40X-U is a "universal" device that can be configured via software to operate in either CO mode or CP mode. In this document, any reference to the HN40x-CO also applies to an HN40x-U that has been configured to operate in CO mode. Similarly, any reference to the HN40x-CP also applies to an HN40X-U that is configured as to operate in CP mode.

2.1. Determining Loop Length

The copper loops are a very important part of the Ethernet over Copper solution and special consideration needs to be given to them during HN40x installation and provisioning. Prior to terminating the cooper loops on an HN40x-CO, there are several tasks that need to be performed. The first task is to determine the length of the copper loops.

2.1.1 Using Circuit Records

The circuit records may provide information about the make up and length of the copper loops. If Circuit Layout Records (CLR) or Design Layout Records (DLR) records are available, record the AWG and length of each segment of the copper loop in Table 2-1.

Table 2-1 Circuit Record Information

Loop Segment	AWG of Wire	Length (feet)	Gage Factor	EWL (feet)
1				
2				
3				
4				
5				
Total				

The following equation is used to calculate the Equivalent Working Length (EWL), a length of 26 AWG cable with attenuation approximately equal to that of the copper loop:

```
EWL = (1.00)*L26 + (0.75)*L24 + (0.60)*L22 + (0.40)*L19
```

L26 is the total length of 26 AWG wire, L24 is the total length of 24 AWG wire, L22 is the total length of 22 AWG wire, and L19 is the total length of 19 AWG wire. The resulting EWL is the equivalent working length for 26 AWG wire. The gage factor is 1.00 for 26 AWG wire, .75 for 24 AWG wire, .60 for 22 AWG wire, and .40 for 19 AWG wire.

These values are used in the table above and the equation is used to calculate the EWL of the copper loops. Fill in the Gage Factor and calculate the EWL of the loop using the equation shown above.

2.1.2 Using a Test Set

If these circuit records are not available, then the circuit length must be determined by using a metallic test set such as the following:

- Manufacturer: Sunrise Telecom
- Product: SunSet MTT (hand-held unit with one module)
- Module: G.SHDSL/HDSL2 Module (SSxDSL-14)

The test set has the capability of three methods to determine the length of the copper loops, as described in the following sections.

2.1.2.1 TDR Method

The Time Domain Reflectometer (TDR) function of the test set operates on the principle that impedance changes on a transmission line cause reflection of electrical energy. The TDR launches an electrical pulse at one end of the copper pair and then “listens” for reflections, especially for reflections from the far end of the copper pair.

The TDR may also be used to find common faults associated with the copper pair. Table 2-2 lists some of these common faults and their appearance on the TDR screen.

Table 2-2 Common TDR Faults

Fault	Appearance on TDR	Effect on Service
Bridge Tap	Down spike followed by upwards bump	Degraded performance
Load Coil	Upwards bump	Prevent communications
Open Pair	Upwards bump	Prevent communications
Shorted Pair	Down spike	Prevent communications
Split Pair	Down spike or up spike	Degraded performance

Use the TDR function to determine the TDR length of the copper loop and record the results in the Table 2-3 on page 2-3.

2.1.2.2 Capacitance Length Method

The capacitance length method uses the fact that a cable pair has a capacitance of 83 nF per mile. The test set measures the total capacitance of the copper pair and the result is divided by this value to obtain the capacitance length of the copper pair.

Use the "AUTOTEST" or manual test mode of the test set to determine the capacitance length of the copper loop and record the results in Table 2-3 on page 2-3.

2.1.2.3 Resistance Length Method

The resistance length method requires access to the far end of the copper pair. If access is not available to the far end of the copper pair, skip this test. If access to the far end of the copper pair is available, short the "tip" wire to the "ring" wire of the copper pair.

Use the "AUTOTEST" or manual test mode to measure the resistance (in ohms) from the "tip" wire to the "ring" wire. The resistance of copper wire is:

- 88.0 ohms per 1000 feet for 26 AWG wire (for SEALPIC cable)
- 54.5 ohms per 1000 feet for 24 AWG wire (for SEALPIC cable)

The length of the cable is calculated using the following formula:

- L = (Total Resistance / 88.0) for 26 AWG wire, or
- L = (Total Resistance / 54.5) for 24 AWG wire.

At the conclusion of this test, be sure to "un-short" the tip and ring wires at the far end of the copper pair. Use a VOM or other test set to determine the resistance length of the copper loop and record the results in the table below. The resistance method of determining the loop length may be inaccurate if the composition of the copper loop consists of a mix of wire gauges.

2.1.3 Summary of Length Measurement Method

Record the three length calculations in Table 2-3.

Table 2-3 Length Calculations

Length Measurement Method	Length (feet)
TDR Method	
Capacitance Method	
Resistance Method	

These values should be fairly close to each other. If they are not, then the copper pair may have bridge taps and or load coils on it or there may be a wire-gauge change in the copper pair. If agreement on the copper loop length is not reached, manual investigation of the copper loop may be required.

Finally, convert the copper pair length to a 26 AWG cable Equivalent Working Length (EWL) using the formula provided on page 2-2.

2.2. Determining an “Operating Point”

The final step is to determine the rate that you should be able to achieve on the copper pair. Using the EWL that you determined in the previous section and the “**crosstalkoffset**” value that you intend to use (-3 dB is the default and complies most closely with the ANSI T1.417 deployment guidelines), determine the rate that you should be able to achieve using the black line on the rate/reach curve shown in Figure 2-1.

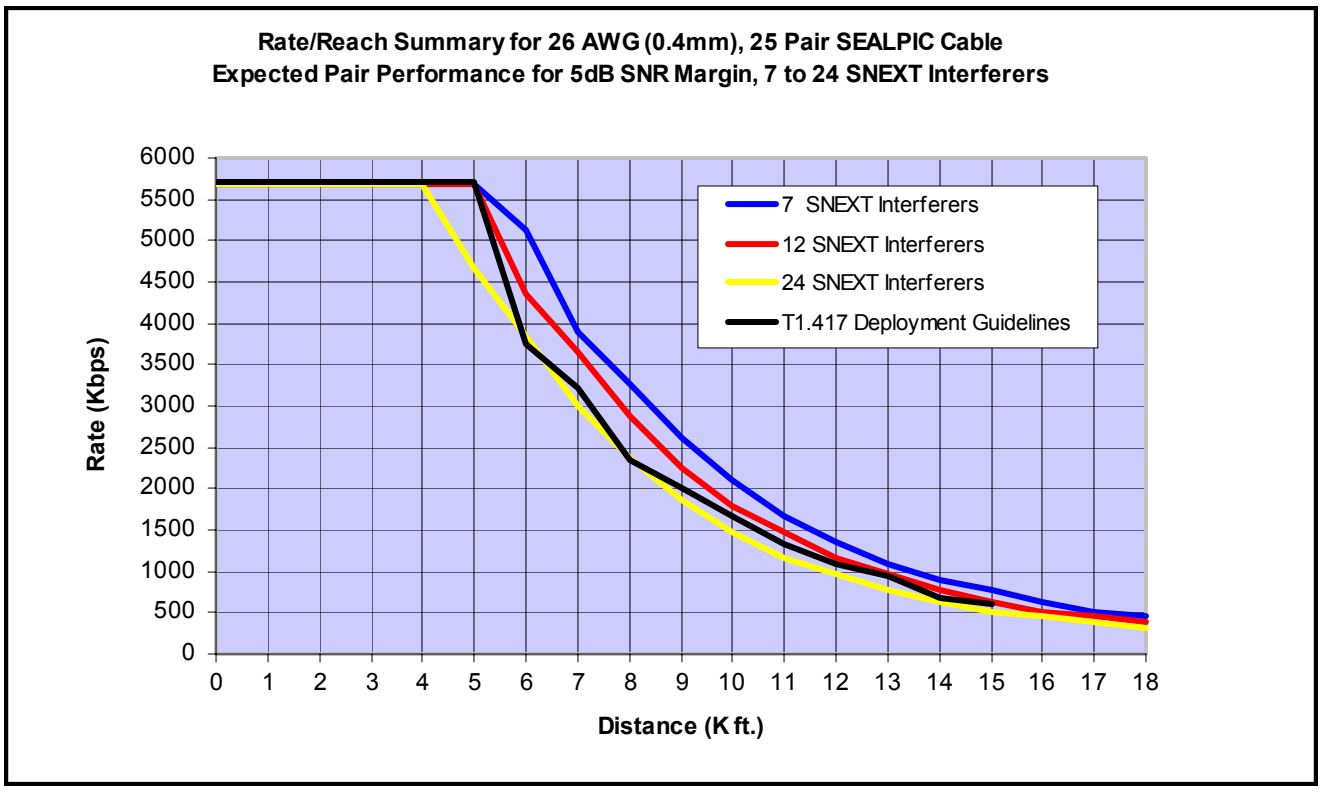

Figure 2-1 Rate/Reach Curves

For example, if you determined that the EWL is 11,000 feet, then the achievable rate is approximately 1.28 Mbps per pair.

If the actual rate that you achieve when you power up the HN400 software link varies from this value, you may have to make some adjustments as described in the PME section below.

The operating point may also be determined by using the Hatteras Networks Rate Reach calculator.

2.3. Things To Do and Check After Completing The Hardware Installation

After you complete the hardware installation of the linked HN40x-CO (in the CO, POP, RT, or CEV) and the HN40x-CP on the customer premise, perform and or check the following items:

1. Connect the 10/100BASE-TX Ethernet port on the HN40x-CO at the CO to the carrier Ethernet switch.
2. Connect the 10/100BASE-TX Ethernet port on the HN40x-CP at the customer premise to the customer premise Ethernet switch, IAD, etc.
3. Connect the HN40x-CO at the CO copper pair cables to the carrier MDF or 66 blocks.
4. Connect the HN40x-CP at the customer premise copper pair cables to the customer premise 66 blocks or other copper pairs termination connection.
5. Check to make sure all mounting screws are tight.
6. Check to make sure all cables are completely plugged in and latched securely.
7. Route, dress, and tie down all cables.
8. After the HN40x-CO link is powered up and copper loop connectivity is completed, observe the LEDs for the following conditions:

Table 2-4 LED Status

LED	Expected Status
OK	Green (constant)
Fail	Off
Power A	Green (constant)
Power B	Green (constant)
10/100BASE-TX Link	Green (constant)
10/100BASE-TX Activity	Green (blinking for traffic)
PME	Green (blinking slow)
CPE Mode	Amber (constant for CPE) Off (for CO)

If the LEDs are in any status other than the ones shown in the table above, refer to Chapter 1: Troubleshooting Guidelines or the installation manual to determine the problem and corrective action.

2.4. Provisioning Ethernet Ports

An HN40x 10/100BASE-TX Ethernet ports' default configuration is set for auto-negotiation. In most cases this setting works well and these ports are able to achieve maximum compatibility. In some cases auto-negotiation will not produce optimal results. Throughput may seriously be affected if these Ethernet ports auto-negotiate half duplex or 10 Mbps where they should negotiate full duplex and or 100 Mbps.

Use the **show ethernet 1** and **cpe show ethernet 1** commands to display the device's Ethernet information. If you determine that the Ethernet ports have not achieved optimal duplex setting or rate, change the **autonegotiate** parameter to disable and manually set the duplex and speed to the correct values. You may also have to perform this same operation on the Ethernet switch that the HN40x-CO is connected to and to the device (Ethernet switch, IAD, router, etc.) that the HN40x-CP is connected to at the customer premise.

The Ethernet 1 port on the HN40x-CO can be assigned an IP address either manually or via DHCP (with the **config ip 1** command). Ethernet 1 port on the HN40x-CP can also be optionally assigned an IP address either manually or via DHCP (from the HN40x-CO with the **cpe config ip 1** command).

To verify device connectivity, ping from an HN40x-CO to an Ethernet switch to which it is connected or to some other host or port on the carrier network. You can also ping from the HN40x-CP Ethernet 1 port to a host or port on the customer's network if an IP address has been assigned to Ethernet 1 port on the HN40x-CP.

Traffic in both directions should be verified by examining the Ethernet 1 port statistics for both the HN40x-CO and the HN40x-CP.

2.5. Provisioning 2BPME Ports (Copper Pairs)

The copper pair ports on the Hatteras Networks products are called 2BASE-TL Physical Media Entity (2BPME) ports. These ports automatically handshake, train, optimize, activate, and bond together based on the parameters dictated by the product's span profile. After the copper pairs have completed activation and bonding, the green 2BPME LEDs should be slowly blinking green. The slow blinks represent OAM packets that are periodically sent from the HN40x-CO to the HN408-CP and vice versa.

The **show 2bmpe *** command displays a device's line rate (speed), SNR margin, and loop attenuation of the copper pair. Compare the line rate of the copper loops with the operating point on the rate/reach curve that you determined in the section"Determining an "Operating Point"" on page 2-4. If the achieved rate varies significantly from the operating point rate, then

there may be a problem with the copper loop and the parameters of its span profile may need adjustment.

If the upstream and downstream target SNR margin specified by the span profile is 5 dB, then the upstream and downstream SNR margins that the **show 2bpme *** command displays should be approximately 5 dB or higher. If they are less than 4 dB, the span profile for that copper pair must be changed in order to set the target SNR margin higher.

The **show 2bpme *** command also shows the loop attenuation, which is dependent on the length of the copper loop, wire gauge, and many other factors. This value should be checked for consistency with the other copper pairs loop attenuation, assuming that all the other copper loops are somewhat identical.

The command **show pmstats * numintervals 2** will provide counters of errored seconds (ES), CRC anomalies (CRC), severely errored seconds (SES), loss of sync word seconds (LOSWS), and unavailable seconds (UAS) for the current 15 minutes or fraction thereof and the previous 15 minutes. If the copper loop is accumulating CRC anomalies at a significant rate, then the SNR margin of the copper loop will have to be increased incrementally until the CRC anomalies drop to an acceptable level.

It is a good practice to set threshold crossing alerts (TCA) for the SNR margin, loop attenuation, and CRC anomalies for each copper pair. This is accomplished via the span alarm profiles (using the **create spanAlarmProfile** and **config spanAlarmProfile** commands). The SNR margin TCA should be set at 2 dB, which is the default retrain SNR margin. The loop attenuation TCA should be set at 5 dB above the highest measured loop attenuation. The CRC anomalies TCA should be set at a fairly large number such as 10,000 or 50,000.

Provisioning Alarms

After the HN40x-CO and HN40x-CP are placed in service there may be some standing alarms that are current. Use the **show alarm *** command to list these alarms. It is good practice to clear these initial standing alarms. The most common standing alarms and the procedure to clear them described in the following sections.

2.5.1 CPE Power B Alarm

The HN40x-CP may be dual powered (with both A and B power feeds), but it is fairly unusual for the B power feed to be connected by itself. Most CPE installations utilize only one power feed and it is usually connected to the A power feed. The standing alarm will show that the HN40x-CP B power feed is not connected and therefore in alarm. The **cpe config env pwrAAlarm suppress** command will suppress this alarm.

2.5.2 2BPME Alarms

The 2BPMEs that are not connected to copper loops will also produce standing alarms. These alarms may be cleared by administratively disabling the unused copper ports. The commands **config 2bpme n admin disable** and **cpe config 2bpme n admin disable** will clear these alarms.

Any other standing alarms should be cleared if possible.

2.6. Provisioning Event Logs

The HN40x-CO and in the HN40x-CP devices maintain event logs. These event logs are circular files that hold up to 4080 entries. Only events and alarms are written to an event logs if its priority is equal to or higher than the configured priority threshold in the event log.

It is good practice to change the priority threshold of the port and BPM device modules from **notify** to **info** for both the HN40x-CO and the HN40x-CP event logs. This will cause many more events to be written to the event logs regarding the Ethernet and copper ports than normally would be; however, in the event of a problem, it will provide much more information to analyze and debug the problem. After the first few weeks of operation, the threshold settings can be changed back to their default values.

After the initial installation and turn up of the HN40x-CO and the HN40x-CP, both event logs should be cleared to provide the network operator with a known starting point and an empty event log for the equipment.

2.7. Provisioning Statistics and PM

There are three sets of statistics and one set of PM data that are supported by the HN40x-CO and the HN40x-CP. The statistics include Ethernet port statistics for Ethernet port 1, Ethernet port 1001, CPE Ethernet port 1, and CPE Ethernet port 1001, OAM statistics for the IEEE 802.3ah OAM channel between the HN40x-CO and the HN40x-CP, and 2BPME statistics for the copper ports both upstream and downstream. The PM data consists of the same data as the 2BPME statistics except it is accumulated and presented in the current and previous 15-minute buckets.

After the initial installation and turn up of the HN40x-CO and the HN40x-CP, it is a good practice to clear all of these statistics. The PM data cannot be cleared, but the initial turn up errors will roll out of the current and previous 15-minute buckets after 30 minutes have elapsed.

2.8. Provisioning the Clock

An HN40x device's clock should be correctly set either manually or by configuring a SNTP server so that the events in the event log and alarms will be time stamped with the correct time. The command **config clock tod "12/10/2004 10:14:00"** can be used to manually set the clock. Be sure to put quotation marks at the beginning and end of the date and time to execute the command successfully.

The Coordinated Universal Time (UTC) offset should also be configured. The command to set the clock to Eastern Standard Time (EST) is:

```
config clock utcoffset -4
```

It is better to set a SNTP server if one is available to configure the date and time of the HN40x-CO. To determine if a SNTP service is available, execute the command **net time /DOMAIN**

from the command prompt of a PC on the network. If a SNTP server is reachable, the command will return the DNS-resolved name of that server. You may have to use the command **ping www.sntp.com** to resolve the name of the SNTP timeserver to an IP address.

Provisioning Descriptions

There are several descriptions and data that should be input to the Hatteras Networks equipment. The most important ones that can be added using the **config sys** command are listed in Table 2-5.

Table 2-5 Device Descriptions

Keyword/Argument	Description
hostName	This field is the name of the system. It is used in TL1 as Source Identifier (SID) and in SNMP as **sysName**.
location	This field is used for the address of the location where the equipment is located.
contact	This field is used for the name and telephone number(s) of the primary contact person for the equipment.
prompt	This field changes the default CLI prompt to a new prompt. It is convenient to give each piece of equipment a unique prompt.
clli	This field is the Common Language Location Identifier (CLLI) code for the location where the equipment is installed.
description	This field is used to add a description of the equipment or location that may be helpful to the network operator.
additionalInfo	This field is used to add any additional information that is not covered under any other field

The other important descriptions to add are circuit numbers or other identifiers for the copper loops. The command to add these descriptions is **config 2bpme *n* description**. The description may contain up to 64 characters. Use quotes around the text string if it contains spaces.

Troubleshooting Guidelines

3

Hatteras Networks equipment supports testing, diagnostic, and troubleshooting capabilities, which can be accessed either locally from the craft port or remotely using in-band or out-of-band management.

Hatteras Networks equipment has a full range of monitoring and diagnostic capabilities at multiple network layers. The diagnostic capabilities can be categorized into monitored information, reporting capabilities, and diagnostic operations.

3.1. *Monitored Information*

Hatteras Networks equipment maintains a large amount of information specifically designed for troubleshooting and diagnostic purposes. The equipment supports a variety of physical and layer two statistics to help the network operator troubleshoot problems.

Loop attenuation measurement – The equipment can display a real time measurement of the copper loop attenuation both upstream and downstream for all loops simultaneously in dB.

SNR margin measurement – The equipment can display a real time measurement of the SNR margin of the copper loops both upstream and downstream for all loops simultaneously in dB.

Temperature measurement – The equipment can display a real time measurement of the HN40x-CO equipment and all the attached HN40x-CP equipment temperature in degrees C and degrees F.

Ethernet Layer Statistics – The Hatteras HN40x-CO equipment can display detailed counters for all Ethernet ports including HN40x-CO and HN40x-CP Ethernet ports for unicast frames, broadcast frames, transmit octets, received octets, frames of different sizes, dropped frames, etc.

Performance Monitoring Buckets – The equipment collects and stores the current 15-minute bucket and the previous15-minute buckets for errored seconds (es), severely errored seconds (ses), CRC anomalies (crc), loss-of-sync-word seconds (losws), and unavailable seconds (uas) for both upstream and downstream traffic on the copper loops.

Performance Monitoring Statistics – The equipment collects and stores cumulative counters for errored seconds (es), severely errored seconds (ses), CRC anomalies (crc), loss-of-sync-word seconds (losws), and unavailable seconds (uas) for both upstream and downstream traffic on the copper loops.

Port Status Statistics – The equipment can display the status of all ports and entities in real time including active NIUs, failed, NIUs, which pairs are used, etc.

Logical/Service Layer Statistics – The equipment (HN4000 or HN408-U only) can display statistics such as octets accepted into the service, octets rejected to due exceeding configured policer, etc.

Forwarding Information – The equipment can display forwarding information including an ARP table, MAC learning tables etc. (HN4000 and HN408-U only).

Event Logs – The equipment stores an event log and a boot log that may be analyzed to diagnose and trouble-shoot problems.

Audit Logs – The equipment tracks which users change or access which management objects.

Boot Logs – The equipment records information regarding the booting up process and stores it in the boot log.

Tech Support Information – The equipment has the capability to display a list of technical support information. This information can be captured via a terminal session using the "show tech-support" command and emailed to Hatteras technical support for further analysis.

3.2. Reporting Capabilities

The Hatteras Networks equipment supports a variety of reporting capabilities the help the network operator troubleshoot problems.

Alarms – The equipment reports alarms via CLI, TL1 and or SNMP. Current alarms may also be queried via the CLI. Alarm severities are configurable.

SNMP Notifications – The equipment reports alarms, events, traps, notifications, errors, and information to one or more SNMP hosts.

TL1 Notifications – The equipment reports alarms, events, traps, notifications, errors, and information via TL1.

IEEE 802.3ah OAM Reporting – The Hatteras HN40x-CP equipment reports alarms, events, traps, notifications, errors, and information via the IEEE 802.3ah OAM channel to the Hatteras HN40x-CO equipment.

Threshold Crossing Alerts (TCA) – The equipment supports configurable threshold crossing alerts for loop attenuation (dB), SNR margin (dB), errored seconds (seconds), severely errored seconds (seconds), CRC anomalies (number), loss-of-sync-word seconds (seconds), and unavailable seconds (seconds) for each copper loop.

Minimum Rate Alarm – The equipment will generate an alarm if the combined rate of the bonded group falls below a set threshold.

Alarm IO Port – The HN4000 only supports and alarm IO port that has two outputs (major alarm and critical alarm) and one input (user definable alarm).

Event Log FTP – The equipment supports exporting the event log via FTP for off line inspection.

Test Alarm – The equipment can send a test alarm trap to a SNMP host and a clear alarm message to the SNMP host to test the alarm connectivity of the equipment.

3.3. Diagnostic Capabilities

The equipment supports a variety of diagnostic capabilities to help the network operator troubleshoot problems.

Ethernet Loopback – The equipment can send a loopback command to the HN40x-CP equipment in order to put the HN40x-CP equipment's 2BASE-TL Ethernet port into a loopback condition where all incoming traffic received is transmitted back in the direction it came from. The Hatteras HN40x-CO equipment can also send a "clear" command to the Hatteras HN40x-CP equipment to remove the loopback. The looped back traffic may be dropped or optionally forwarded at the Hatteras HN40x-CO equipment.

Ethernet Layer 2 Ping – The equipment can generate a layer 2 ping toward the Hatteras HN40x-CP equipment and the Hatteras HN40x-CP equipment can reply to the layer 2 ping.

IP Ping – The equipment (both HN40x-CO and HN40x-CP) can generate an IP ping and reply to an IP ping.

IP Traceroute – The equipment (both HN40x-CO and HN40x-CP) can originate the IP traceroute command and display its results.

MLT Test Port – The HN4000 only supports two MLT test ports (in and out). A test set may be connected to this MLT test port and this test set may be connected to any of the copper pairs terminated on the HN4000 via an internal cross-connect. The test set may then be used to conduct either a TDR and or a G.SHDSL test on the copper loop.

3.4. Troubleshooting Using Device Indicators

The HN400 family of Ethernet-over-copper products provide LEDs that provided valuable information in troubleshooting situations. The following sections describe the basic trouble-shooting steps for the three HN400 products:

- "HN40x-CO" on page 3-4
- "HN40x-CP" on page 3-6
- "HN4xx-U" on page 3-8

3.4.1 HN40x-CO

Table 3-1 summarizes the HN40x-CO troubleshooting steps. Figure 3-1 describes the LEDs and connectors that are located on the device's front panel.

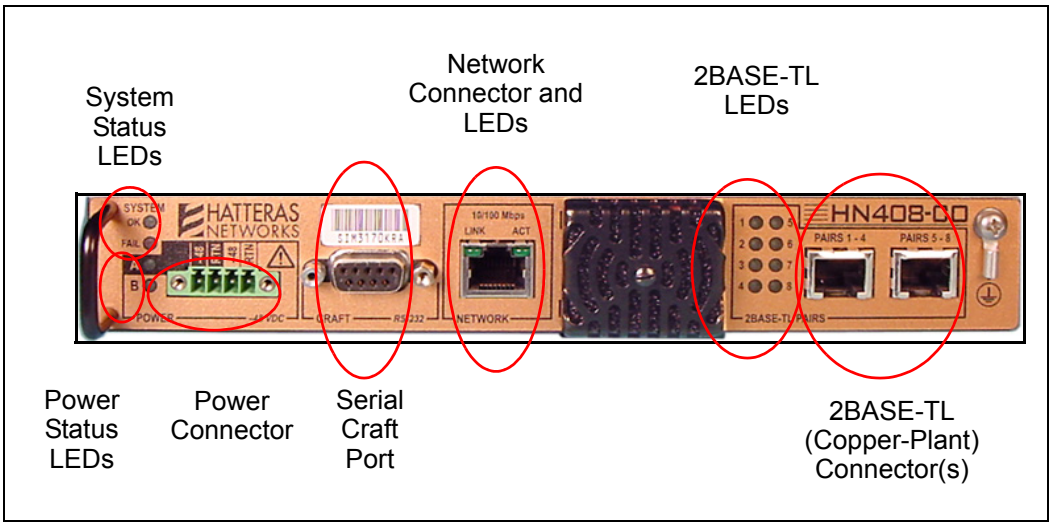

Figure 3-1 HN40x-CO Device Connectors and LEDs

Table 3-1 HN40x-CO Troubleshooting Steps

Condition	Solution
All front-panel LEDs are off.	1. Verify that the device is receiving -48 VDC power. 2. Verify that the power cable is wired correctly (see "Connecting -48 VDC Power" on page 3-5). 3. If only one power source is being used, switch the power cables to the connection that is not in use (for example, to the "B" connection if the "A" connections are being used. 4. Replace the device with a unit known to be in proper working condition.

Table 3-1 HN40x-CO Troubleshooting Steps (Continued)

Condition	Solution
The red System FAIL LED is on.	In normal operation, the system FAIL LED will blink on and off immediately after the device is powered up (while the device runs its self-test diagnostics). If the system FAIL LED is on after diagnostics have run, it indicates that the device has detected a hardware problem. 1. Remove power from the device and power it back up. 2. Replace the device with a unit known to be in proper working condition.
One or more of the numbered 2BASE-TL LEDs are off.	In normal operation, a numbered 2BASE-TL LED will be off if there is no copper pair connected to the port (or if a copper pair is connected at the port but is not terminated at an operational remote device). If a numbered 2BASE-TL LED is off when a copper pair is connected: 1. Verify that the copper pairs are terminated at an operational remote device. 2. Verify that the copper pairs are wired correctly in the copper-pair CAT 5 cable. Refer to "Connecting the Copper-Plant Pairs to the HN40x-CO" on page 3-10 for wiring information.
The Network LINK LED is off.	In normal operation, the Network LINK LED is on when a link is detected between the HN40x-CO and a remote device. 1. Verify that the CAT 5 cable is connected properly to a 10/100 Mbps port on an operational Ethernet device.
The Network ACT LED is off.	In normal operation, the Network ACT LED blinks when the device detects traffic on the Network port. If the Network ACT LED is off and the Network LINK LED is on: 1. Verify that there is Ethernet traffic on the network connection.

3.4.2 HN40x-CP

Table 3-2 summarizes the HN40x-CP troubleshooting steps. Figure 3-2 shows the location of the device's LEDs and connectors.

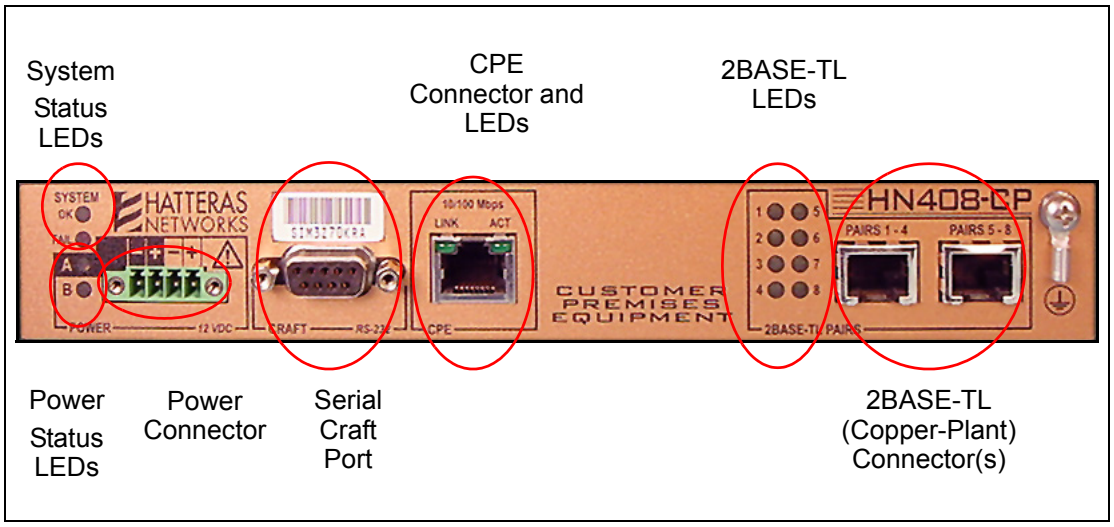

Figure 3-2 HN40x-CP Device Connectors and LEDs

Table 3-2 HN40x-CP Troubleshooting Steps

Condition	Solution
All front-panel LEDs are off.	1. Verify that the device is receiving 12 VDC power. 2. Verify that the power cable is wired correctly (see "Connecting the HN40x-CP's Power Module" on page 3-7). 3. If only one power source is being used, switch the power cables to the connection that is not in use (for example, to the "B" connection if the "A" connections are being used. 4. Replace the device with a unit known to be in proper working condition.
The red System FAIL LED is on.	In normal operation, the system FAIL LED will blink on and off immediately after the device is powered up (while the device runs its self-test diagnostics). If the system FAIL LED is on after diagnostics have run, it indicates that the device has detected a hardware problem. 1. Remove power from the device and power it back up. 2. Replace the device with a unit known to be in proper working condition.

Table 3-2 HN40x-CP Troubleshooting Steps (Continued)

Condition	Solution
One or more of the numbered 2BASE-TL LEDs are off.	In normal operation, a numbered 2BASE-TL LED will be off if there is no copper pair connected to the port (or if a copper pair is connected at the port but is not terminated at an operational remote device). If a numbered 2BASE-TL LED is off when a copper pair is connected: 1. Verify that the copper pairs are terminated at an operational remote device. 2. Verify that the copper pairs are wired correctly in the copper-pair CAT 5 cable. Refer to "Connecting the Copper-Plant Pairs to the HN40x-CP" on page 3-13 for wiring information.
The CPE LINK LED is off.	In normal operation, the CPE LINK LED is on when a link is detected between the HN40x-CP and a remote device. 1. Verify that the CAT 5 cable is connected properly to a 10/100 Mbps port on an operational Ethernet device.
The CPE ACT LED is off.	In normal operation, the CPE ACT LED blinks when the device detects traffic on the Network port. If the CPE ACT LED is off and the CPE LINK LED is on: 1. Verify that there is Ethernet traffic on the network connection.

3.4.3 HN4xx-U

Table 3-3 summarizes the HN40x-U troubleshooting steps. Figure 3-3 describes the LEDs and connectors that are located on the devices' front panels.

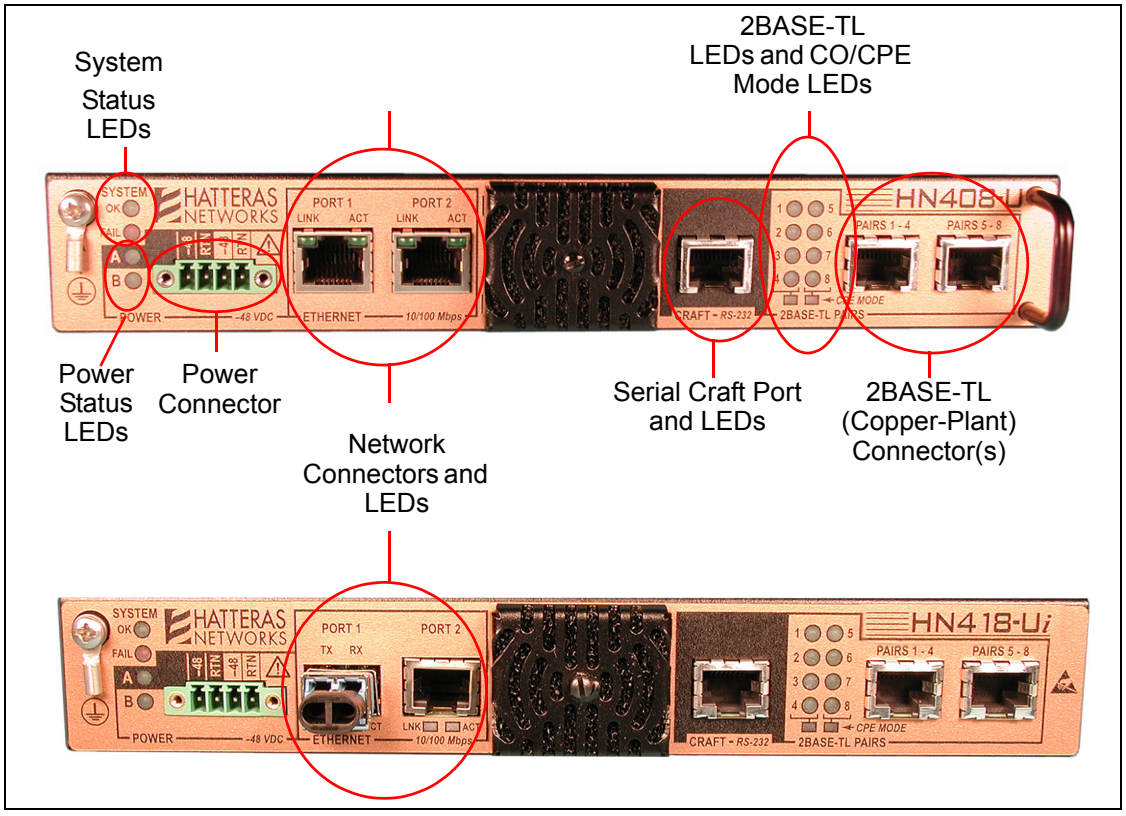

Figure 3-3 Device Connectors and LEDs (HN408-U Top and HN418-U Bottom)

Table 3-3 HN400 software Troubleshooting Steps

Condition	Solution
All front-panel LEDs are off.	1. Verify that the device is receiving -48 VDC power. 2. Verify that the power cable is wired correctly (see "Connecting -48 VDC Power" on page 3-14). 3. If only one power source is being used, switch the power cables to the connection that is not in use (for example, to the "B" connection if the "A" connections are being used. 4. Replace the device with a unit known to be in proper working condition.
The red System FAIL LED is on.	In normal operation, the system FAIL LED will blink on and off immediately after the device is powered up (while the device runs its self-test diagnostics). If the system FAIL LED is on after diagnostics have run, it indicates that the device has detected a hardware problem. 1. Remove power from the device and power it back up. 2. Replace the device with a unit known to be in proper working condition.

Table 3-3 HN400 software Troubleshooting Steps (Continued)

Condition	Solution
One or more of the numbered 2BASE-TL LEDs are off.	In normal operation, a numbered 2BASE-TL LED will be off if there is no copper pair connected to the port (or if a copper pair is connected at the port but is not terminated at an operational remote device). If a numbered 2BASE-TL LED is off when a copper pair is connected: 1. Verify that the copper pairs are terminated at an operational remote device. 2. Verify that the copper pairs are wired correctly in the copper-pair CAT 5 cable. Refer to "Connecting the Copper-Plant Pairs to the HN400-U" on page 3-23 for wiring information.
The Network LINK LED is off.	In normal operation, the Network LINK LED is on when a link is detected between the HN400 software and a remote device. 1. For HN40x-U devices, verify that the CAT 5 cable is connected properly to a 10/100 Mbps port on an operational Ethernet device. 2. For HN4xx-U (optical) devices: • a) verify that the fiber optic cable is connected properly to a fiber optic port on an operational Ethernet device. • b) follow appropriate local practices to ensure that optical-fiber connector ends are clean and free from contamination.
The Network ACT LED is off.	In normal operation, the Network ACT LED blinks when the device detects traffic on the Ethernet port. If the Network ACT LED is off and the Network LINK LED is on: 1. Verify that there is Ethernet traffic on the network connection.
A 2BASE-TL bank's CPE Mode LED is off.	In normal operation, a 2BASE-TL bank's CPE Mode LED is off when the device is operating in CO mode. If the LED is off when the device is in CPE mode (as confirmed by using the CLI's "show deviceMode" command, the LED is not operating properly.

Fiber Optic Ports - Optical Safety. Never look at the transmit LED/laser through a magnifying device while it is powered on. Never look directly at the fiber port or fiber cable ends when they are powered on.

Caution

To avoid degradation of optical-fiber signals and poor system performance, follow appropriate local practices to ensure that optical-fiber connector ends are clean and free from contamination. Always install the provided dust covers on transceiver optical ports and connector ends that are not being used.

HN400 Passwords

A

As shipped from the factory, the HN400 CLI supports a default username and password for the administrator (**admin**) privilege level. Table A-1 lists these defaults.

Table A-1 CLI User-Account Privilege Levels

Privilege Level	Default Username/Password	Description
admin	**admin/admin**	Administrative (superuser) access. The user has full read/write access plus access to all of the CLI's administrative commands, including the ability to create and delete CLI users.

Note	CLI passwords are case sensitive. It is strongly recommended that the you change the administrative username and password following the initial installation process.

Users can display their assigned CLI privilege level with the CLI **whoami** command. For example:

```
HN408-CP# whoami
username: craft_25
privilege: prov

HN408-CP#
```

Safety Information

B

 Warning	**Read the following safety information thoroughly before installing this Hatteras Networks equipment. Failure to follow this safety information can lead to personal injury or damage to the equipment.**

B.1 Definition of Qualified Personnel

Installation, maintenance, removal of parts, and removal of the HN4xx-U and components must be performed by qualified service personnel only.

Qualified service personnel are people having appropriate technical training and experience necessary to be aware of the hazards to which they are exposed when performing a task and of measures to minimize the danger to themselves or other people.

B.2 Field-Replaceable Components

The HN4xx-U equipment is designed to enable qualified personnel to replace **only** the following components:

1. SFP optical transceiver in the Ethernet port of the HN414-U and HN418-U devices.

	**Fiber Optic ports - Optical Safety**. Never look at the transmit LED/laser through a magnifying device while it is powered on. Never look directly at the fiber port or fiber cable ends when they are powered on.

B.3 Safety Information Warnings

1. Installation, maintenance, removal of parts, and removal of the equipment must be performed by qualified service personnel only.
2. Install the equipment only as described in this document.
3. Never install telephone wiring during a lightning storm.
4. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations.
5. Use caution when installing or modifying telephone lines.
6. Never touch uninsulated telephone wires or terminals unless disconnected at the network interface.

B.4 Power

 Warning	**Power Warning** - This equipment has two power connections. When removing power from the equipment, ensure that both power connections (A and B) are disconnected.

1. Do not use a power source that does not meet the device's specified requirements over the entire installed temperature range.

B.5 Handling Electrical and Optical Equipment - Static Electricity

 ESD	Static electricity can damage or decrease the reliability of electrical and optical equipment.While unpacking and handling electrical and optical equipment, wear a grounding wrist strap to discharge the static buildup. The grounding wrist strap is designed to prevent equipment damage caused by static electricity. Before unpacking and installing equipment or making system interconnections, connect the grounding wrist strap.

B.6 Common Safety Symbols

Table B-1 describes the safety-related symbols used in this document or on the equipment.

Table B-1 Safety Symbols

Symbol	Description
 Caution	Caution - failure to follow documented procedures could result in damaged or inoperative equipment.
 Warning	Warning - risk of electric shock is present.
 ESD	Observe precautions for handling electrostatic discharge-sensitive devices.
	Laser warning. Never look at a transmit LED/laser through a magnifying device while it is powered on or look directly at fiber port or fiber cable ends when they are powered on.

Table B-1 Safety Symbols (Continued)

Symbol	Description
	Direct current.
	Earth (ground) terminal.

Technical Assistance

C

C.1 Hatteras Networks Technical Support

- The toll-free Hatteras Networks Technical Assistance Center phone number is 1.866.694.2883.
- E-mail access to the Technical Assistance Center is available at:

  support@hatterasnetworks.com

C.2 Repair and Return Address

Before you return a product to Hatteras Networks, you must obtain a Returned Materials Authorization (RMA) number from the Hatteras Networks Technical Assistance Center.

The Hatteras Networks repair and return address is:

Hatteras Networks, Inc.
523 Davis Dr., Suite 500
Durham, NC 27713