



Net-Net OS-E

Release 3.6

System Installation and Commissioning Guide

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Preface

About Net-Net OS-E® Documentation

The Net-Net OS-E references in this documentation apply to the Net-Net OS-E operating system software that is used for the following Acme Packet and third-party SBC products:

- Net-Net Application Session Controller (ASC)
- Net-Net OS-E Session Director (SD) Session Border Controller (SBC)
- Net-Net 2600 Session Director (SD) Session Border Controller (SBC)
- Third-party SBC products that license and use Net-Net OS-E software on an OEM basis.

Unless otherwise stated, references to Net-Net OS-E in this document apply to all of the Acme Packet and third-party vendor products that use Net-Net OS-E software.

The following documentation set supports the current release of the OS-E software.

- *Net-Net OS-E – Net-Net 2610/2620 Quick Installation*
- *Net-Net OS-E – Network Interface Card Installation*
- *Net-Net OS-E – USB Creation and Commissioning Instructions*
- *Net-Net OS-E – Slide Rail Kit Installation Instruction*
- *Net-Net OS-E – Virtual Machine Information Guide*
- *Net-Net OS-E – System Installation and Commissioning Guide*
- *Net-Net OS-E – Management Tools*
- *Net-Net OS-E – System Administration Guide*
- *Net-Net OS-E – Session Services Configuration Guide*

- *Net-Net OS-E – Objects and Properties Reference*
- *Net-Net OS-E – System Operations and Troubleshooting*
- *Net-Net OS-E – Release Notes*

See the *Net-Net OS-E – USB Creation and Commissioning Instructions* for information on the supported third-party hardware.

Revision History

This section contains a revision history for this document.

Date	Revision Number	Description
December 1, 2009	Revision 1.00	<ul style="list-style-type: none"> • FCS Release of OS-E 3.6.0 software.
December 14, 2009	Revision 1.01	<ul style="list-style-type: none"> • GA Release of OS-E 3.6.0 software
February 9, 2010	Revision 1.02	<ul style="list-style-type: none"> • Updates guide with Appendix B: Third Party Licenses.
March 10, 2010	Revision 1.10	<ul style="list-style-type: none"> • Updates Appendix B: Third Party Licenses with current license information. • Removes all references to MX-1 card support.
July 30, 2010	Revision 1.11	<ul style="list-style-type: none"> • Updates Appendix B: Third Party Licenses.
December 3, 2010	Revision 1.12	<ul style="list-style-type: none"> • Updates Acme Packet contact information. • Updates Appendix B: Third Party Licenses.
June 24, 2011	Revision 1.20	<ul style="list-style-type: none"> • Changes references to the software from Net-Net 2600 and NN2600 to Net-Net OS-E and OS-E. • Adds 3.6.0m4 adaptations. • Updates Appendix B: Third Party Licenses. • Removes Chapter 7. Commissioning E911 Networks. • Removes Network RFCs section in Appendix A. • Removes Configuring Media Partners from Chapter 4.
July 14, 2011	Revision 1.30	<ul style="list-style-type: none"> • Updates information regarding the installation of multiple NICs.

Conventions Used in This Manual

Typographical Conventions

Key Convention	Function	Example
KEY NAME	Identifies the name of a key to press.	Type abc , then press [ENTER]
CTRL+x	Indicates a control key combination.	Press CTRL+C
brackets []	Indicates an optional argument.	[<i>portNumber</i>]
braces { }	Indicates a required argument with a choice of values; choose one.	{ <i>enabled</i> <i>disabled</i> }
vertical bar	Separates parameter values. Same as “or.”	{TCP TLS}
Monospaced bold	In screen displays, indicates user input.	config> config vsp
Monospaced italic	In screen displays, indicates a variable—generic text for which you supply a value.	config servers> config lcs <i>name</i>
bold	In text, indicates literal names of commands, actions, objects, or properties.	...set as the secondary directory service (with the unifier property)...
bold italic	In text, indicates a variable.	...set the domain property of the <i>directory</i> object.

Acronyms

The OS-E manuals contain the following industry-standard and product-specific acronyms:

AAA	Authentication, authorization, and accounting
ALI	Automatic location identifier
ANI	Automatic number identification
ANSI	American National Standards Institute
AOR	Address of record
API	Application programming interface
ARP	Address Resolution Protocol
AVERT	Anti-virus emergency response team
B2BUA	Back-to-back user agent
BOOTP	Bootstrap Protocol

CA	Certificate authority
CAP	Client application protocol
CBC	Cipher block chaining
CBN	Call back number
CCS	Converged Communication Server
CDR	Call detail record
CIDR	Classless interdomain routing
CLI	Command line interface
CMOS	Comparison mean opinion score
CNAME	Canonical name record
CNI	Calling number identification
CODEC	Compressor/decompressor or coder/decoder
CPE	Customer-premise equipment
CRL	Certificate revocation list
CSR	Certificate signing request
CSTA	Computer-supported telecommunications applications
CSV	Comma-separated values
DDDS	Dynamic delegation discovery system
DHCP	Dynamic Host Configuration Protocol
DMZ	Demilitarized zone
DN	Distinguished name
DNIS	Dialed number identification service
DNS	Domain name service
DOS	Denial of service
EIM	Enterprise instant messaging
ESD	Electrostatic discharge
ESGW	Emergency services gateway
ESQK	Emergency services query key
ESRN	Emergency services routing number
FQDN	Fully qualified domain name
GUI	Graphical user interface
HTTP	Hypertext Transfer Protocol

HTTPS	Hypertext Transfer Protocol Secure
I2	National Emergency Number Association defined VoIP solution
ICAP	Internet Calendar Access Protocol
ICMP	Internet Control Message Protocol
IM	Instant messaging
IP	Internet Protocol
JDBC	Java database connectivity
JMX	Java management extensions
JRE	Java runtime environment
LATA	Local access and transport area
LCS	Live Communications Server
LCR	Least-cost routing
LDAP	Lightweight Directory Access Protocol
LIS	Location information service
MAC	Media access control
MCS	Multimedia Communications Server
MIB	Management information base
MOS	Mean opinion score
MSAG	Master street address guide
MTU	Maximum transmission unit
NAPTR	Naming authority pointer
NAT	Network address translation
NENA	National Emergency Number Association
NIC	Network interface card
NS	Name server
NSE	Named signaling events
NTLM	NT Lan Manager
NTP	Network Time Protocol
OC	Office Communicator
OCI	Open Client Interface
ODBC	Open database connectivity
OTP	Over temperature protection

OVP	Over voltage protection
PBX	Private branch eXchange
PEM	Privacy-enhanced mail
PERL	Practical Extraction and Reporting Language
PING	Packet internet groper
PKCS#12	Public Key Cryptography Standard #12
PKI	Public Key Infrastructure
PSAP	Public safety answering point
PSCP	PuTTY secure copy
PSTN	Public switched telephone network
QOP	Quality of protection
QOS	Quality of service
RADIUS	Remote Authentication Dial-in User Service
RTC	Real-time collaboration
RTCP	Real-time Control Protocol
RTP	Real-time Transport Protocol
RTT	Round-trip time
SATA	Serial ATA
SCSI	Small computer system interface
SDK	Software development kit
SDP	Session Description Protocol
SFTP	Secure Shell File Transfer Protocol
SIMPLE	SIP Instant Messaging and Presence Leveraging Extension
SIP	Session Initiation Protocol
SIPS	Session Initiation Protocol over TLS
SLB	Server load balancing
SMB	Server message block
SNMP	Simple Network Management Protocol
SOA	Server of authority
SOAP	Simple Object Access Protocol
SQL	Structured Query Language
SRTP	Secure Real-time Transport Protocol

SRV	Server resource
SSH	Secure Shell
SSL	Secure socket layer
SSRC	Synchronization source
STUN	Simple Traversal of UDP over NATs
TCP	Transmission Control Protocol
TDM	Time division multiplexing
TGRP	Trunk group
TLS	Transport Layer Security
TOS	Type of service
TTL	Time to live
UPS	Uninterruptable power supply
US	User agent
UAC	User agent client
UAS	User agent server
UDP	User Datagram Protocol
UID	Unique identifier
URI	Uniform resource identifier
URL	Uniform resource locator
UTC	Universal coordinated time
VoIP	Voice over IP
VLAN	Virtual local area network
VPC	VoIP positioning center
VRRP	Virtual Router Redundancy Protocol
VSP	Virtual system partition
VXID	Virtual router interface ID
WAR	Web application resource
WAV	Waveform audio
WM	Windows Messenger
WSDL	Web Services Description Language
XML	Extensible Markup Language
XSL	Extensible Stylesheet Language

Product Support

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E-mail: support@acmepacket.com

For existing Acme Packet customers, product information, software updates, and documentation are available from the Acme Packet support web site. If you have difficulty logging on to the web site using your existing account, call Acme Packet at 781-756-6920 for assistance.

Product Damage

If you receive Acme Packet products that are damaged in shipping, contact the carrier immediately and notify Acme Packet for return shipping information and product replacement. Do not return any products until you receive instructions from Acme Packet.

Chapter 1. Net-Net OS-E® Series Overview

About this Chapter

This chapter provides an overview of the Acme Packet OS-E® Series hardware and software. In addition to running on Acme Packet hardware offerings, OS-E software is supported on compatible third-party platforms and blades.

See the *Net-Net OS-E – USB Creation and Commissioning Instructions* for information on the supported third-party devices.

Net-Net OS-E Overview

The OS-E series of enterprise data and service provider systems provide application level security, control, monitoring and interoperability services for applications based on the Session Initiation Protocol (SIP). The OS-E resides at points in the network where administrators define and enforce fine-grained policies on the SIP-based signaling and media traffic.

In Enterprise Deployments

In an enterprise deployment, OS-E systems reside in a corporate “Demilitarized Zone” (DMZ), between the SIP-based business applications and the enterprise boundary, such as,

- SIP-enabled IP telephony
- Session border control, real-time collaboration, multi-media conferencing, SIP trunking, third-party call control

- Multivendor interoperability among hosted SIP applications, such as IBM Sametime and Microsoft Live Communications Server (LCS) and Office Communication Server (IOCS)

In Service Provider/Carrier Networks

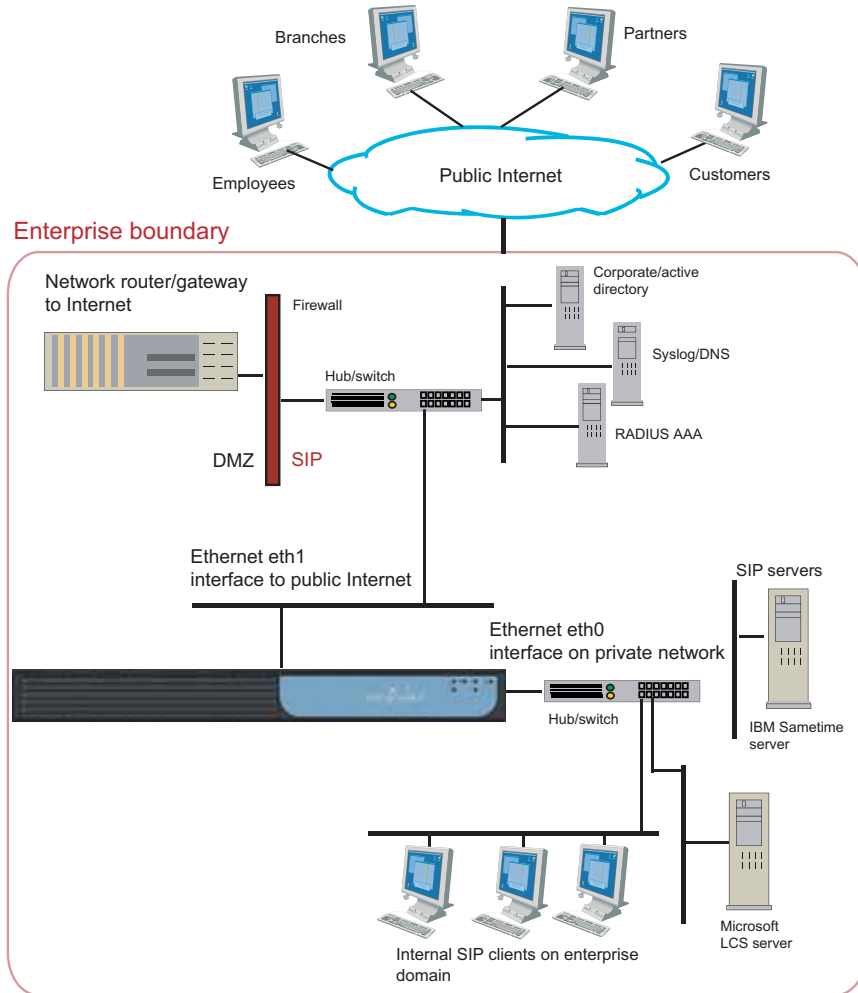
The OS-E provides secure “business class” VoIP and real-time collaboration services for residential, Small and Medium Businesses (SMB), and enterprise subscribers. Service provider deployments include:

- **Subscriber edge**—Where the OS-E terminates secure voice sessions.
- **Customer premises**—Where the OS-E is a managed CPE component for end-to-end VoIP services offered by carriers and service providers.

The OS-E system includes an operating system, application and management software installed on data center and carrier class server systems. The system software includes integrated clustering, synchronization, load balancing, and failover technology that enables enterprises to scale the performance and availability of the system up to carrier class levels simply by adding systems to the cluster.

The OS-E supports an optional, custom-designed media acceleration card for environments that require high media performance under heavy load.

External SIP clients accessing hosted SIP applications



The following image shows a sample OS-E service provider network

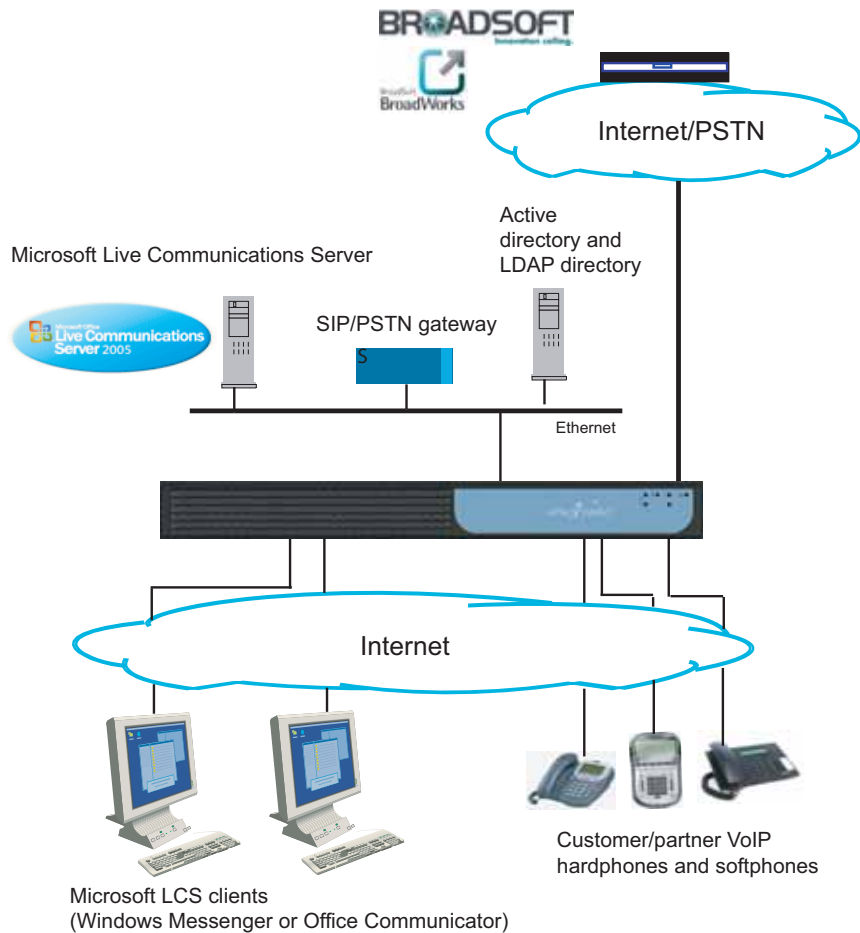


Figure 1

Running the Net-Net OS-E on Other Devices

You can run the OS-E on a number of supported third-party servers.

For complete information on all supported third-party devices and the requirements for installing OS-E software on these products, refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions*.

Net-Net OS-E 2610 and 2620 Series models

Acme Packet provides the Net-Net OS-E NN 2610 and 2620 series systems in the following configurations:

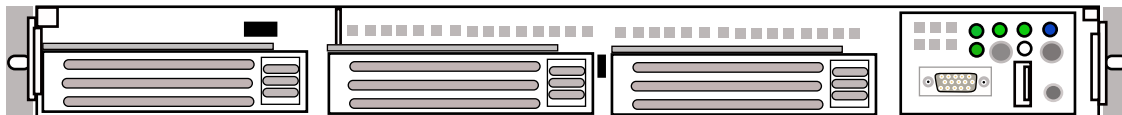
- **NN 2610**— 1U rack-mountable chassis, 120/240V AC powered, dual quad-core processor system with non-redundant power supplies and cooling fans; up to six (6) Ethernet ports with optional network interface cards; 750 GB hard disk drive; standard 8GB memory, multiprocessor upgrade option. Commissioned using an Acme Packet Net-Net OS-E USB stick.
- **NN2620** — 2U rack-mountable chassis, 120/240V AC powered, dual quad-core processor system with redundant, hot swappable power supplies and cooling fans; up to eighteen (18) Ethernet ports using a combination of two optional MX-1 media acceleration cards and network interface cards; 750 GB standard hard disk drive, optional 1.5 TB hard disk drive with RAID; standard 8GB memory, multiprocessor upgrade option. Commissioned using an Acme Packet USB stick

The following image illustrates the NN 2610 series with and without the front bezel installed.

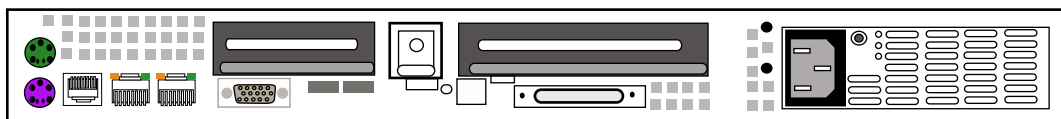
CXC-350 with front bezel



CXC-350 with front bezel removed



CXC-350 back view



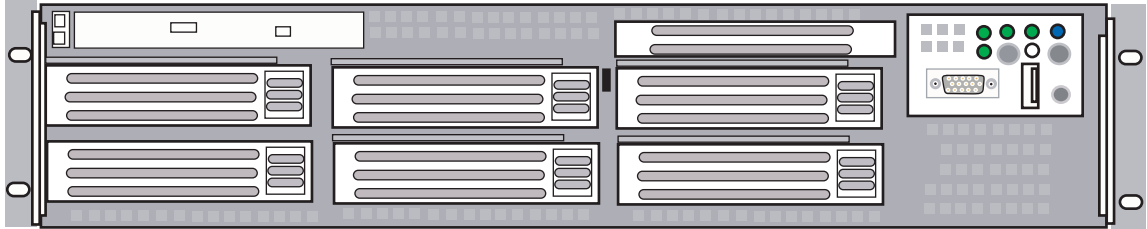
admin_2

The following image illustrates the NN 2620 (2U) Series chassis.

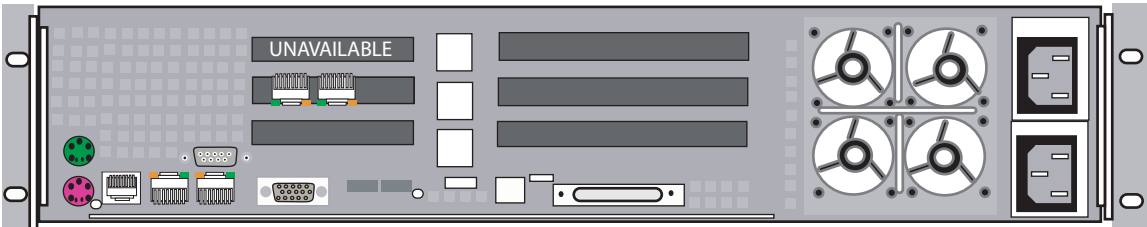
NN 2620 with front bezel



NN 2620 with front bezel removed



NN 2620 back view



admin_3

Information on Net-Net OS-E Software and Licensing

Using the Internet and secure Web URLs, Acme Packet provides all necessary software downloads for USB creation, product licensing, and commissioning of your selected hardware.

As part of each download, and depending on your actual requirements, Acme Packet can provide the following:

- Acme Packet USB Creation Utility with the OS-E software
- Feature licenses
- Documentation on how to create an Acme Packet USB stick and commission the OS-E software on your selected hardware
- Standard set of Acme Packet OS-E technical publications

You must provide a USB stick with between 1-4GB storage to handle Acme Packet software downloads. Acme Packet has tested a variety of USB sticks available from current suppliers and manufacturers. Most USB sticks manufactured today will work.

For complete information on accessing the Acme Packet download server, creating an installation USB stick, and commissioning OS-E systems, refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions*.

Running License Fetch

You will need to run **license fetch** under certain conditions, such as renewing an expired license, and when installing licensed features that you did not originally purchase with the system under the original license.

To “fetch” your customized signed license, you will need a private key. This key, as supplied to you by Acme Packet, will unlock and enable the features that you purchased when you run the **license fetch** command from the Acme Packet CLI or the OS-E Management System.



Note: If you do not run the **license fetch** command to successfully unlock your customer-specific features, you will not be able to configure the OS-E system with any of the licensed options provided by Acme Packet.

Prerequisites

Before you execute the **license fetch** command,

1. Ensure that you have a connection to the public Internet, and
2. Port 616 is available and not blocked by any firewalls. This allows OS-E connectivity to the Acme Packet license server.

Fetching the Signed License From the CLI

From the CLI prompt, run the following command:

```
NNOS-E> license fetch <license-key-text>  
Success!
```

Where **<license-key-text>** is the private key provided to you by Acme Packet. This command will contact the Acme Packet licensing server, authenticate your unique key, and then install a license on your system. Make sure that the OS-E reports “Success!”



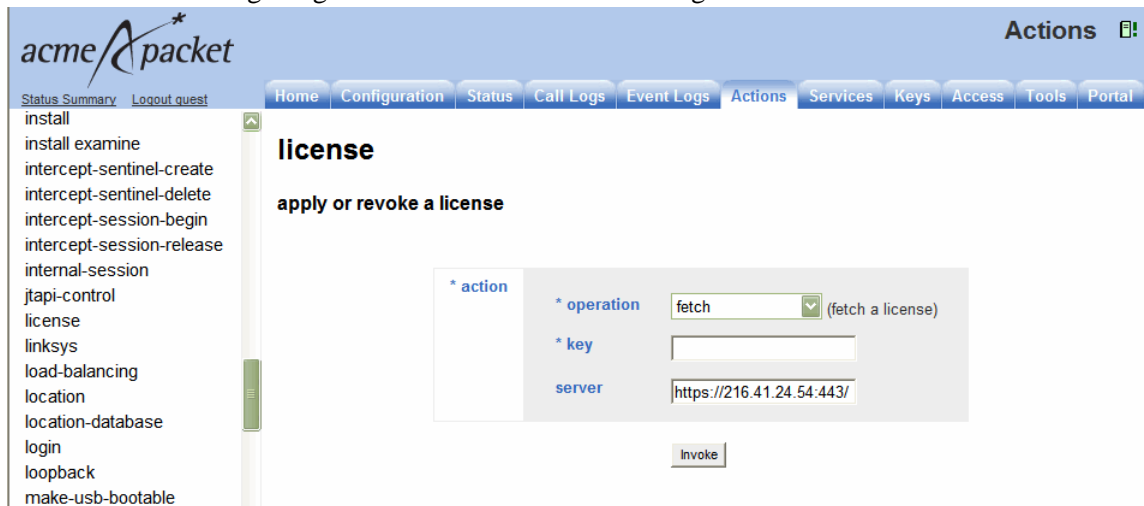
Note: If you are unable to fetch an encrypted license using the Acme Packet key, cannot access the Acme Packet licensing server, or if you receive a message other than “Success!,” contact Acme Packet Product Support immediately for assistance.

You will need to run **license fetch** for each system that you installed. If you ordered five systems to be installed in a cluster, Acme Packet will provide you with a single license key for the cluster.

Any or all standalone systems outside of a cluster require a separate and unique license.

Fetching the Signed License From the OS-E Management System

If you are using the OS-E Management System, go the **Actions** tab and select **license->fetch** and paste the Acme Packet key into the key field, as illustrated in the following image. Click **Invoke** to install the signed license.



The screenshot shows the Acme Packet web interface. The top navigation bar includes 'Home', 'Configuration', 'Status', 'Call Logs', 'Event Logs', 'Actions', 'Services', 'Keys', 'Access', 'Tools', and 'Portal'. The 'Actions' tab is selected. On the left, a sidebar lists various actions, with 'license' highlighted. The main content area is titled 'license' and 'apply or revoke a license'. It contains a form with the following fields:

- * action**: A dropdown menu with 'fetch' selected, with a tooltip that says '(fetch a license)'.
- * operation**: A text input field.
- * key**: A text input field.
- server**: A text input field containing 'https://216.41.24.54:443/'.

Below the form is an 'Invoke' button.

You can also manage licenses with the **Tools** tab, using the **Retrieve License** and the **Upload License** functions. **Retrieve License** operates the same as the **license fetch** command, contacting the Acme Packet license server over the Internet.

If for some reason you are unable to access the Acme Packet license server, and if Acme Packet sends you the license, place the license on your local PC, use **Upload License** to browse for file, check the **Apply License** box, then click **Upload**.

Adding New Features Later

If you find that you do not have one or more of the features that you purchased, or if you want to add features that you did not originally purchase, contact your Acme Packet Sales Representative or Acme Packet Product Support. Acme Packet will correct the problem and supply you with a new key that you can rerun with the **license fetch** command.

As Acme Packet software becomes available with newly-added features, your Acme Packet Sales Representative will assist you with ordering the software. Acme Packet will then provide you with a new licensing key.

License Expirations and Renewals

If your customer-specific license comes with an expiration date, the OS-E system will generate an event when the license nears the expiration date. You can renew your license by re-executing the **license fetch** command. The Acme Packet license server verifies that there is a valid license renewal associated with your system ID, and then resets the license expiration to a new date.

Evaluation Systems

For evaluation systems in lab environments without Internet connectivity, Acme Packet will provide you with an alternate method for acquiring the appropriate license to operate and configure the OS-E system. Contact your Acme Packet Sales Representative or Acme Packet Support for details.

System Management

Before you install the system, you should decide on the management tool(s) that you want to use to configure and monitor the system. This will help you decide where you need to create connections based on your equipment and network resources.

System management capabilities include the following secure management interfaces:

- The OS-E command line interface (CLI) from a local console, Telnet, or SSH connection
- The OS-E Management System, a graphical user interface (GUI) that supports remote management using the Internet Explorer Web browser
- Simple Network Management Protocol (SNMP) using third party SNMP MIB compiler/browser applications
- Web Services Description Language (WSDL) and Simple Object Access Protocol (SOAP) messaging using the software development kit (SDK)

For information on configuring the management options, refer to *Net-Net OS-E – Management Tools*

For More Information

See Appendix A, “Technical Specifications,” for regulatory information and product data.

Chapter 2. *Installing the Net-Net OS-E System*

About This Chapter

This chapter covers OS-E system installation

Net-Net OS-E Series Models

Acme Packet provides the OS-E Series systems in the following configurations:

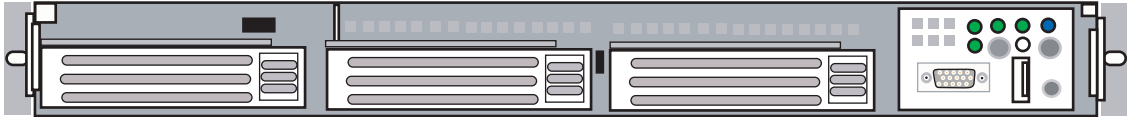
- **NN 2610**— 1U rack-mountable chassis, 120/240V AC powered, dual quad-core processor system with non-redundant power supplies and cooling fans; up to six (6) Ethernet ports with optional network interface cards; 750 GB hard disk drive; standard 8GB memory, multiprocessor upgrade option.
- **NN 2620**— 2U rack-mountable chassis, 120/240V AC powered, dual quad-core processor system with redundant, hot swappable power supplies and cooling fans; up to eighteen (18) Ethernet ports using a combination of two optional MX-1 media acceleration cards and network interface cards; 750 GB standard hard disk drive, optional 1.5 TB hard disk drive with RAID; standard 8GB memory, multiprocessor upgrade option.

The following image illustrates the NN 2610 series with and without the front bezel installed.

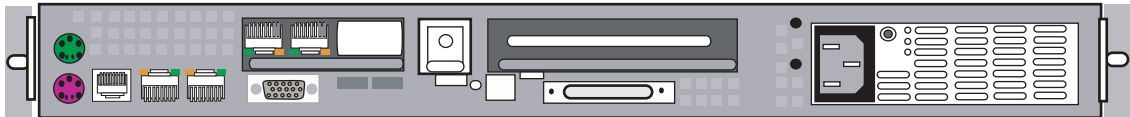
NN 2610 with front bezel



NN 2610 with front bezel removed



NN 2610 back view

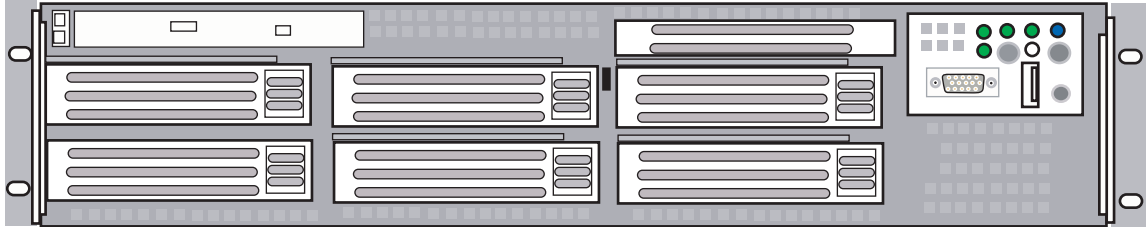


The following image illustrates the NN 2620 (2U) series chassis.

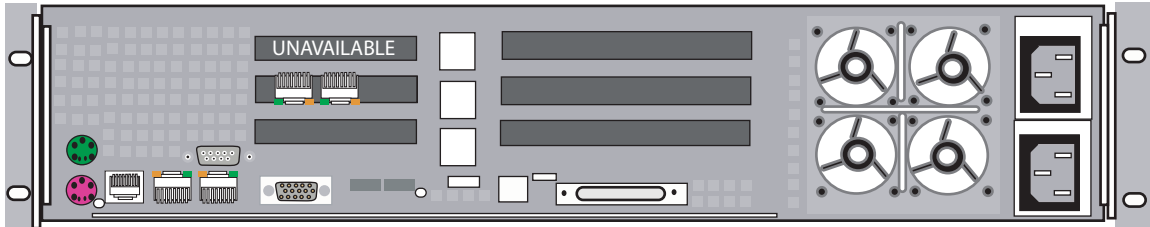
NN 2620 with front bezel



NN 2620 with front bezel removed



NN 2620 back view



Net-Net OS-E Series specification

NN2610 Specifications

Specification	Description
Chassis form factor	1U rack mount server
Dimensions	Height: 1.7" (4.3 cm) Width: 16.93" (43.0 cm) Depth: 26.46" (67.2) cm) Weight: 30 lbs (13.6 kg) approximate
Processors	Quad-Core Intel® Xeon® processor 5355, 8M Cache, 2.66 GHz, 1333 FSB
Memory	8 GB DDR2 667 MHz SDRAM
Storage	750 GB non-redundant hard disk storage
Power supply	Power: Single 600W AC voltage: 100-127/200-240VAC; 6.5 / 3.2A, 43-67 Hz, auto-ranging
Network interfaces	Up to six (6) 10/100/1000BaseTX (RJ-45) Ethernet ports with dual network interface cards installed.
Power and heat dissipation	NN 2610 with dual Ethernet cards (6 ports): 540W input (worst case); 1843 BTUs
Management	Policy based management software (CLI, Web GUI, Java (desktop) GUI, SNMP, XML, WSDL
External I/O ports	One (1) RJ-45 Serial B (DB-9 adapters supplied with product) One (1) PS2 keyboard 2 x 15-pin VGA
Fans and cooling	Four dual-rotor 56mm fans and one single-rotor 28mm fan mounted in tool-less fan module to support cooling for processors, hard drives, and add-in cards. Two 28mm fans for power supply cooling. All fans monitored and instrumented to provide RPM data for fan-failure prediction and detection.
Security	Mechanical locking bezel with key

Specification	Description
Ambient temperature	Operating: 0°C to +40°C (+32°F to 104°F) Non-operating: -20°C to +70°C (-4°F to 158°F)
Relative humidity	Operating and non-operating: 5% to 95% relative humidity, non-condensing

NN 2620 Specifications

Specification	Description
Chassis form factor	2U rack mount server
Dimensions	Height: 3.45" (8.75 cm) Width: 16.93" (43.0 cm) Depth: 26.46" (67.2 cm) Weight: 50 lbs (22.7 kg) approximate
Processors	Quad-Core Intel® Xeon® processor 5355, 8M Cache, 2.66 GHz, 1333 FSB
Memory	8 GB DDR2 667 MHz SDRAM
Storage	750 GB non-redundant hard disk storage, or 1.5 TB (max) redundant (RAID-10) hard disk storage
Power supply	Power: 2X redundant, 750W hot swappable AC voltage: 100-127/200-240VAC; 5.4 / 3.2A, 43-67 Hz, auto-ranging; separate power cords
Network interfaces	Up to eighteen (18) Ethernet 10/100/1000BaseTX (RJ-45) ports using dual network interface cards and dual MX-1 media acceleration cards installed.
Power and heat dissipation	NN 2620 with dual Ethernet cards (6 ports): 660W input (worst case); 2048 BTUs NN 2620 with dual Ethernet cards (6 ports), plus dual MX-1 Media acceleration cards (8 ports): 730W input (worst case); 2491 BTUs
Management	Policy based management software (CLI, Web GUI, Java (desktop) GUI, SNMP, XML, WSDL
External I/O ports	One (1) RJ-45 Serial B (DB-9 adapters supplied with product) One (1) PS2 keyboard 2 x 15-pin VGA
Fans and cooling	2X redundant sets of four (4) 60mm fans in tool-less fan module; fans provide cooling for the processors, hard drives, and add-in cards; two 40mm fans per power-supply module for cooling the power-supply module All fans monitored and instrumented to provide RPM data for fan-failure prediction and detection.
Security	Mechanical locking bezel with key

Specification	Description
Ambient temperature	Operating: 0°C to +40°C (+32°F to 104°F) Non-operating: -20°C to +70°C (-4°F to 158°F)
Relative humidity	Operating and non-operating: 5% to 95% relative humidity, non-condensing

System and Network Connections

This section summarizes the interface ports and connections that are supported with the OS-E 2600 Series. The image above illustrates the ports and connections on the NN2610. The NN2620 uses these same ports and connections as the NN2610 and are similarly located.

VGA Video, System Keyboard, and Power

The system provides direct connections for a VGA video monitor, keyboard, and AC power. Connecting these devices allows direct access to the CLI.



Note: VGA video connections are available on both the front and rear of the chassis. Only one of the VGA video connections can be used at a time.

RS-232 Serial B Port, DB9-to-RJ45 Adapter, and Null Modem Cable

The RS-232 Serial B port on the back of the system allows you to connect a PC or terminal directly to the system. Use the RS-232 Serial B port if you want to use Telnet or SSH to access the CLI, or if you are using an SNMP application to manage the system locally.

DB9 to RJ-45 Adapter

The system comes with three identical DB9-to-RJ45 cable adapters. While you only need one per system console connection, Acme Packet provides two spare adapters that you can use as needed.

Null Modem Serial Cable

For console and laptop PC connections to the RJ45 RS232 Serial B port, you will need a DB9-to-DB9 null modem cable and one DB9-RJ45 adapter.

Note Regarding RS-232 DB-9 Port on NN 2620 Systems

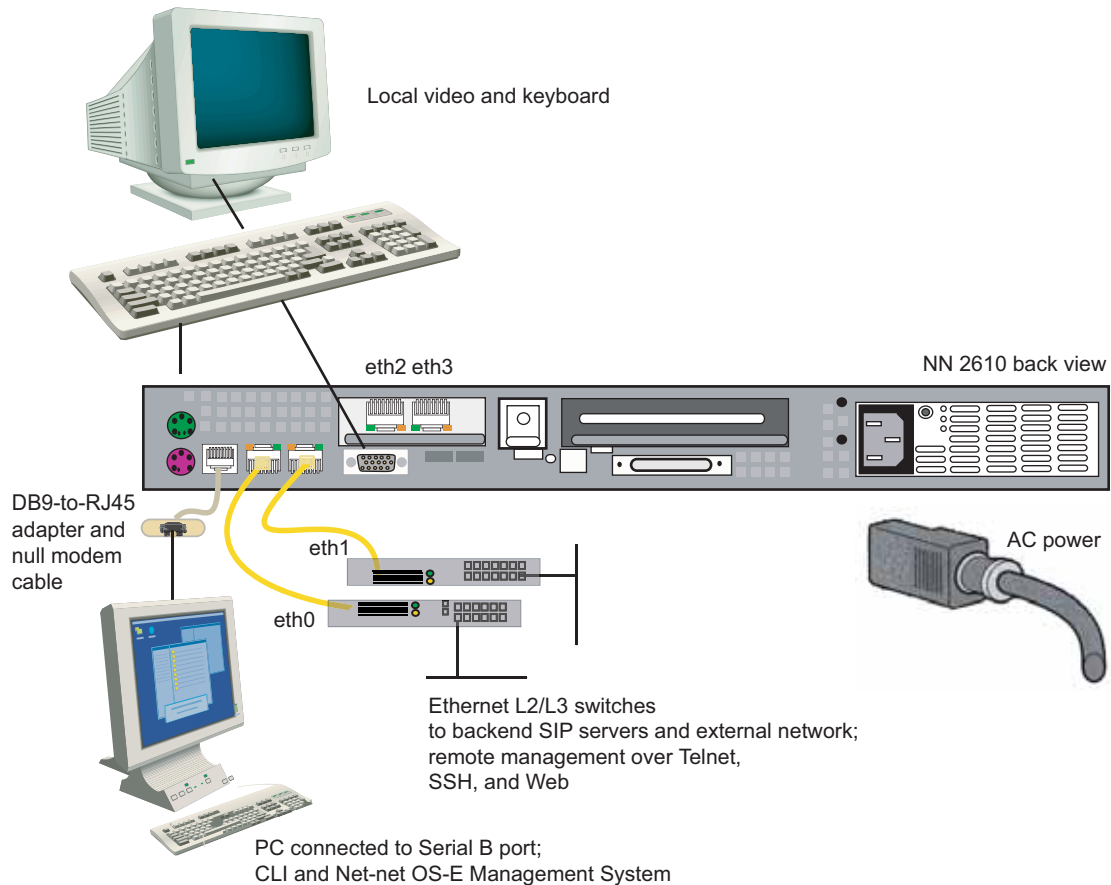
The physical RS-232 DB-9 port, while present on the back of N 2620 systems, is *not* available as an active console port. *Do not* plug the DB-9 end of a null modem console cable into this port.

Gigabit Ethernet (IEEE 802.3ab, 1000Base-TX)

The Ethernet interfaces on the system support auto negotiation 10/100/1000 Mbps copper network interface connections (NIC).

Gigabit Ethernet is the latest version of Ethernet that supports data transfer rates of up to 1 Gigabit (1,000 megabits) per second. The Ethernet ports are IEEE 802.3ab for CAT5 or CAT5e unshielded twisted pair (UTP) cable, with 8-pin NIC connector.

The following image displays OS-E network connections.



admin_14

USB 2.0 Port

The Universal Serial Bus (USB) 2.0 ports allow you to perform the following functions:

- Commission and license OS-E software at initial startup.
- Create a system restore USB stick containing the latest system configuration should the system have a catastrophic failure requiring system recovery.

- Create a system utilities USB from which you can run Acme Packet programs to diagnose system problems.

Refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions* for complete information.

System Software and Licensing

The system software and features license is downloaded to the system hard drive(s) when you insert the Acme Packet USB stick and power up the system for the first time. Software upgrades are available and released by Acme Packet on a regular basis.

For complete information, refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions*

System Components

This section summarizes the system hardware components provided with the Acme Packet OS-E 2610 and 2620 systems:

- Intel® SE7520JR2 Server Board
- Cooling fans
- Power modules
- Hard disk drives
- Removable bezel

Intel® SE7520JR2 Server Board

The Intel® SE7520JR2 Server Board controls the following system features:

- Two Ethernet data ports (Ethernet 10/100/1000 Mbps auto negotiation); up to four Ethernet ports on the 2U chassis with the MX-1 media acceleration card.
- RJ-45 Serial B port for terminal or PC hookup
- Light-emitting diode indicators (LEDs) on Ethernet ports

- PS2 ports for a directly-attached keyboard and mouse; video connector for a directly-attached monitor
- System status indicator LEDs on front control panel
- AC power input; dual/redundant AC input in 2U chassis
- 500W power module in 1U chassis; redundant 700W hot-swappable power modules in the 2U chassis
- Over temperature protection (OTP) and over voltage protection (OVP) circuitry

System Fans and Cooling

Acme Packet OS-E systems require a normal operating environment for computing equipment, using internal fans, air baffles, and air ducts to ensure adequate airflow. When external ambient temperatures remain within specified limits, the system fans provide sufficient airflow through the system, pulling air from the front of the chassis to the back.

The NN 2610 chassis uses a non-redundant multi-system fan module and dual non-redundant power module fans. The NN 2620 chassis supports up to eight system fans in a modular 4+4 configuration.

In addition to the eight system fans, each power module installed provides an additional two non-redundant fans that pull air from inside the chassis to the back. By default, the NN 2620 chassis is equipped with four system fans with no fan redundancy.

During system installation, allow at least 6 inches (150 mm) of unobstructed space at the front and back. The chassis requires no air space above or below.

If you install the system in an enclosed equipment rack, be sure there is adequate airflow and the following environmental requirements:

- Operating ambient air temperature: 10°C to +35°C (50° to 95°F)
- Non-operating ambient air temperature: -40°C to +70°C (-40° to 158° F)
- Non-operating humidity: 90% non-condensing @ 35°C
- Power and heat dissipation:
 - NN 2610 with dual Ethernet cards (6 ports): 540W input (worst case); 1843 BTUs

- NN 2620 with dual Ethernet cards (6 ports): 660W input (worst case); 2048 BTUs
- NN 2620 with dual Ethernet cards (6 ports), 730W input (worst case); 2491 BTUs

Power Modules

For NN 2610 (1U) Chassis

The NN 2610 (1U) chassis uses a single non-redundant 500W power module with the following integrated management features:

- Status LED
- Over temperature protection (OTP)
- Over voltage protection (OVP)

The power supply provides two non-redundant 28mm fans for self cooling and system cooling at an airflow rate of 10 CFM. Air moving through the power supply is pre-heated from the system and exhausts out the back.

To protect the equipment, Acme Packet recommends using a conditioned power source or uninterruptable power supply (UPS). The power source must provide a reliable earth ground, and provide the following:

- Voltage: 100 to 127 VAC @ 43 to 67 Hz; 6.5A maximum
- Voltage: 200 to 240 VAC @ 43 to 67 Hz; 3.2A maximum

The power module connector uses a standard 3-prong keyed IEC 320 C-14 receptacle rated for 15A/250VAC. The power cord is supplied with an IEC connector on one end, NEMA 5-15 plug (U.S. domestic) on the other end.

For the NN 2620 Chassis

The NN 2620 chassis uses up to two 700W power supplies. The system can be configured to support a single power module in a non-redundant configuration, or dual power modules in a 1+1 redundant power configuration. In a redundant configuration, a single failed power module can be hot-swapped with the system running. Either configuration supports up to a maximum of 700 watts of power with the following integrated management features:

- Status LED
- Over temperature protection (OTP)
- Over voltage protection (OVP)

Acme Packet recommends using a conditioned power source or uninterruptable power supply (UPS). The power source must provide a reliable earth ground, and provide the following:

- Voltage: 100 to 127 VAC @ 50/60 Hz; 8.9A maximum
- Voltage: 200 to 240 VAC @ 50/60 Hz; 5.4A maximum

The power module connector uses a standard 3-prong keyed IEC 320 C-14 receptacle rated for 15A/250VAC. The power cord is supplied with an IEC connector on one end, NEMA 5-15 plug (U.S. domestic) on the other end.

Hard Disk Drives

OS-E systems use 500GB and 750GB hard disk drives to store the operating system and the OS-E software.

NN 2610 (1U) Chassis

The NN 2610 chassis provides three hot-swappable hard drive bays and one slim-line bay at the front of the chassis. The hard drive bays support Serial ATA (SATA)* hard disk drives.

- For hot swap drive configurations, 3.5" x 1" hard disk drives are mounted to hot swap drive trays for easy insertion and extraction.
- For cabled drive configurations, SATA drives are mounted to non-hot swappable drive trays. Cabled hard drives can only be removed by unlatching the drives from inside the chassis.



Caution: All hard drive bays must be populated to maintain system airflow and cooling. Drive trays must have a drive or a drive blank inserted.

NN 2620 2U Chassis

The NN 2620 chassis provides up to five (default) SATA hard disk drives. One slim-line peripheral bay is available for either optical or floppy drive.

- For hot swap drive configurations, 3.5”x 1” hard disk drives are mounted to hot swap drive trays for easy insertion and extraction.
- For cabled drive configurations, SATA drives are mounted to non-hot swappable drive trays. Cabled hard drives can only be removed by unlatching the drives from inside the chassis.



Caution: All hard drive bays must be populated to maintain system airflow and cooling. Drive trays must have a drive or a drive blank inserted.

Removable Bezel

OS-E Series systems have a removable front bezel. The bezel snaps into the front of the chassis and is secured with a keyed lock. These systems can operate with or without the front bezel. Removing the bezel allows you to access the system control panel and the hard disk drives on the front of the system. Installing the bezel provides a secure way to protect the system from unwanted intrusion and manipulation of the system control panel. For information on removing and installing the bezel, refer to Chapter 7, “Performing Maintenance and System Upgrades.”

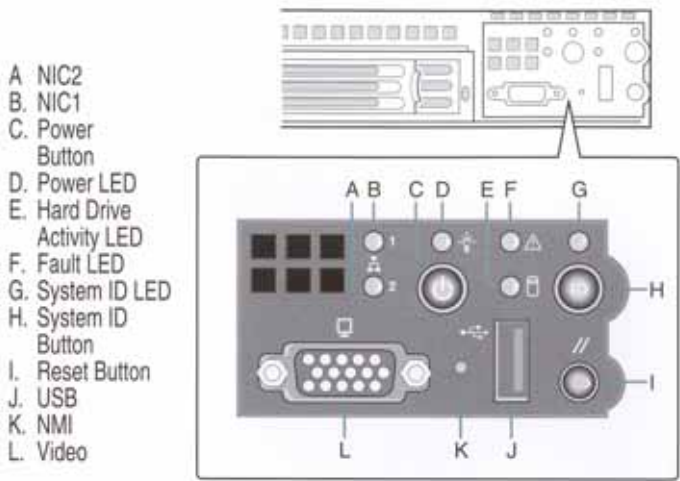
* SATA is a specification for consumer hard drive connections that boosts the data transfer rate up to 150MB/second. It changes IDE/ATA from a parallel interface requiring 40 separate wires to connect components to a serial interface requiring only 6 wires.

System Control Panel

The system control panel supports several push buttons and status LEDs on the front of the system. OS-E Series systems use the same control panel.

Push buttons and LEDs

The following image illustrates the system control panel push buttons and LEDs.



The following table displays system control panel functions.

Reference	Feature	Function
B	NIC1 (eth0) activity	Continuous green light indicates a link between the system and the network to which it is connected
A	NIC2 (eth1) activity	Blinking green light indicates network activity
C	Power/Sleep button	Toggles the system power on/off. This button also functions as a Sleep button if enabled by an ACPI-compliant operating system.
D	Power/Sleep LED	Continuous green light indicates the system has power applied to it. Blinking green indicates the system is in a sleep state. No light indicates the power is off.
E	Hard disk drive activity LED	Random blinking green light indicates hard disk drive activity (SCSI or SATA). No light indicates no hard disk drive activity.

Reference	Feature	Function
F	System Fault LED	<p>Solid green indicates normal operation.</p> <p>Blinking green indicates degraded performance.</p> <p>Solid amber indicates a critical or non-recoverable condition.</p> <p>Blinking amber indicates a non-critical condition.</p> <p>No light indicates power-on-self-test (POST) is running or the system is off.</p>
G	System Identification LED	<p>Solid blue indicates system identification is active.</p> <p>No light indicates system identification is not activated.</p>
H	System Identification button	Toggles the front panel ID LED and the baseboard LED on/off. The baseboard LED is visible through the rear of the chassis and allows you to locate the server you are working on from behind a rack of servers.
I	Reset button	Reboots and initializes the system.
<i>(continued)</i>		
J	USB 2.0 port	Allows you to commission the system using a USB stick. See the <i>Net-Net OS-E – USB Creation and Commissioning Instructions</i> for information.
K	NMI button	Puts the system in a halt state for diagnostic purposes.
L	Video port	Allows you to attach a video monitor to the front of the chassis. The front and rear video ports cannot be used at the same time.

Installing the NN 2610 and 2620 Series

This section covers the required information for installing the NN 2610 and NN 2620 Series systems.

Required Tools

If you are installing the system in a rack, you will need a #2 Phillips screwdriver to install the mounting ears to the front of the chassis. There are no other special tools required for installing the system. Refer to the instructions included with the rack mounting hardware for information.

Unpacking the System

The system shipping container includes the following items:

- NN 2610 or NN 2620 chassis
- *Net-Net OS-E – Net-Net 2610/2620 Quick Installation* card
- System accessories (front bezel, rack mounting rails, etc.)



Note: Hardware needed to mount the system to a rack or cabinet, such as custom mounting screws, nuts and miscellaneous hardware items, are not included due to the many variations available.

If you ordered the tool-less rail kit that allows you to mount the system in a compatible rack or cabinet, the necessary hardware and rack installation instructions are included in the kit.

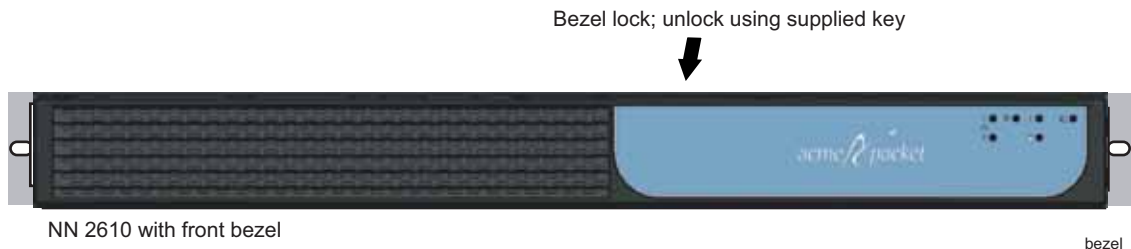
If any of these components are missing, contact Acme Packet. Locate the unpacking instructions included with the shipment for the proper procedures for safely unpacking the system.

Installing and Removing the Front Bezel

OS-E systems have a removable front bezel. The bezel snaps into the rack mounting brackets at front of the chassis and is secured with a keyed lock, illustrated in the following image. NN 2610 and NN 2620 Series systems can operate with or without the front bezel.

Removing the bezel allows you to access the system control panel and the hard disk drives on the front of the system. Installing the bezel provides a way to protect the system from unwanted intrusion and manipulation of the system.

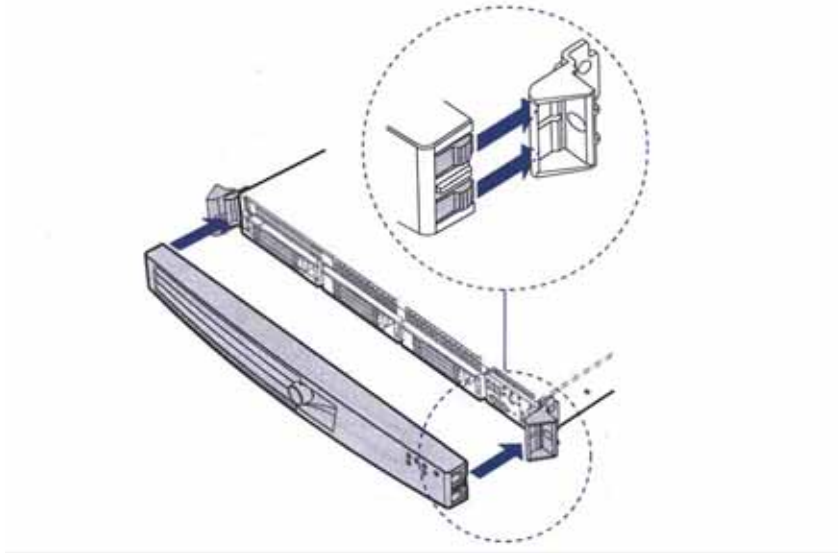
Figure 2-1. NN 2610 locking bezel



To install the front bezel, perform the following steps:

1. At each end of the bezel, line up the center notch on the bezel with the center guide on the rack handles.
2. Push the bezel onto the front of the chassis until it clicks into place.
3. Connect any necessary cables to the front control panel area at the right side of the chassis.
4. Lock the bezel using the supplied key.

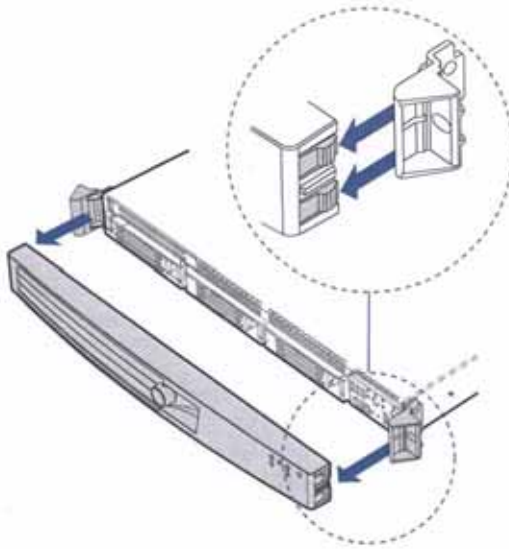
The following image displays the front bezel being installed.



To remove the bezel, perform the following steps:

1. Unlock the bezel using the supplied key.
2. Remove any cables that are attached to the front of the system.
3. Pull on the left- and right-most edges of the bezel to pop it out.

The following image displays the front bezel being removed.



Mounting the System In a Rack

The OS-E 2600 Series chassis installs in any standard 19-inch by 30-inch deep 2- or 4-post computer rack or 4-post EIA-310D compatible server cabinet.

A sliding rail kit allows you to mount the chassis in a standard (19-inch by and up to 30-inch deep) rack. When installing the system in a rack, Acme Packet recommends you install systems from the bottom of the rack to the top. This means that you install the first system in the rack into the bottom position of the rack, the second system in the second position from the bottom, and so on.

Instructions for installing the rack are included with the rail kit in the shipping container as well as in PDF format with the OS-E technical documentation.

Connecting Console Equipment

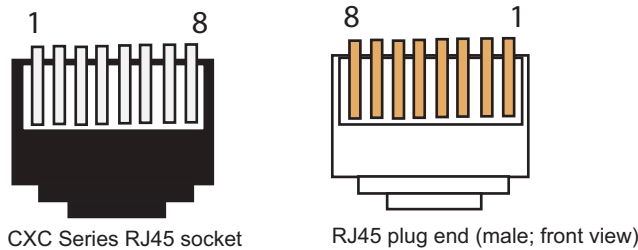
This section shows you how to connect console equipment (PC or terminal) to the system: There are two ways to make a direct local connection:

- Using the Serial B port on the back of the chassis
- Using the video and keyboard connections

Using the Serial B Console Port

The Serial B console port provides a serial EIA-561 RS232D connection with a DTE interface using a male RJ-45 plug. Attaching a terminal or PC allows you to connect to the system CLI for initial setup at the installation site. To connect a terminal or PC to the RJ-45 Serial B port, you need a DB-9 to DB-9 serial cable and the supplied RJ-45 dongle that connects between the DB-9 cable and the RJ-45 socket.

The following image illustrates the RJ-45 and lists the pin/signal information.



Pin No.	Signal Name/Description	
1	RTS	Request to Send
2	DTR	Data Terminal Ready
3	TXD(Transmit Data
4	GND	Ground
5	RI	Ring Indication
6	RXD	Receive Data
7	DSR/DCD	Data Set Ready/Data Carrier Detect 1
8	CTS	Clear to Send

admin_8

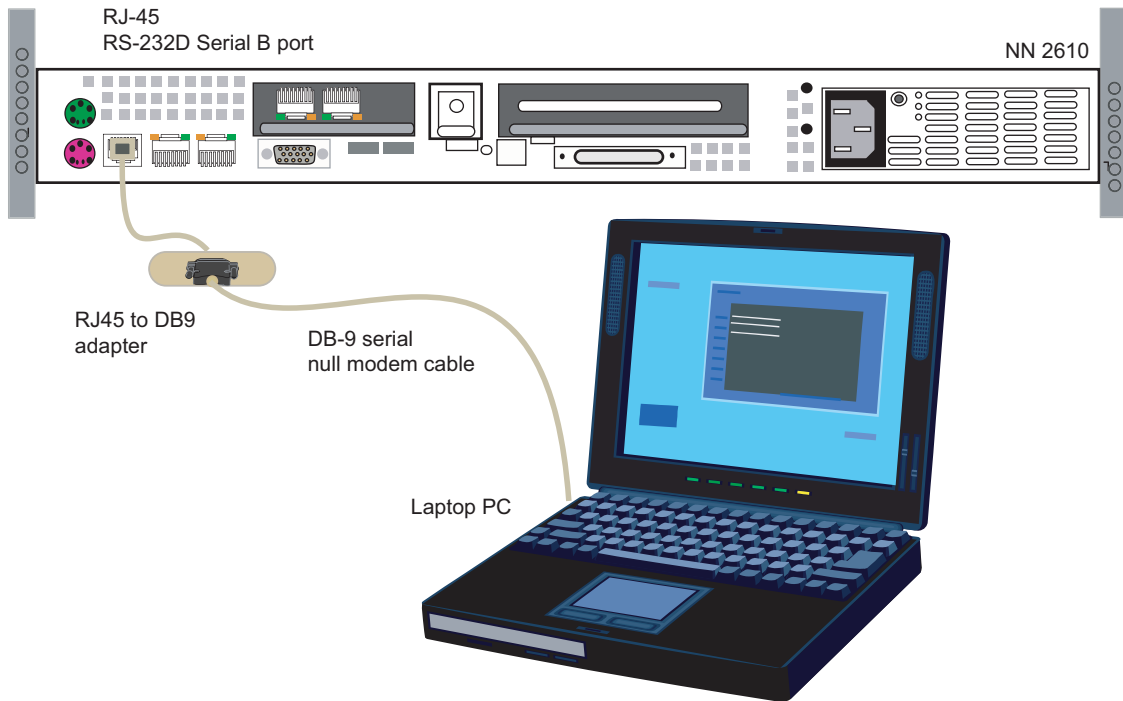


Note: The physical RS-232 DB-9 port, while present on the back of NN 2620 systems, is *not* available as an active console port. *Do not* plug the DB-9 end of a null modem console cable into this port.

Perform the follow steps to connect a PC or video terminal to the Serial B port:

1. Check the video terminal or PC for the type of serial connector that it uses (either DB-9 or DB-25) and locate the appropriate cable:
 - DB-9 to DB-9 (customer supplied null modem)
 - DB-9 to DB-25
2. Using a DB9- to RJ45 adapter, connect the RJ45 plug end of the cable into the Serial B port.
3. Connect the DB-9 end of the null modem serial cable to the adapter; connect the other end of the cable (DB-9 or DB-25 to the video terminal or PC.
4. Turn the video terminal or PC on.
5. Configure the video terminal or PC (using a terminal emulation program such as HyperTerminal) with the following settings:
 - Baud rate: 115200
 - Terminal type: VT-100 (if prompted)
 - Connect to: COM1
 - Stop bits: 1
 - Data bits: 8
 - Parity: none
 - Flow control: none

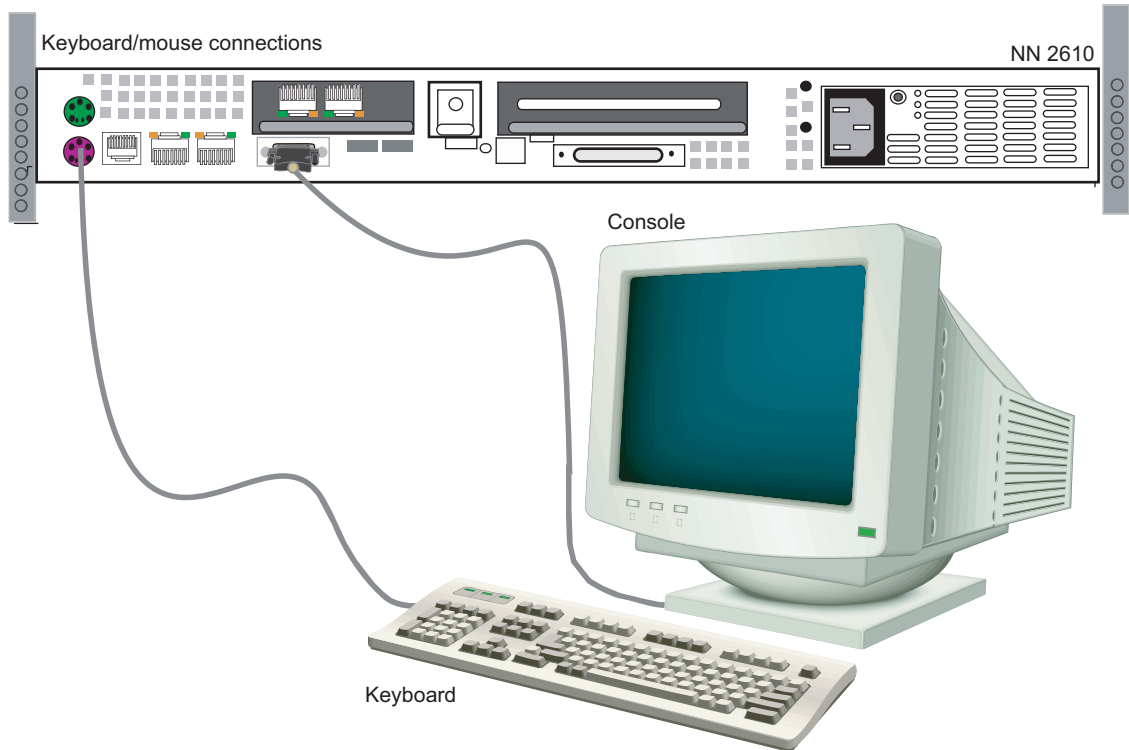
The following image illustrates connecting a PC or terminal.



Using the Video and Keyboard Connections

You can create direct connections to the system by simply connecting a monitor and keyboard. The system has two video console interfaces that accept a standard 15-pin console cable; one connector on the front of the system, and another on the back. You can only connect one video console at a time. This means that both video connectors cannot be used simultaneously.

The following image illustrates the direct video and keyboard connections. A VGA console is recommended.



Connecting the Ethernet Interfaces

The Ethernet interfaces on the system support auto negotiation 10/100/1000 Mbps copper network interface connections (NIC). This means that you can connect to Ethernet equipment that supports 10, 100, or 1000 Mbps connections. Ethernet ports label 1 to 4 translate to Ethernet interfaces eth 0 to eth3 in the product software.

The NN 2610 is equipped with up to six Ethernet interfaces, and the NN 2620 is equipped with up to twenty Ethernet interfaces using network interface cards.

To connect to the data network, you need the following:

- For connection to an Ethernet hub or switch, an RJ-45 to RJ-45 straight-through cable (100 ohm, Category 5 or 5E, with a maximum length of 328 feet (100 meters))

- For a direct connection to a PC or laptop computer, an Ethernet cross-over cable (for local Telnet connection or access to the OS-E Management System from your Web browser).
- For links to the external network, a connection to an upstream Layer 2 switch behind the firewall, and a switch that connects to the backend communications servers.

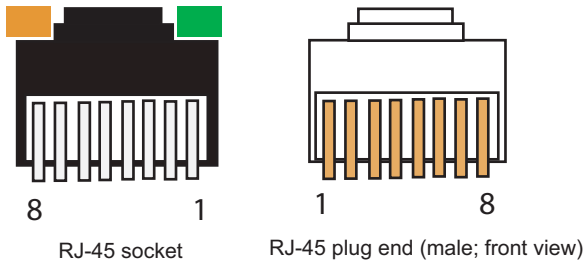


Caution: Do not insert an RJ-11 telephone connector into any Ethernet interface on the system. Damage to the interface may occur.



Note: Any Ethernet interface can be used for management traffic. However, Acme Packet recommends the use of eth1, as eth0 is reserved for fault-tolerant clustering with other OS-E systems. Management traffic is also supported on any interface that is carrying private or public network traffic. This means that it would be possible to use eth1 to carry SIP traffic and management traffic.

The following image illustrates the Ethernet port associated pin information.



Pin No.	Signal Description	
	Fast Ethernet	Gigabit Ethernet
1	TX+	MD0+
2	TX-	MD0-
3	RX+	MD1+
4	T45	MD2+
5	T45	MD2-
6	RX-	MD1-
7	T78	MD3+
8	T78	MD3-

Perform the following steps to connect to the Ethernet interfaces:

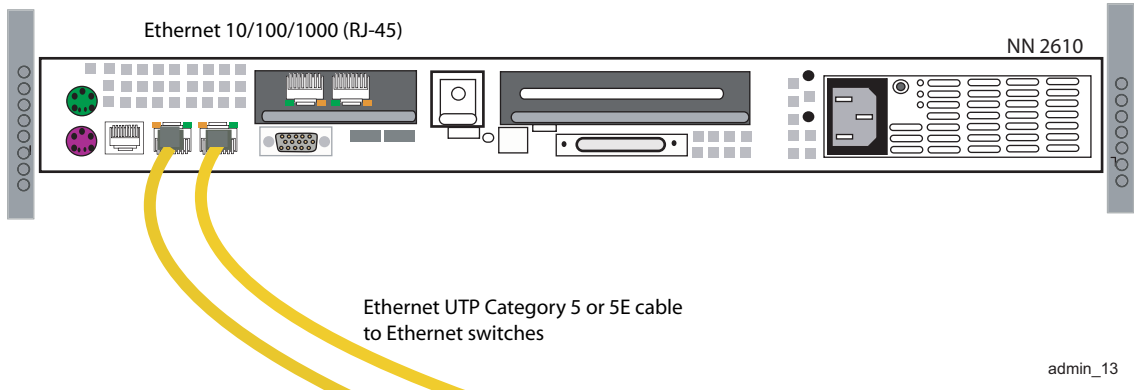
1. Connect one end of the RJ-45 Ethernet straight-through cable to the port labeled 1 or 2. (eth0 and eth1, respectively).



Note: Ethernet ports on the system are labeled with numbers, and are oriented left to right, top to bottom. The port labeled “1” is the same as eth0, the port labeled “2” is the same as eth1, and so on.

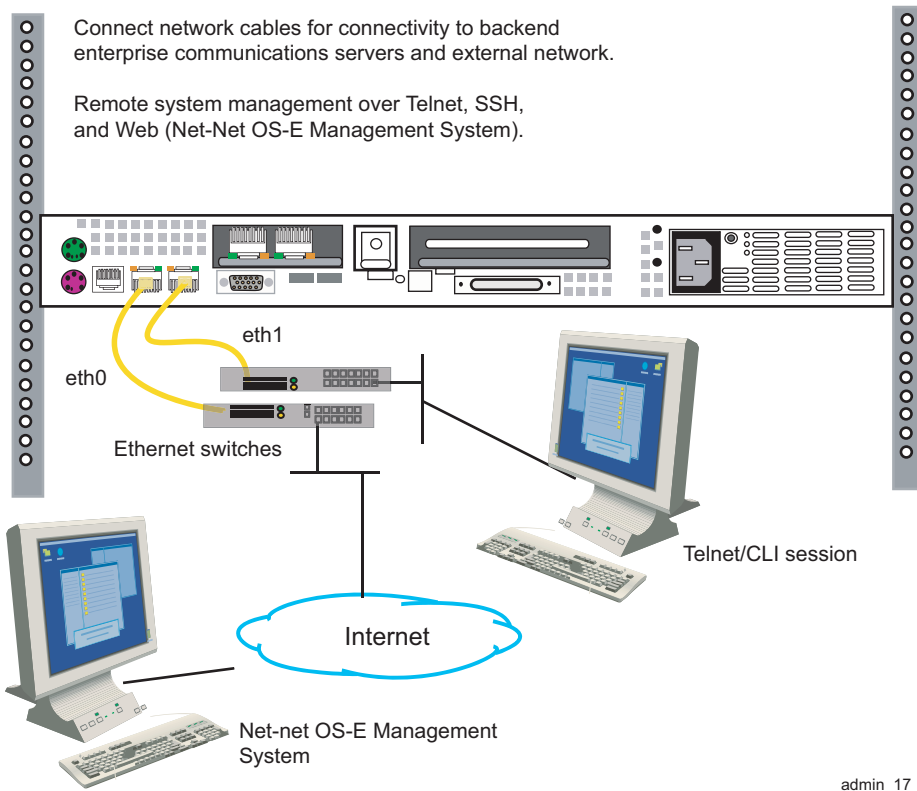
2. Connect the other end of the cable to an available port on the Ethernet hub or switch. The LEDs should display green (Link) and yellow (Activity).
3. If connecting a PC or laptop computer directly to eth0 or eth1, use an Ethernet crossover cable or crossover adapter to ensure a proper connection to the port.

The following image illustrates the OS-E 2600 Series Ethernet connections.



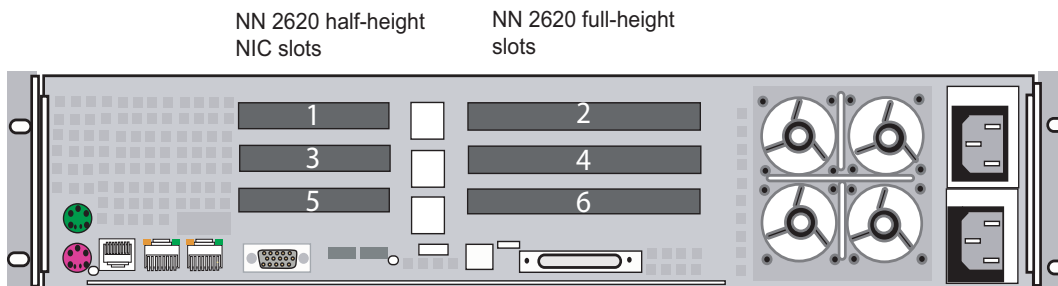
admin_13

The following image illustrates the Net-Net OS-E Series sample network connections.



NN 2620 Half- and Full-Height Slots

The following image illustrates the back of the NN 2620 chassis showing the half- and full-height NIC slots, labeled 1 to 6. Both the half- and full-height slots can accommodate the standard Ethernet dual-port NIC.



For Standard Dual-Port NIC Installations

Install multiple NICs in the following sequence:

1. Install the first NIC in full-height slot 5.
2. Install the second NIC in full-height slot 3.

Ethernet Port Assignments

NN 2620 Ethernet port numbering depends on the number of NIC cards that you are using. Looking at the back of the chassis, port numbering runs left to right, and progresses top to bottom.

- Chassis ports: **eth0, eth1**
- Ethernet NIC 1: **eth2, eth3**

Moving NICs After Installation

There are a number of important considerations if you must relocate NIC cards within the same NN 2620 chassis.

1. Installed NIC cards maintain their port numbering and MAC addressing after initial installation. This means that if you relocate a NIC card from half-height slot 1 to half-height slot 3, the first Ethernet port in slot 3 will be eth2.
2. When relocating a NIC from a half-height slot to a full-height slot, the orientation of the card will be reversed in the new full-height slot installation. This means that the port numbering from the original installation will be reversed in the new slot.
3. Adding NIC cards after the initial installation will result in new port numbers that begin using the highest port number plus 1. For example, if the highest port number is eth11, the first port on the newly added card will be eth12.

Connecting AC Power

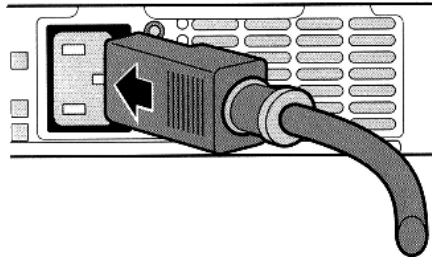
This section shows you how to connect and apply system power to the NN 2600 Series system..

AC Power Requirements

Before installing the power cable, be sure that your site meets the following AC power requirements:

- Voltage: automatic selection/ranging
100 to 127 VAC; 8.2 A maximum @ 50/60HZ;
200 to 240 VAC; 4.1 A max @ 50/60 HZ
- AC power cord — North America (CBL-PWR-USA):
Power module connector: Standard 3-prong keyed IEC receptacle on power module; cord supplied with IEC connector on one end, NEMA 5-15 plug (U.S. domestic) on the other end.
- Other power cords are available for the following countries:
 - Europe (CBL-PWR-EUR)
 - United Kingdom (CBL-PWR-GBR)

The following image illustrates the NN 2610 power connection at the back of the system.

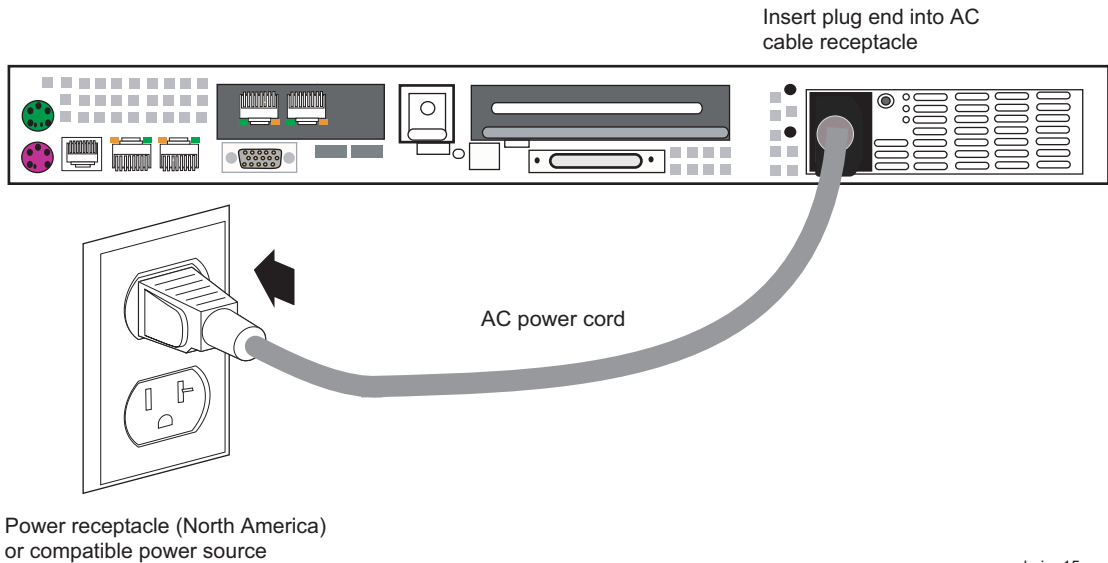


Connecting the AC Power Source

To connect the AC power cables, perform the following steps

1. Locate the system power cord.
2. Insert the plug end into the AC cable receptacle at the back of the system.
3. Plug the other end of the cable into a compatible power source.
4. Repeat Steps 1 to 3 for the redundant power supply, if installing the NN 2620 with redundant power.

The following image displays the NN 2610 AC power installation.



admin_15

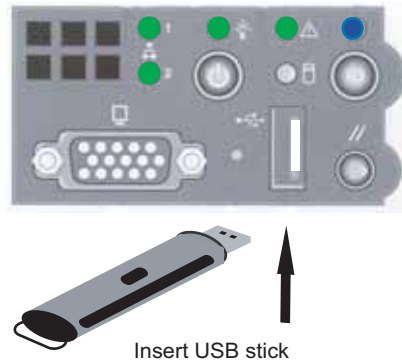
Inserting the USB Stick

Before proceeding with this step, and if you have not already done so, create an installation USB stick from the OS-E software download. Refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions* for complete information on how to use the software download process, create an installation USB, and then commission the system from the USB stick.

When you install the USB into any of the USB ports and then apply power to a new system, the process will install the license and initialize the system. At the end of the boot-up process, the system rewrites the USB stick so that the box identifier and the installed license are matched to this particular system.

You need to remove the USB stick after the system has successfully booted. Later, and if required, you can use this USB stick to run system utilities to restore the system in the event of a failure. Other functions are also available from the utility USB stick.

The following image illustrates inserting the USB stick.



Refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions* for information on USB commissioning, as well as how to create system utility and system restore USBs.

Applying Power

To apply power and to initiate system startup, make sure that the USB stick is installed, then press the system power button on the control panel.

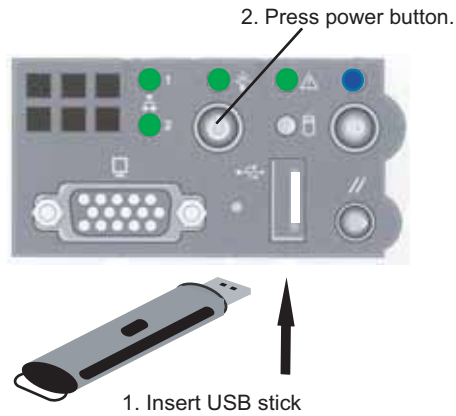


Note: Depending on the actual hardware revision that you are running, the system may power up a few seconds after you attach the power cord. This means that the system will start without having to press the system power button.

The system will take several minutes to go through the startup and diagnostics routines before you will see the username and login prompts.

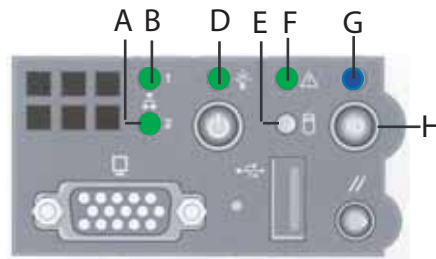
At the NNOS-E prompt, type **umount usb** to properly dismount the USB stick. Physically remove the USB stick from the USB connector.

The following image illustrates the OS-E Series power button.



Checking the LEDs

After powering the system ON, check the system LEDs to ensure proper cabling and connections. The following image illustrates the control panel.



The following table lists LED States that you should verify after powering the system on.

Reference	Feature	Function
B	NIC1 (eth0) activity	Continuous green light indicates a link between the system and the network to which it is connected.
A	NIC2 (eth1) activity	Blinking green light indicates network activity.
D	Power/Sleep LED	Continuous green light indicates the system has power applied to it. Blinking green indicates the system is in a sleep state. No light indicates the power is off.
E	Hard disk drive activity LED	Random blinking green light indicates hard disk drive activity (SCSI or SATA). No light indicates no hard disk drive activity.
F	System Fault LED	Solid green indicates normal operation. Blinking green indicates degraded performance. Solid amber indicates a critical or non-recoverable condition. Blinking amber indicates a non-critical condition. No light indicates power-on-self-test (POST) is running or the system is off.
G	System Identification LED	Solid blue indicates system identification is active. No light indicates system identification is not activated.
H	System Identification button	Toggles the front panel ID LED and the baseboard LED on/off. The baseboard LED is visible through the rear of the chassis and allows you to locate the server you are working on from behind a rack of servers.

Logging On and Starting the CLI

Using a locally attached console with a terminal emulation program, log on to the system for the first time by first pressing the [Enter] key a few times to display the username prompt, and then by responding to the username and password prompts by pressing the [Enter] key. This displays the NNOS-E> prompt on your screen.

```
username: [Enter]  
Password> [Enter]  
NNOS-E>
```

Additional Information on Net-Net OS-E Licensing

Refer to the *Net-Net OS-E – USB Creation and Commissioning Instructions* for information on commissioning a system with the licensed features that you purchased. However, you will need to run **license fetch** under certain conditions, such as renewing an expired license, and when installing licensed features that you did not originally purchase with the system under the original license.

To “fetch” your customized signed license, you will need a private key. This key, as supplied to you by Acme Packet, unlocks and enables the features that you purchased when you run the **license fetch** command from the Acme Packet CLI or OS-E Management System.



Note: If you do not run the **license fetch** command to successfully unlock your customer-specific features, you will not be able to configure the device with any of the licensed options provided by Acme Packet.

Prerequisites

Before you execute the **license fetch** command,

1. Ensure that you have a connection to the public Internet, and
2. Port 616 is available and not blocked by any firewalls. This allows connectivity to the Acme Packet license server.

Fetching the Signed License From the CLI

From the CLI prompt, run the following command:

```
NNOS-E> license fetch <license-key-text>  
Success!
```

Where **<license-key-text>** is the private key provided to you by Acme Packet. This command will contact the Acme Packet licensing server, authenticate your unique key, and then install a license on your system. Make sure that the system reports “Success!”



Note: If you are unable to fetch an encrypted license using the Acme Packet key, cannot access the Acme Packet licensing server, or if you receive a message other than “Success!,” contact Acme Packet Product Support immediately for assistance.

You will need to run **license fetch** for each system that you installed. If you ordered five systems to be installed in a cluster, Acme Packet will provide you with a single license key for the cluster.

Any or all standalone systems outside of a cluster require a separate and unique license.

Fetching the Signed License From the OS-E Management System

If you are using the OS-E Management System, go the **Actions** tab and select **license->fetch** and paste the Acme Packet key into the key field, as illustrated in the following image. Click **Invoke** to install the signed license.

The screenshot shows the Acme Packet web interface. The top navigation bar includes 'Home', 'Configuration', 'Status', 'Call Logs', 'Event Logs', 'Actions' (selected), 'Services', 'Keys', 'Access', 'Tools', and 'Portal'. The left sidebar lists various actions: 'install', 'install examine', 'intercept-sentinel-create', 'intercept-sentinel-delete', 'intercept-session-begin', 'intercept-session-release', 'internal-session', 'jtapi-control', 'license', 'linksys', 'load-balancing', 'location', 'location-database', 'login', 'loopback', and 'make-usb-bootable'. The main content area is titled 'license' and contains the sub-header 'apply or revoke a license'. Below this is a form with the following fields:

- * action**: A dropdown menu with 'fetch' selected, with a tooltip '(fetch a license)'.
- * key**: A text input field.
- server**: A text input field containing 'https://216.41.24.54:443/'.
- Invoke**: A button at the bottom right of the form.

You can also manage licenses with the OS-E Management System **Tools** tab, using the **Retrieve License** and the **Upload License** functions. **Retrieve License** operates the same as the **license fetch** command, contacting the Acme Packet license server over the Internet.

If for some reason you are unable to access the Acme Packet license server, and if Acme Packet sends you the license, place the license on your local PC, use **Upload License** to browse for file, check the **Apply License** box, then click **Upload**.

Adding New Features Later

If you find that you do not have one or more of the features that you purchased, or if you want to add features that you did not originally purchase, contact your Acme Packet Sales Representative or Acme Packet Product Support. Acme Packet will correct the problem and supply you with a new key that you can rerun with the **license fetch** command.

As Acme Packet software becomes available with newly-added features, your Acme Packet Sales Representative will assist you with ordering the software. Acme Packet will then provide you with a new licensing key.

License Expirations and Renewals

If your customer-specific license comes with an expiration date, the system generates an event when the license nears the expiration date. You can renew your license by re-executing the **license fetch** command. The Acme Packet license server verifies that there is a valid license renewal associated with your system ID, and then resets the license expiration to a new date.

Evaluation Systems

For evaluation systems in lab environments without Internet connectivity, Acme Packet will provide you with an alternate method for acquiring the appropriate license to operate and configure the system. Contact your Acme Packet Sales Representative or Product Support for details.

Assigning a Management IP Address

Before you can manage an OS-E system remotely over the Internet using the OS-E Management System or over a Telnet connection, you need to locally assign an IP address to one of the Ethernet interfaces, **eth0**, **eth1**, **eth2**, or **eth3**. If you are setting up the device remotely, you will also need to configure an IP route, a route to a destination host or network, and a gateway IP address.

If you are using the OS-E Management System, you will also need to know the assigned IP address on one of the Ethernet ports to manage the OS-E configuration. The OS-E Management System application runs directly on the OS-E system over the Internet using the Internet Explorer Web browser.

The following CLI session creates and enables an IP interface named *mgmt-int*, sets the static IP address and network mask, configures an IP route (if connecting remotely), and enables Web access on this IP interface. You will need to enable ICMP on the OS-E IP interface before you can use the **ping** command from your console to test the device as a responding node on the network. Use the **show -v** command to display the configuration.

CLI Session

```
NNOS-E> config box
config box> set hostname local2610
config box> config interface eth0
config interface eth0> config ip mgmt-int
Creating 'mgmt-int'
config mgmt-int> set admin enabled
config mgmt-int> set ip-address static 192.168.124.5/24
config mgmt-int> config routing
config routing> config route internetGateway
Creating 'route internetGateway'
config route internetGateway> set destination default
config route internetGateway> set gateway 192.168.124.3
config route internetGateway> return
config routing> return
config ip mgmt-int> config web
config web> set admin enabled
config web> set port 80
config web> return
config mgmt-int> config icmp
config icmp> set admin enabled
config icmp> top
config> save
config> show -v
```

Using the Setup Script

An optional configuration setup script called *cxc.setup* is now included with newly shipped systems. After installing a new system, you can run the script directly from the NNOS-E> prompt, as shown in the example session below.

The script presents a set of questions to help you with the initial system configuration. The information in the script include the following:

- Local hostname
- IP interface names and addresses
- SSH and Web access
- Default route and any additional static routes per interface for remote management
- User-defined CLI prompt

Every OS-E Series system has a minimum of two Ethernet interfaces. Any Ethernet interface on the system can be used for management traffic, however, Acme Packet recommends the use of eth1, as eth0 is reserved for fault-tolerant clustering with other systems. Management traffic is also supported on any interface that is carrying private or public network traffic. This means that it would be possible to use eth1 to carry SIP traffic and management traffic.

CLI Session

```
NNOS-E> config setup
set box\hostname: <name>
config box\interface: eth1
set box\interface eth1\ip a\ip-address: <ipAddress/mask>
config box\interface eth1\ip a\ssh (y or n)? n
config box\interface eth1\ip a\web (y or n)? y
config box\interface eth1\ip a\routing\route: <routeName>
set box\interface eth1\ip a\routing\route localGateway\gateway:
<ipAddress>
set box\cli\prompt: <newPrompt>
Do you want to commit this setup script (y or n) y
Do you want to update the startup configuration (y or n)? y
```



Note: The /cxc directory on the system may include vendor-specific scripts that address unique startup configuration requirements. Specify the name of the script on the command line following the **config setup** command. For example:

```
NNOS-E> config setup vendor.setup
```

Check the /cxc directory for any vendor-specific setup files included with your system.

Enabling Network Access

To ensure you can manage the system using services such as Telnet or the OS-E Management System, you must configure the system so that it is available on the network. You need to create a default (or static) IP route, a route to a destination host or network, and a gateway IP address.

After you configure the static route, enable ICMP and then use the **ping** command at the top-level of the CLI to test network accessibility.

Defining a Default Route and Gateway IP

If you are setting the box remotely, you will need to configure an IP route, a route to a destination host or network, and a gateway IP address.

CLI Session

The example CLI session shows the routing context (in **bold** text) and the route named *internetGateway*. This the default route that uses 192.168.124.3 as the default gateway

```
NNOS-E> config box
config box> set hostname local2610
config box> config interface eth0
config interface eth0> config ip mgmt-int
Creating 'mgmt-int'
config mgmt-int> set admin enabled
config mgmt-int> set ip-address static 192.168.124.5/24
config mgmt-int> config routing
config routing> config route internetGateway
Creating 'route internetGateway'
config route internetGateway> set destination default
config route internetGateway> set gateway 192.168.124.3
config route internetGateway> return
config routing> return
config ip mgmt-int>
```

Cluster Installation

If you are installing OS-E systems in a network cluster, refer to Chapter 4, “Installing Net-Net OS-E Clusters,” and the *Net-Net OS-E – Release Notes* for the latest information.

Chapter 3. Quick Commissioning New Net-Net OS-E Systems

About This Chapter

The chapter provides the basic information that allows you to configure OS-E software after you have physically installed the system in your network. Commissioning enables an OS-E system or compatible third-party device to process locally registered SIP phone calls.

Prerequisites to Quick Commissioning

Before using the information in this chapter, make sure that you have properly installed and cabled the system, as covered in Chapter 1. The following OS-E documents provide additional information on configuring Session OS-E services, as well as how manage the system using the OS-E CLI and the OS-E Management System.

- *Net-Net OS-E – System Administration Guide*
- *Net-Net OS-E – Objects and Properties Reference*
- *Net-Net OS-E – Management Tools*

Additionally, the *Net-Net OS-E – Release Notes* provides important information about the software that you should review before commissioning a system in your network.

Steps 1 through 5 cover the tasks and services for getting the system up and running on an IP network so that the Ethernet interfaces can process SIP sessions. When enabled on an IP network, you can manage the system and its configuration remotely over the Internet using the OS-E Management System.

Steps 6 through 10 cover the tasks that allow you to control and monitor SIP sessions, as well as store call detail records and recordings.

Building the Configuration File

The OS-E configuration file (*cxc.cfg*) is made up of configuration objects and property settings that control how the system processes and manages SIP traffic. As you open these objects and set properties using the CLI or the Net-Net OD-E Management System, the software builds a configuration hierarchy of objects that are applied to SIP sessions. You can display this configuration hierarchy using the **show** and **show -v** (verbose) commands.

For new users, as well as for users who are adding functionality to their configuration, you will need to open configuration objects using the **config** command to enable the default settings for those objects, even if you choose not to edit any of their associated properties. For example, if you need to enable the **ICMP** protocol and its default settings, you simply open the object and execute **return**, as shown in the session below. Notice that the ICMP object has been added to the configuration hierarchy at the end of the session on the eth4 interface.

```
config> config box interface eth4
config interface eth4> config ip 172.26.2.14
config ip 172.26.2.14> config icmp
config ip 172.26.2.14> return
config interface eth4> return
config box> return
config> show -v
  interface eth4
    admin enabled
    mtu 1500
    arp enabled
    speed 1Gb
    duplex full
    autoneg enabled
    ip 172.26.2.14
      admin enabled
      ip-address dhcp
      geolocation 0
      metric 1
      classification-tag
      security-domain
      address-scope
      filter-intf disabled
```

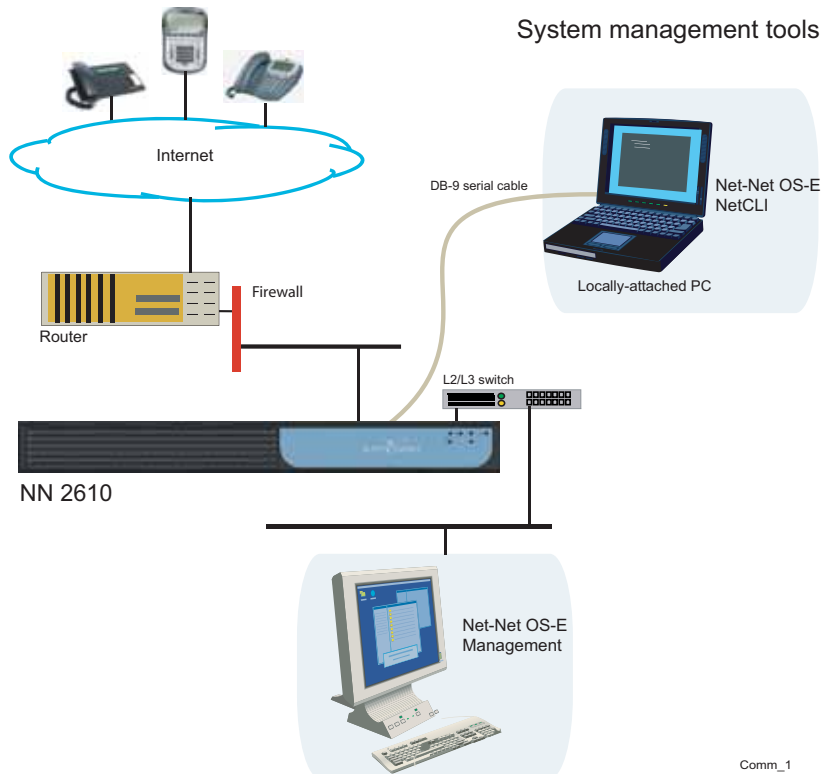
```
icmp
  admin enabled
  limit 10 5
```

To remove an object from the configuration hierarchy, use the CLI or OS-E Management System **delete** command.

Basic Network Topology

The following image illustrates a network topology using the OS-E with a directly-attached PC for initial setup, and the OS-E Management System for remote access using a graphical user interface.

VoIP phones and softphones



Comm_1

Step 1. Configuring Basic IP Connectivity

Before you can manage an OS-E system remotely over the Internet using the OS-E Management System or over a Telnet or SSH connection, you need to locally assign an IP address to one of the Ethernet interfaces, **eth0**, **eth1**, **eth2**, or **eth3**. If you are setting up the device remotely, you will also need to configure an IP route, a route to a destination host or network, and a gateway IP address.

If you are using the OS-E Management System, you will also need to know the assigned IP address on one of the Ethernet ports to manage the OS-E configuration. The OS-E Management System application runs directly on the OS-E system over the Internet using the Internet Explorer Web browser.

The following CLI session creates and enables an IP interface named **192.168.124.5**, sets the static IP address and network mask, configures an IP route (if connecting remotely), and enables Web access on this IP interface. You will need to enable ICMP on the OS-E IP interface before you can use the **ping** command from your console to test the device as a responding node on the network. Use the **show -v** command to display the configuration.

CLI Session

```
NNOS-E> config box
config box> set hostname local2610
config box> config interface eth1
config interface eth1> config ip mgmt-int
Creating 'mgmt-int'
config mgmt-int> set admin enabled
config mgmt-int> set ip-address static 192.168.124.5/24
config mgmt-int> config routing
config routing> config route internetGateway
Creating 'route internetGateway'
config route internetGateway> set destination default
config route internetGateway> set gateway 192.168.124.3
config route internetGateway> return
config routing> return
config ip mgmt-int> config web
config web> set admin enabled
config web> set port 80
config web> return
config mgmt-int> config icmp
config icmp> set admin enabled
config icmp> top
config> save
config> show -v
```

Using the Setup Script

An optional configuration setup script called *exc.setup* is now included with newly shipped systems. After installing a new system, you can run the script directly from the NNOS-E> prompt, as shown in the example session below.

The script presents a set of questions to help you with the initial system configuration. The information in the script includes the following:

- Local hostname
- IP interface names and addresses
- SSH and Web access
- Default route and any additional static routes per interface for remote management
- User-defined CLI prompt

Every OS-E system has a minimum of two Ethernet interfaces. Any Ethernet interface on the system can be used for management traffic, however, Acme Packet recommends the use of eth1, as eth0 is reserved for fault-tolerant clustering with other OS-E systems. Management traffic is also supported on any interface that is carrying private or public network traffic. This means that it would be possible to use eth1 to carry SIP traffic and management traffic.

CLI Session

```
NNOS-E> config setup
set box\hostname: <name>
config box\interface: eth1
set box\interface eth1\ip a\ip-address: <ipAddress/mask>
config box\interface eth1\ip a\ssh (y or n)? n
config box\interface eth1\ip a\web (y or n)? y
config box\interface eth1\ip a\routing\route: <routeName>
set box\interface eth1\ip a\routing\route localGateway\gateway:
<ipAddress>
set box\cli\prompt: <newPrompt>
Do you want to commit this setup script (y or n) y
Do you want to update the startup configuration (y or n)? y
```



Note: The `/cxc` directory on the OS-E system may include vendor-specific scripts that address unique startup configuration requirements. Specify the name of the script on the command line following the **config setup** command. For example:

```
NNOS-E> config setup vendor.setup
```

Check the `/cxc` directory for any vendor-specific setup files included with your system.

Enabling Network Access

To ensure you can manage the system using services such as Telnet or the OS-E Management System, you must configure the OS-E system so that it is available on the network. You need to create a default (or static) IP route, a route to a destination host or network, and a gateway IP address.

After you configure the static route, enable ICMP and then use the **ping** command at the top-level of the CLI to test network accessibility.

Defining a Default Route and Gateway IP

If you are setting the box remotely, you will need to configure an IP route, a route to a destination host or network, and a gateway IP address.

Refer to Step 1. Configuring Basic IP Connectivitythe previous section in this chapter, for the example CLI session that shows the routing context and the route named *internetGateway*. This is the default route that uses 192.168.124.3 as the default gateway.

Launching the OS-E Management System

In addition to the CLI, you can use the OS-E Management System to configure the OS-E. To access the OS-E using the OS-E Management System, open an HTTP or secure HTTP window (HTTPS) to the IP address of the Eth0 port on the OS-E system. For example:

`https://192.168.124.5`

You should see the Acme Packet OS-E Log In window, illustrated in the following image.

Acme Packet Net-Net OS-E

To access the NNOS-E management interface, you must first log in. Please provide your user name and password.

Username:

Password:

Login

By default, there are no user accounts configured on a new system. This means any value can be entered in for username & password, or leave the fields blank and click **Login**. Once you log in, the OS-E Management System main page appears.

acme packet

Logout guest

Home

Configuration

Status

Call Logs

Event Logs

Actions

Services

Keys

Access

Tools

Portal

Get summary for:

Box 1

Refresh

Help

box-identifier

Loading...

box-status

IPAddress
State
build-version
build-number

master-services

Loading...

up-time

time
timezone
uptime

system-info

cpu-usage-one-second

call-info

active-calls

location-info

total-cache-entries
location-bindings

The remaining steps in this chapter use the OS-E Management System to commission the OS-E.

Step 2. Configuring Advanced IP Connectivity

Use the **Configuration** tab or the CLI to configure several additional Ethernet interfaces, as covered in Step 1. As a security device, the NN 2600 Series uses a default setting of **disabled** for these objects in the configuration file. This means that you must enable each interface. These objects include:

- **SSH**—To enable SSH client connectivity on the interface
- **Media ports**—To enable a range of port numbers for on the interface
- **SIP**—To enable SIP traffic on the interface)

When editing Ethernet interface and examining each object using the OS-E Management System, note that many of the objects are already visible, but they are not yet enabled. For these objects to actually be enabled on the OS-E system, you must select the object and save the configuration.

After editing an interface configuration, elect **Set**, then **Update & save configuration**, as illustrated in the following image.

The screenshot shows the AcmePacket Configuration web interface. The left sidebar displays a tree view of the configuration hierarchy, with 'ip heartbeat' selected. The main panel shows the configuration for 'Configure cluster: AcmePacket, Inc. box 1\interface eth0\ip heartbeat'. The 'general' section includes fields for name, admin, ip-address, geolocation, security-domain, address-scope, filter-intf, and media-ports. The 'other properties' section includes metric, classification-tag, routing-tag, trusted-peer, telnet, ssh, snmp, web, and web-service.

When you select **Configuration/Update and save configuration** you will be asked "Do you want to update the live configuration?" followed by "Do you also want to save the live configuration?" Click **OK** for both questions to ensure that the configuration is properly saved to the OS-E configuration file, *cxc.cfg*.

The following steps are necessary to set some specific parameters for the objects listed above:

1. Select the Configuration **Cluster/ Box 1/Interface Eth0/IP local** object on the left menu tree. Under the **General** field, edit the Media Ports properties as desired, then click **Set**.
2. Under the **Other Properties** field, edit the SSH properties. Accept the defaults by clicking **Set**.

3. Select **SIP** from the menu tree. Enter the following values for each fields:
 - admin: enabled (default)
 - NAT translation: disabled (default)
 - UDP port: Select **Add UDP port**, accept the defaults, then click **Finish->Set**.
 - TCP port: Select **Add UDP port**, accept the defaults, then click **Finish->Set**.
 - TLS port: Select **Add UDP port**, accept the defaults, then click **Finish->Set**.
 - Certificate: blank (default)

When you are finished editing the SIP fields, select **Set->Configuration/Update and save configuration**.

Step 3. Creating User Accounts for Basic Access

By default, the OS-E does not contain any predefined user accounts. This means it is possible to access the management interfaces without entering any login credentials (username and password). You are not required to create user accounts, but it may be desirable for security reasons. If you want to create a user account at this time, follow the steps below. If not, go directly to Step 4.

1. Using the OS-E Management System, select the **Access** tab, then select **Access** from the left menu pane. The Access Permissions/Configure Access page appears.

Access Permissions: all

Configuration Setup View

access

- permissions guest
- permissions jen
- permissions grant
- permissions test
- permissions 1
- users
- radius

Configure access Help Index

Set Reset Delete

permissions

	permissions	cli	gui
Edit Delete	permissions.guest	advanced	enabled
Edit Delete	permissions.jen	advanced	enabled
Edit Delete	permissions.grant	normal	enabled-web-only
Edit Delete	permissions.test	normal	enabled
Edit Delete	permissions.1	normal	enabled

Add permissions

directories

	directories	admin
▼ Edit Delete	users	enabled
▲ Edit Delete	radius	enabled

Add enterprise
Add radius
Add users

Set Reset

Help Index

2. Under **permissions**, select **Add permissions** and create a permissions group called *super-user* and accept all default settings with all permission types enabled. Select **Set**, then select **Update and save configuration** from the Configuration pull-down in the left pane.
3. From the **Directories** object, select **Add users**. Accept the default setting of enabled.
4. Select **Add user** and enter the required **name** and **password** of your choice, then re-enter the password to **confirm** your original password entry. In the **permissions** field, choose the permissions group that you just created (*super-user*).
5. Click **Create**. Select **Configuration->Update and save configuration**.

These steps created a username and password for a super-user account. Future attempts to log in to the OS-E (using the CLI or the OS-E Management System) will require that you specify these login credentials. If needed, you can also create user accounts with one or more of the super-user permissions.

Step 4. Enabling Master Services

The **master-services** configuration enables directory, accounting, database and registration services to run on the system. Perform the following steps to configure these master services:

1. Select the **Services** tab, then select **master-services** from the left menu pane.
2. Accept the default settings for **cluster-master**, **directory**, **accounting**, **database** (with **Show advanced** button selected), and **registration**. Click **Set**.

After you have configured all five services, select Configuration->**Update and save configuration**. The completed Master Services configuration should appear as shown in the following image.

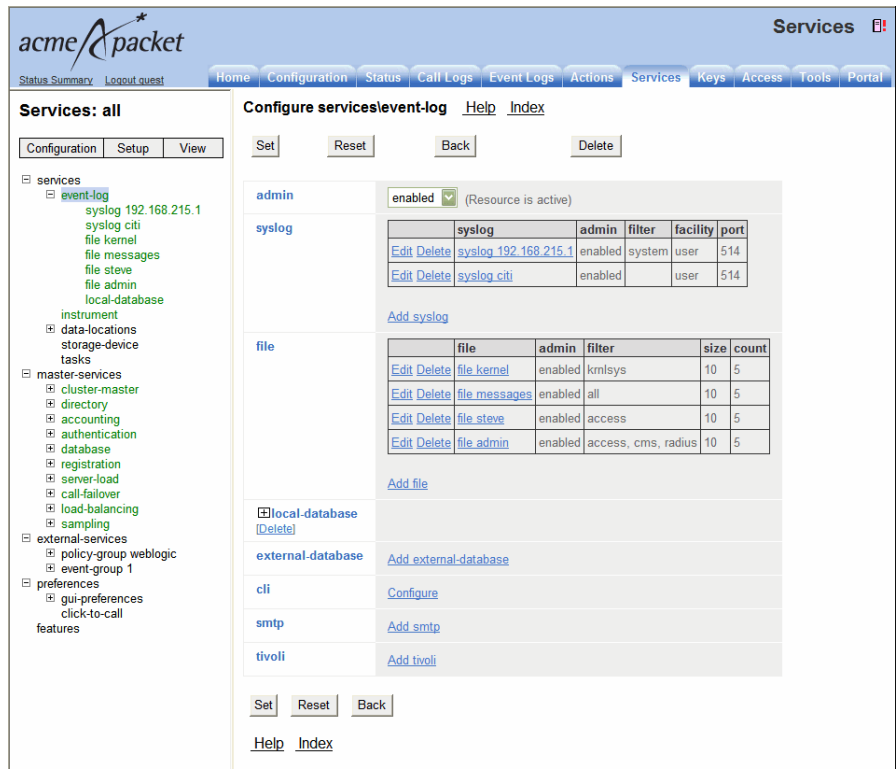
The screenshot shows the 'acme packet' web interface. The 'Services' tab is selected. On the left, a tree view shows 'Services: all' expanded, with 'master-services' selected. The main area is titled 'Configure master-services' and contains five service configuration panels, each with 'Set', 'Reset', and 'Delete' buttons. All services are enabled.

Service	admin	host-box	group	preempt	takeover-timer-value
cluster-master	enable (checked) (Resource is active)	cluster/box 1	0 (from 0 to 32, default=0)	false (checked)	1000 milliseconds
directory	enable (checked) (Resource is active)	cluster/box 1	0 (from 0 to 32, default=0)	false (checked)	1000 milliseconds
accounting	enable (checked) (Resource is active)	cluster/box 1	0 (from 0 to 32, default=0)	false (checked)	1000 milliseconds
authentication	enable (checked) (Resource is active)	cluster/box 1	0 (from 0 to 32, default=0)	false (checked)	1000 milliseconds
database	enable (checked) (Resource is active)	cluster/box 1			

Step 5. Configuring Basic Services

The **Services** configuration enables event logging and virus scanning services to run on the OS-E. Perform the following steps to configure event logging on the system.

1. Select the **Services** tab then select Services from the left menu pane.
2. On the Configure services page, select **event-log** from the menu pane, accept the defaults and click **Set**. Under the **event-log** configuration, additional options are available that you can configure, as illustrated in the following image.



You can direct the event logs to one or more of the following locations:

- A syslog server
- An ASCII file in an OS-E directory
- A database on the OS-E system
- An external database

The following image shows a configuration that specifies that logs should be directed to a syslog host (at 192.168.215.1), a local file on the system, and the local database. The syslog system will receive messages of the system severity (or lower). The local file is named *messages* is created in the log directory.

The configuration also shows two filters: the first filter captures events of the *system* class with **debug** severity level, and the second filter captures event messages that match the **error** severity level. Refer to the *Net-Net OS-E – System Administration Guide* for information about event logs, syslog, and event filters.

3. In the **file** object, click **Edit**, then enter the name *event-log* in the text block. Click **Set**.

This configures event logging so that messages are written to the local file named *event-log*.

The screenshot shows the 'acme packet' web interface. The top navigation bar includes 'Home', 'Configuration', 'Status', 'Call Logs', 'Event Logs', 'Actions', 'Services', 'Keys', 'Access', 'Tools', and 'Portal'. The 'Services' tab is active. On the left, a tree view shows 'Services: all' with a list of services including 'event-log' (highlighted). The main content area is titled 'Configure services/event-log/file messages' and contains the following configuration fields:

- * file:** messages
- admin:** enabled (Resource is active)
- filter:** A table with two columns: 'filter' and 'severity'. The first row shows 'error' in the 'severity' column. Below the table are links for 'Edit', 'Delete', and 'filter all', and an 'Add filter' link.
- size:** 10 Mbytes (from 1 to 100, default=10)
- count:** 5 (from 1 to 20, default=5)

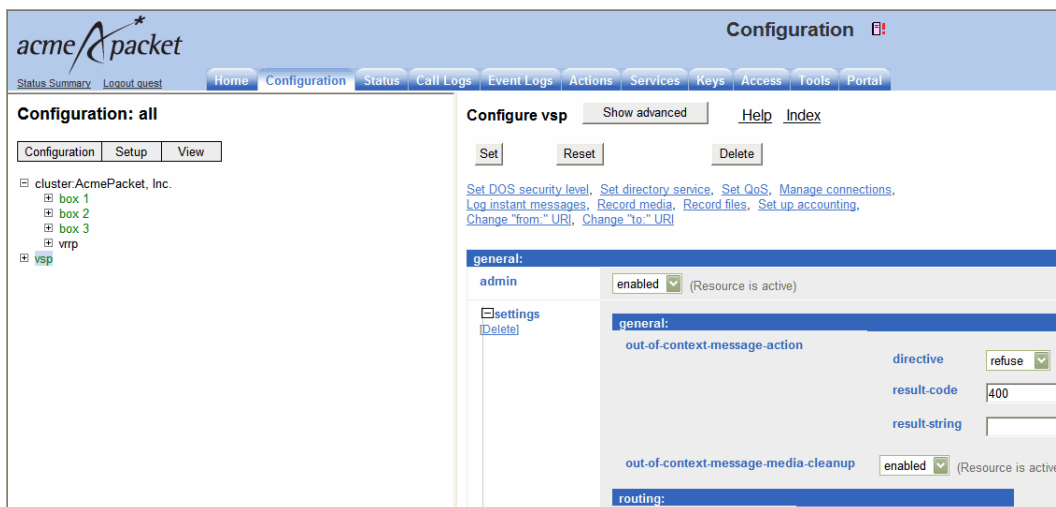
Buttons for 'Set', 'Reset', 'Back', 'Copy', and 'Delete' are located at the top and bottom of the configuration area. 'Help' and 'Index' links are also present.

Step 6. Enabling the Virtual System Partition (VSP)

The OS-E virtual system partition (VSP) is the part of the system that holds the comprehensive customer-defined configuration that controls how the system processes, stores, directs, and routes SIP traffic. The VSP is where you can create session configurations, registration and dial plans, and policies that handle SIP REGISTER and SIP INVITE traffic (and other SIP methods) that the system will receive and forward to a SIP call destination, authentication and accounting database, VoIP service provider or carrier, enterprise server, and so on.

Using the OS-E Management System, perform the following steps.

1. Select the **Configuration** tab, then select **vsp** from the menu to open the Configure vsp page, as illustrated in the following image.



2. Under the general heading:, change the **admin** state to **enabled**.
3. Click **Set**, then select **Configuration->Update and save configuration**.

Step 7. Configuring the Accounting Environments

This step is necessary to configure the system to store call detail records and voice call recordings.

1. Select the OS-E Management System **Configuration** tab, then select **vsp->accounting** from the menu to display the Configure vsp\accounting page, as illustrated in the following image.

The screenshot shows the acmePacket Configuration interface. On the left is a tree view under 'Configuration: all' with a 'View' button. The tree includes 'cluster:AcmePacket, Inc.' with sub-items 'box 1', 'box 2', 'box 3', and 'vrp'. Under 'vrp' is 'vsp', which contains 'registration-service' and a list of services including 'access', 'default-session-config', 'autonomous-ip', 'tls', 'pre-session-config', 'policies', 'user cxc', 'static-stack-settings', 'session-config-pool', 'dial-plan', 'registration-plan', 'enterprise', 'carriers', 'calling-groups', 'accounting' (selected), 'radius', 'database', 'file-system', 'monitor-group kak', 'radius-group Boston', 'radius-group aaaGroup1', 'radius-group aaaGroup2', 'radius-group 1', 'radius-group default', 'im-filtering', 'dns', 'location-service', 'database', 'settings', 'services-routing', 'oci-settings', 'external-services\policy-group weblogic', 'authentication-settings', and 'authorization-settings'. The main panel is titled 'Configure vsp\accounting' and has buttons for 'Set', 'Reset', 'Back', and 'Delete'. It contains several sections: 'options:' with 'admin' set to 'enabled' (Resource is active); 'targets:' with 'radius', 'syslog', 'database', 'file-system' (with a 'Delete' link), and 'external-file-system' (all with 'Configure' links); 'archiving:' with 'archiving' (with a 'Configure' link); 'purge:' with 'purge-criteria' set to 'purge-always', 'retention-period' set to '7 days 00:00:00', and 'purge-disk-utilization-percent' set to '95'; and 'other properties:' with 'duration-type' set to 'default', 'subdirectory-size' set to '1000', and a 'report' link. At the bottom are 'Set', 'Reset', and 'Back' buttons.

2. Under **targets**, go to the **database** and set the **admin** property to enabled.
3. Select the database **Add group** command. The Edit group screen appears, as illustrated in the following image.

The screenshot shows the 'acme packet' Configuration page. The left sidebar shows a tree view with 'cluster:AcmePacket, Inc.' expanded, showing 'box 1', 'box 2', 'box 3', 'vrrp', and 'vsp'. The 'vsp' section is expanded, showing 'registration-service', 'access', 'default-session-config', 'autonomous-ip', and 'tls'. The main content area is titled 'Create vsplaccounting|database|group localdb - Step 2 of 2: Edit server'. It shows 'group localdb >> server' and 'Please configure a server for group localdb.' There are two input fields: '* name' with 'localdb' and '* type' with a dropdown menu set to 'local'. Below the fields are buttons: 'Previous', 'Create', 'Reset', and 'Cancel'.

4. Enter *localdb* in the **target-name** field and select **Create** to display the Configure database group page, as illustrated in the following image..

The screenshot shows the 'acme packet' Configuration page. The left sidebar shows a tree view with 'cluster:AcmePacket, Inc.' expanded, showing 'box 1', 'box 2', 'box 3', 'vrrp', and 'vsp'. The 'vsp' section is expanded, showing 'registration-service', 'access', 'default-session-config', 'autonomous-ip', 'tls', 'pre-session-config', 'policies', 'static-stack-settings', 'session-config-pool', 'dial-plan', 'registration-plan', 'enterprise', 'carriers', 'calling-groups', 'accounting', 'radius', 'database', 'file-system', and 'monitor-group kak'. The main content area is titled 'Configure vsplaccounting|database|group localdb'. It shows 'Set', 'Reset', 'Back', 'Copy', and 'Delete' buttons. There are several input fields: '* target-name' with 'localdb', 'admin' with a dropdown menu set to 'enabled', '* mode' with a dropdown menu set to 'duplicate', and '* server' with a table. The table has columns: 'server', 'admin', 'type', and 'username'. The table contains one row: 'server', 'admin', 'enabled', 'local'. Below the table is a button 'Add server'. There are also links for 'call-field-filter' (Delete), 'column-replacement-names' (Add column-replacement-names), and 'batch-insert-size' (25, from 1 to 50, default). At the bottom are buttons: 'Set', 'Reset', 'Back', 'Copy', and links: 'Help', 'Index'.

5. Click **Edit** and configure the following settings:
- **admin:** enabled
 - **name:** localdb
 - **type:** Select **local**

- **username:** postgres
- **password-tag:** postgres



Note: If you set the server **type** to *local*, using the local database as the accounting target, set the **username** and the **password-tag** to *postgres*. If you edit the **username** and **password-tag** properties to anything other than *postgres*, data will not be written to the database.

For information about password tags, refer to the *Net-Net OS-E – Objects and Properties Reference*.

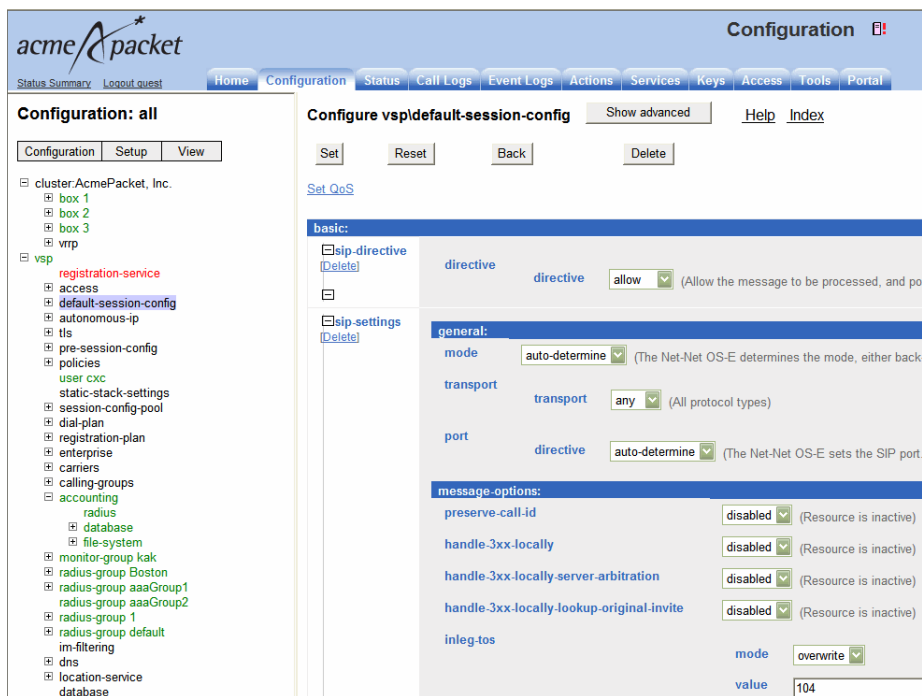
6. Click **Set**, then select **Configuration->Update** and save configuration. The screen appears as illustrated in the following image.

The screenshot shows the acmeApocket Configuration interface. The left sidebar lists the configuration tree under 'Configuration: all', including 'cluster:AcmePacket, Inc.', 'box 1', 'box 2', 'box 3', 'vrrp', 'vsp', 'registration-service', 'access', 'default-session-config', 'autonomous-ip', 'tls', 'pre-session-config', 'policies', 'user cxc', 'static-stack-settings', 'session-config-pool', 'dial-plan', and 'registration-plan'. The main panel displays the configuration for 'Configure vsplaccounting\database\group localdbserver:localdb'. It includes buttons for 'Set', 'Reset', 'Back', and 'Copy'. The configuration fields are: 'admin' (enabled), '* name' (localdb), '* type' (local), 'username' (postgres), and 'password-tag' (postgres). There is a 'Manage Password' link next to the password-tag field. At the bottom, there are 'Help' and 'Index' links.

Step 8. Editing the Default Session Configuration

Step 8 configures a default system policy that allows the OS-E to process SIP traffic. By default, and for security purposes, the OS-E does not allow any SIP traffic to pass.

1. Select the Configuration tab, then select **vsp->default-session-config** from the menu to display the vsp/default-session-config page, as illustrated in the following image (top portion).

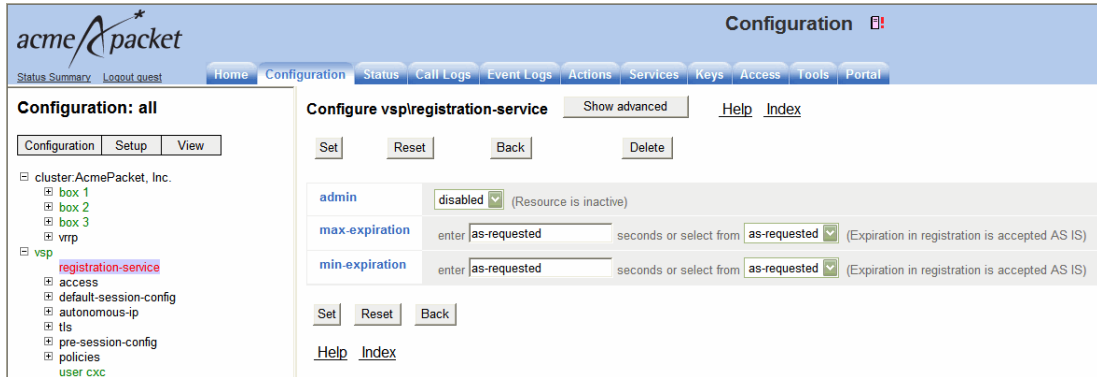


2. In the **sip-directive** object, change the directive policy to **allow**, if not already set. This allows SIP traffic to traverse the OS-E system. Click **Set**.
3. Scroll down to the **media** object. Change the **anchor** and the **recording-policy/record** properties to **enabled**. Accept all other default settings.
4. Click **Set**, then select **Configuration->Update and save configuration**.

Step 9. Enabling Registration Services

Step 9 enables the OS-E to handle SIP REGISTER sessions, allowing locally registered SIP clients to pass SIP sessions, as well as forward REGISTER sessions to upstream destination registrars.

1. Select the Configuration tab, then select **vsp/ registration-service** from the menu tree to display the vsp/registration-service page, as illustrated in the following image.



2. Accept the default settings and click **Set**. This enables the registration service on the OS-E system.

The OS-E will now provide support for basic SIP calls between locally registered clients.

Step 10. Reviewing the Configuration

Once you have completed Steps 1 through 9, review the configuration to make sure it is accurate. A quick way to do this is to scan the OS-E Management System navigation tree to make sure there is an entry for each of the objects that you configured.

The following image is a listing of the Configuration and Services objects configured as part of basic OS-E commissioning. If you are using the CLI, run the `show -v` command from the NNOS-E prompt to display the configuration that you just created. The following image displays the configuration and services navigation trees.

Configuration: all

Configuration

Setup

View

cluster:AcmePacket, Inc.

box 1

box 2

box 3

vrp

vsp

registration-service

access

default-session-config

autonomous-ip

tls

pre-session-config

policies

user cxc

static-stack-settings

session-config-pool

dial-plan

registration-plan

enterprise

carriers

calling-groups

accounting

monitor-group kak

radius-group Boston

radius-group aaaGroup1

radius-group aaaGroup2

radius-group 1

radius-group default

im-filtering

dns

acme packet

Status Summary

Logout quest

Services: all

Configuration

Setup

View

services

event-log

instrument

data-locations

storage-device

tasks

master-services

cluster-master

directory

accounting

authentication

database

registration

server-load

call-failover

load-balancing

sampling

external-services

preferences

gui-preferences

click-to-call

features

Chapter 4. Installing Net-Net OS-E Clusters

About This Chapter

This chapter provides information on how to install an OS-E cluster, a group of OS-E systems that operate together to support redundancy and failover, high-availability, load balancing, and configuration.

Net-Net OS-E Cluster Overview

A “high-availability” cluster is a group of OS-E systems that provides a single point of configuration management, and at the same time, expands functionality across multiple devices participating in the cluster. An OS-E *master* manages the configuration for the entire cluster. All members of the cluster share network resources, network load, media ports and streaming, registration, and other processes.

OS-E systems within a cluster may be geographically dispersed in the network. A cluster recovers from the failure of one or more cluster members through health monitoring, shared master services migration, and network redundancy using the Virtual Router Redundancy Protocol (VRRP).

A cluster can be set up to operate as a two-system primary/standby redundant configuration.

Cluster Operations and Services

In the two-system redundant configuration, one OS-E system is the active master, performing signaling & media processing, and the other OS-E system is available as a standby system for the signaling & media processing if the master fails. Master failover allows another OS-E system to assume the master role in the cluster should the originally configured master become unavailable. VRRP is responsible for handling the failover from the master to the backup device.

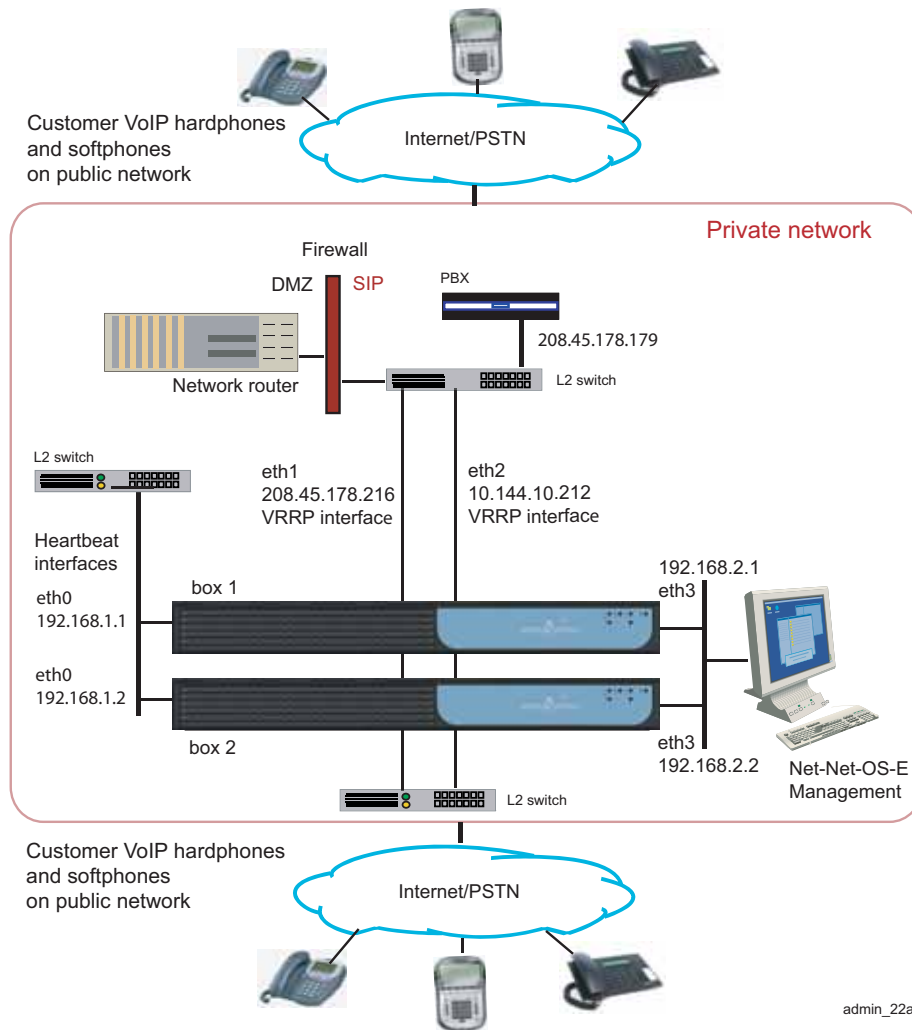
Master-Services

The **master-services** configuration is responsible for mirroring the state of the cluster to allow reliable failover to a standby device. The following sections describe the suggested settings for the **master-services** objects:

Cluster-Master

A **cluster-master** configuration on the OS-E system designated as the master is responsible for passing configuration changes to cluster members. A secondary property called **takeover-timer-value** specifies the number of milliseconds (such as 500) that the master-service stays in “awaiting takeover” mode at boot time.

Use the **show -v** command to display the **current takeover-timer** value. When the OS-E boots, each hosted master-service waits for this period to determine if any existing devices in the cluster are already running that service before assuming mastership.



Directory

When enabled, directory services allows the OS-E master to use enterprise (or corporate) directories that contain the identities of SIP users who are authorized to access the SIP enterprise communications servers.

In environments running CSTA, it is necessary to link the **directory** master service into a VRRP group with an interface to reach a Broadsoft OCI server. If the directory service is running on an OS-E system that cannot reach the OCI server, the CSTA-to-OCI translation will not function. Use a **takeover-timer-value** of 500 milliseconds.

Accounting

When enabled, accounting services supports RADIUS accounting, system logging (syslog), DIAMETER protocol services, the accounting database, and the accounting file-system

Authentication

Authentication services enables or disables all authentication functions on the OS-E, such as RADIUS and local user profiles. If authentication is disabled, you can still configure the authentication services, but the services do not become active until you enable this master service.

It may be necessary to link the authentication service to VRRP interface(s) using a group configuration if the VRRP interface is used to contact the authentication servers. Use a **takeover-timer-value** of 500 milliseconds for authentication.

Database

The master-services **database** object allows you to configure maintenance and other settings for the OS-E system database. The OS-E database is the local repository for call accounting records and media files

The **database** master service should be on a backup OS-E system, with the secondary property **preempt** set to *true*. This will help maintain the data in one location in the event of a brief service outage.

The **preempt** property specifies whether the master-service should resume the mastership if it has gone down and then returned to operation. If set to *true*, the master resumes its position. If set to *false*, the backup service retains master control.

Server-Load

The master-services **server-load** object configures the OS-E to calculate server load. This object must be enabled if your dial plan arbiter rule settings use **least-load** as the routing algorithm option. (The arbiter rule property sets the criteria by which the OS-E selects the server to which it forwards calls.)

Configure the **server-load** master-service for outbound server load balancing or server based admission\emission control. Currently, the **server-load** master-service should be linked to the VRRP SIP signaling interfaces over a configured group.

Call-Failover

The **call-failover** master-service configures failover for the media and signaling streams. As a master-service, the configured host OS-E master distributes copies of the media and kernel rules to all backup devices in a cluster. The OS-E uses the database on the host box, but enabling **call-failover** ensures that there is an active copy of the database on another device in the cluster in the event of a failure.

Registration

Enabling the registration service allows the OS-E to accept SIP REGISTER requests in behalf of other SIP servers (called *registrar peers*) that reside in other domains.

The **registration** master-service configures the registration process for intracuster registration lookups. In a cluster, the registration database runs on the specified master and the selected backups. The **host-box** property establishes the master and selective mirroring. The first OS-E listed is the master, while subsequent devices have mirrored databases. The OS-E systems not configured with the **host-box** property use the local location cache instead of the registration database. The **registration** master-service must be enabled for load-balancing of SIP processing (across backing interfaces configured with the **sip** object) to function correctly.

Load-Balancing

The master-services **load-balancing** object configures OS-E systems to host the load-balancing master service. For detailed information, see Configuring Cluster Load Balancing.

File-Mirror

The master-services **file-mirror** object sets all participating OS-E systems to share particular files (the types of files shared are preset in the OS-E operating system), such as media recordings, log files, etc. The file-mirror master service distributes files to all OS-E systems listed as hosts for the service.

Once the files are mirrored, you can play them back from any OS-E system that functions as a host.

Least-Cost-Routing

The master-services **least-cost-routing object** sets the least-cost routing (LCR) master service, which manages the server process. The master service handles requests from local or remote OS-E systems for least cost route definitions.

For detailed information on LCR, see the following manuals:

- *Net-Net OS-E – System Administration Guide*
- *Net-Net OS-E – Objects and Properties Reference*
- *Net-Net OS-E – Session Services Configuration Guide*

Sampling

The master-services **sampling** object opens the mechanism for setting the interval at which the OS-E samples operational aspects of the system for either:

- Display in the OS-E Management System, or
- For sending to an IBM Tivoli server

By setting sampling for a status provider, you can view data for that provider over a specified period of time. The OS-E supports two sampling targets—a Postgres SQL database and an IBM tivoli server. (Set the provider data sent to the target using the **status** and **provider** objects. See *Net-Net OS-E – Objects and Properties Reference* for more information on configuring these objects.)

Once you have enabled **sampling**, the master service stores the samples in its local database.

Third-Party-Call-Control (3PCC)

The master-services **3pcc** (third-party-call-control) object configures call control, allowing the OS-E or a CSTA client to control (become the third party) in a call. Specifically, this object controls the WAV files that the OS-E should play and the external status events reported to an external server for calls created by the OS-E.

For detailed information on CSTA, see the following manuals:

- *Net-Net OS-E – System Administration Guide*
- *Net-Net OS-E – Objects and Properties Reference*
- *Net-Net OS-E – Session Services Configuration Guide*

Heartbeat Interface, BOOTP, and Messaging

Use the Ethernet physical interface **eth0** as the heartbeat interface for the OS-E cluster. This interface is used by default for any backup OS-E system that you added to the cluster. The systems will perform a BOOTP request over that interface and you will be able to add these systems by creating an entry for each to the configuration, and then booting them.

Once an OS-E is a member of the cluster, that system will receive a saved configuration file (*cxc.cfg*) from the master. Each time the *cxc.cfg* file is saved on the master, the latest copy of the *cxc.cfg* file is sent to each device in the cluster. You will need to configure a messaging interface on each cluster member so that the master knows the interface over which members of the cluster will receive the *cxc.cfg* file.

Event Logging

Event logs are stored on each box individually and represent the events that occurred on that particular OS-E system. You configure event logging in the **services/event-logs** configuration object. The recommended event log filters on a cluster are as follows:

- Local-database all error
- File *name* system error
- File *name* krnlsys info
- File *name* system info

- File *name* db info

Network Time Protocol (NTP)

Ensure that you have NTP configured on all OS-E systems, ensuring that they point to a timeserver which will keep their time synchronized. **DO NOT** use a VRRP interface as your route to the timeserver, since one device will always have the VRRP interfaces down and will not be able to contact the NTP server.

If you do not have access to an external NTP server, configure one of the clustered OS-E systems to be an NTP server for the other cluster members. It is important to run NTP, as the time on all clustered system must be kept synchronized. If the times on the OS-E systems drift apart, the Denial of Service (DOS) software will not function properly, as timestamps are required to make this work across the cluster.

You can configure the NTP-server on the messaging interface on one OS-E system, and have all other devices point to this IP address in their NTP-client configuration.

Cluster Redundancy Operations

The OS-E cluster redundancy operates as follows:

- Internal messaging is exchanged so that each OS-E system knows the state of the other boxes, either up or down.
- If the active cluster master goes down, the box listed next in the list of cluster masters becomes the active cluster master. (Note that mastership does not automatically go back to the original system when it returns to service.)
- All the other master services work similarly, with an ordered list of devices that can run the service and the active service running on the next device in the list if the active master fails.

If an OS-E system fails, another device in the cluster will assume its network interfaces using VRRP.

Notes on Cluster Management

The OS-E cluster management operates as follows:

- Within a given cluster, one box functions as the active cluster master.

- Configuration and management of all boxes within a cluster is performed through the cluster master.
- There are no limitations on how many boxes within the cluster can be configured as backup cluster masters or backups for any of the master services.
- The configuration contains a list of boxes that can be cluster masters. The ordering of this list reflects the order in which boxes attempt to become master (i.e. the box listed first becomes the initial master, if that box fails then the next box in the list attempts to become the master, etc.)
- The OS-E Management System connects to the cluster master and provides a single point of management for the following:
 - Configuration
 - Status reports
 - Call logs
 - Accounting data
 - Actions
- The CLI provides single point of management for configuration using the CLI on the cluster master. The CLI is still available on all the other devices in the cluster, so any CLI commands can be executed on individual boxes.
- Note that the management functionality available from a given cluster is dependent on the functionality being performed by that cluster. For example, call logs are available only on clusters where signaling is performed; media recordings are available only on clusters where media streaming is performed.

Cluster Installation Prerequisites

Before beginning the cluster installation, ensure that any L2/L3 switch supporting the cluster has the Port Fast, Fast Link, or similar feature turned on. This allows the switch to run the Spanning Tree 802.1 protocol so that the switch ports being used by the OS-E go directly to the “forwarding” state. If the switch does not support Port Fast or Fast Link, disable the Spanning Tree protocol for the VLANs associated with the switch ports being used by the OS-E.

Cluster Installation Procedure

There are a number of steps that you need to follow to install an OS-E network cluster. You will need to know certain information about all the systems in the cluster for proper operation.

Each step uses a sample CLI session of commands that best illustrate how to best configure important settings.

1. Determine the specific OS-E system to assume the role of cluster master. Configure **master-services** to specify the device the cluster to assume initial mastership.

```
NNOS-E> config master-services
config master-services> config cluster-master
config cluster-master> set admin enabled
config cluster-master> set host-box cluster\box 1
config cluster-master> set host-box cluster\box 2
config cluster-master> set group 1
config cluster-master> return
```

2. Note the MAC address (identifier) on each device in the cluster. The MAC address is on a sticker on the back of the system. Write down each MAC address on a pad or piece of paper.

On each device, if there is no sticker present, attach a laptop or standard PC to the system console port and perform the following steps:

- a. Power up the system
 - b. At the NNOS-E prompt, execute the **show interface-details eth0** command to display the MAC address.
3. Attach a console to the cluster master and power up the OS-E system.
 4. Configure the cluster master by configuring the Ethernet interfaces, IP addresses, and protocols. Ethernet interface eth0 is the “heartbeat” interface for the cluster. Use the eth0 interface on each OS-E system as the connection to the cluster.

```
NNOS-E> config cluster
config cluster> config box 1
config box 1> set identifier 00:04:23:d7:9f:34
config box 1> config interface eth0
config interface eth0> config ip heartbeat
Creating 'ip heartbeat'
config ip heartbeat> set ip-address static 192.168.1.1/24
config ip heartbeat> config telnet
config telnet> return
config ip heartbeat> config ssh
```

```
config ssh> return
config ip heartbeat> config bootp-server
config bootp-server> return
config ip heartbeat> config vrrp
config vrrp> return
```



Note: Optionally, you can run the **config setup** script to configure the IP addresses, management port, and other settings presented in the script.

By configuring messaging on the OS-E master, the master looks through the configurations of all other devices to find out which interface is used for messaging. (If multiple interfaces are configured, the master only communicates with one—the first it finds.) The master then communicates with the identified interface to share configuration and data.

```
config ip heartbeat> config messaging
config messaging> set admin enabled
config messaging> set certificate vsp tls
                    certificate 208.45.178.216.pfx
config messaging> set port 5312
config messaging> set protocol tls
config messaging> return
config ip heartbeat> return
config interface eth0> return
config box 1>
```

Configure the interface and the protocols over which you will run management sessions to the OS-E. This is an “out-of-band” interface that allows you to separate management traffic from SIP signaling and media streams.

```
config box 1> config interface eth3
Creating 'interface eth3'
config interface eth3> config ip mgmt
Creating 'ip mgmt'
config ip mgmt> set ip address static 192.168.2.1/24
config ip mgmt> config ssh
config ssh> return
config ip mgmt> config web
config web> set protocol https 443 0
config web> return
config ip mgmt> config sip
config sip> set udp-port 5060
config sip> return
config ip mgmt> config icmp
config icmp> return
config ip mgmt> config media-ports
config media-ports> return
config ip-mgmt> return
config interface eth3> return
```

```
config box 1> config cli
config cli> set prompt nn2610-1
config cli> set banner ""
config cli> set display paged 50
config cli> return
config box 1> return
config cluster>
```

5. Configure the second OS-E system in the cluster. Note that you also configure eth0 as the “heartbeat” interface to the cluster.

```
config cluster> config box 2
config box 2> set hostname nn2610-2
config box 2> set name ""
config box 2> set contact ""
config box 2> set location ""
config box 2> set identifier 00:04:23:c3:22:f4
config box 2> config interface eth0
config interface eth0> config ip heartbeat
config ip heartbeat> set ip-address static 192.168.1.2/24
config ip heartbeat> config telnet
config telnet> return
config ip heartbeat> config ssh
config ssh> return
config ip heartbeat> config web
config web> set protocol https 443 0
config web> return
config ip heartbeat> config icmp
config icmp> return
config ip heartbeat> config vrrp
config vrrp> return
config ip heartbeat> config messaging
config messaging> set admin enabled
config messaging> set certificate vsp tls
certificate 208.45.178.216.pfx
config messaging> set port 5312
config messaging> set protocol tls
config messaging> return
config ip heartbeat> return
config interface eth0> return
config box 2>
```

Configure the interface and the protocols over which you will run management sessions. This is an “out-of-band” interface that allows you to separate management traffic from SIP signaling and media streams.

```
config box 2> config interface eth3
Creating 'interface eth3'
config interface eth3> config ip mgmt
Creating 'ip mgmt'
config ip mgmt> set ip address static 192.168.2.2/24
```

```
config ip mgmt> config ssh
config ssh> return
config ip mgmt> config web
config web> set protocol https 443 0
config web> return
config ip mgmt> config sip
config sip> set udp-port 5060
config sip> set nat-translation enabled
config sip> return
config ip mgmt> config icmp
config icmp> return
config ip mgmt> config media-ports
config media-ports> return
config ip-mgmt> return
config interface eth3> return
config box 1> config cli
config cli> set prompt NNOS-E-2
config cli> set banner ""
config cli> set display paged 50
config cli> return
config box 1> return
config cluster> set share media-ports true
config cluster> set share signaling-entries true
config cluster> set mirror-media-streams true
```

6. Configure VRRP on the OS-E interfaces to handle the public and private sides of the network. Note that the first VRRP interface connects the public side; the second VRRP interface connects the private side.

A VRRP configuration for IP interfaces includes a list of box/interface pairings. The first pair in this list is the *primary interface*. The second pair in the list is the *backup interface* and will take over if the primary goes down. You can configure additional levels of redundancy by specifying more box/interface pairs of lower priority. Priority is based on the positioning of the **set host-interface** command.

```
config cluster> config vrrp
config vrrp> config vinterface vx0
config vinterface vx0> set group 1
...vinterface vx0> set host-interface cluster box 1 interface eth1
...vinterface vx0> set host-interface cluster box 2 interface eth1
config vinterface vx0> config ip public
Creating 'ip public'
config ip public> set ip-address static 208.45.178.216/28
config ip public> config ssh
config ssh> return
config ip public> config web
config web> set protocol https 443 0
config web> return
config ip public> config sip
config sip> set nat-translation enabled
```

```
config sip> set udp-port 5060
config sip> set tcp-port 5060
config sip> set tls-port 5061
config sip> set certificate vsp\tls\certificate 208.45.178.216.pfx
config sip> return
config ip public> config icmp
config icmp> return
config ip public> config media-ports
config media-ports> return
config ip public> config routing
config routing> config route default
Creating 'route default'
config route default> set gateway 208.45.178.209
config route default> return
config routing> return
config ip public> return
config vinterface vx0> return
config vrrp>

config cluster> config vrrp
config vrrp> config vinterface vx1
config vinterface vx1> set group 1
...vinterface vx1> set host-interface cluster box 1 interface eth2
...vinterface vx1> set host-interface cluster box 2 interface eth2
config vinterface vx1> config ip private
Creating 'ip private'
config ip private> set ip-address static 208.45.178.216/28
config ip private> config ssh
config ssh> return
config ip public> config web
config web> set protocol https 443 0
config web> return
config ip private> config sip
config sip> set nat-translation enabled
config sip> set udp-port 5060
config sip> set tcp-port 5060
config sip> set tls-port 5061
config sip> set certificate vsp\tls\certificate 208.45.178.216.pfx
config sip> return
config ip private> config icmp
config icmp> return
config ip private> config media-ports
config media-ports> return
config ip private> config routing
config routing> config route static-to-asx
Creating 'route static-to-asx'
config route static-to-asx> set destination network 208.45.178.0/24
config route static-to-asx> set gateway 10.144.10.254
config route static-to-asx> return
config routing> return
config ip private> return
```

```
config vinterface vx1> return
config vrrp> return
config cluster> return
```

7. Configure the master-services that you want to run on the cluster.

```
config> config master-services
config master-services> config accounting
config accounting> set host-box cluster\box 1
config accounting> set host-box cluster\box 2
config accounting> set group 1
config accounting> return
config master-services> config database
config database> set host-box cluster\box 1
config database> set host-box cluster\box 2
config database> set group 1
config database> set media enabled
config database> return
config master-services> return
config>
```

8. For TLS, you will need to upload the TLS certificate file on each OS-E system in the cluster. Copy the certificate that you receive from the CA to the OS-E using a compatible file transfer mechanism, such as PuTTY Secure Copy (PSCP). If you have the file on a local network PC, use PSCP to move the file to a directory path on the OS-E.

The following example PSCP command copies the certificate file named **208.45.178.216.pfx** from the PC root directory to the OS-E system at IP address **208.178.216.pfx** in the directory **/cxc/certs/208.45.178.216.pfx**.

```
C:\ pscp -l root -pw sips -P 2200 208.45.178.216.pfx
208.45.178.216:/cxc/certs/208.45.178.216.pfx
```

The following CLI session sets the directory and certificate file name path, specifies the passphrase, and whether to allow SSL Version 2 operability.

```
NNOS-E> config vsp
config vsp> config tls
config tls> config certificate 208.45.178.216.pfx
config certificate 208.45.178.216.pfx> set allow-ssl2 true
config certificate 208.45.178.216.pfx> set certificate-file /cxc/
certs/208.45.178.216.pfx.pfx
config certificate 208.45.178.216.pfx> set passphrase-tag pass
```

By default, the OS-E only supports SSLv3 or TLSv1. If you require SSLv2 for interoperability, set this property **true**. Specify the passphrase-tag associated with the certificate file. Use this property if the certificate file is encrypted to have its private key information protected. This passphrase tag must match the string with which the certificate was encrypted.

9. Power up the other OS-E systems in the cluster and connect them to the network. This initiates a configuration download from the cluster master so the systems acquire their initial configuration (IP addresses, etc.).
10. Use the CLI or OS-E Management System at the cluster master to configure any additional features. These features include the objects and settings under the VSP object, including:
 - default-session-config
 - registration-plan
 - dial-plan
 - enterprise servers, carriers, and gateways

Configuring External Messaging

Messaging is the mechanism the OS-E uses to communicate among boxes in a cluster. Messaging sets up a listening socket on an interface, enabling the interface to receive messaging traffic and participate in clustering and media partnering.

In a cluster, the master looks through the configurations of all OS-E systems to find out which interface is used for messaging. (If multiple interfaces are configured, the master only communicates with one—the first it finds.) The master then communicates with the identified interface to share configuration and data.

In media partnering, you configure a specific IP address (on a different box) as a partner. On the box that owns that IP address, you need to configure and enable messaging for media partnering to operate.

CLI Session

The following CLI session configures messaging on box 1, interface eth0.

```
NNOS-E> config cluster
config cluster> config box 1
config box 1> config interface eth0
config interface eth0> config ip boston1
config ip boston1> config messaging
config messaging> set admin enabled
config messaging> set certificate vsp tls certificate name
config messaging> set port 13002
config messaging> set protocol tls
```

Configuring Cluster Load Balancing

Load balancing of SIP processing across cluster interfaces requires both headend and backing interfaces. The *headend* interface is the central distribution point. It does not do any SIP processing, it only forwards the calls to its configured backing interfaces. When you configure a SIP phone, you would configure it to point to the headend interface.

To configure an IP interface as a headend interface, you simply configure the **sip** object with backing interfaces. Their presence contained within the IP configuration results in the interface being treated by the OS-E as a headend interface.

The *backing-interfaces* are identified as such within this **sip** object. In the **backing-interface** property, you reference previously configured IP interfaces. The backing interface is the location at which the OS-E terminates TCP and TLS connections (and where UDP transport messages arrive) and handles SIP processing. The OS-E uses round-robin load-balancing to distribute message across the configured backing interfaces.

To correctly configure load-balancing for SIP processing, you must do the following:

1. Configure the IP interfaces that will be used for both the headend and backing interfaces.
2. The SIP properties of the backing interfaces must match those of the head interface. For example, they must all use the same port assignments, and if you are using TLS, they must all use the same certificate.
3. You must enable the **master-services registration** object so that the interfaces can share the registration database.

To verify your configuration, first ensure that all SIP properties match. From the CLI at the headend, execute the **show load-balance** command. This lists all associated backing interfaces (and statistics). From each box hosting a backing interface, execute **show backing-interface** to display configuration and statistics information.

The following CLI session assumes that you have configured a three-box cluster, with box 1 containing the headend interface, with boxes 2 and 3 containing the backing interfaces over which traffic is load balanced. This session sets the backing interfaces for load balancing SIP traffic that is distributed from the headend interface at IP address 215.2.3.0/24.

CLI Session

```

config> config cluster
config cluster> config box 1
config box 1> config interface eth1
config interface eth1> config ip public
Creating 'ip public'
config ip public? set ip-address static 215.2.3.0/24
config ip public> config sip
config sip> config load-balancing
config load-balancing> set backing-interface cluster box 2 interface
eth1 ip public
Creating 'cluster\box 2\interface eth1\ip public'
config load-balancing> set backing-interface cluster box 3 interface
eth1 ip public

config sip> show
cluster
box 1
  interface eth1
    ip public
    sip
      admin enabled
      backing-interface cluster\box 2\interface eth1\ip public2
      backing-interface cluster\box 3\interface eth1\ip public3

```

NNOS-E> show load-balance

Head-end IP 215.2.3.0: undersubscribed:

Backing IP	State	Added	Removed	Maximum	Current	Percent
215.6.7.0	Down	0	0	0	0	0.0%
215.8.9.0	Down	0	0	0	0	0.0%
Totals:		0	0	0	0	100.0%

NNOS-E>

Restarting an OS-E Cluster

You can perform a simultaneous warm restart of all systems in a cluster by using the **restart cluster** command. A warm restart simply restarts the OS-E applications on each system without rebooting the operating system.

If you warm restart an individual device in the cluster, the OS-E automatically rejoins the cluster when it comes back up. If that box is hosting a master service or a VRRP interface, the service or interface may fail over to a different OS-E system.

If you need to shut a system down by turning the power off, use the **restart halt** command before pressing the power button or disconnecting the power source. A **restart halt** will properly prepare a system for a shutdown. The OS-E system will rejoin the cluster when it comes back up.

Chapter 5. Installing Certificates and Commissioning TLS Networks

About This Chapter

This chapter provides information on commissioning the OS-E to run the Transport Layer Security protocol (TLS) over Ethernet interfaces.

TLS Overview

TLS is an encapsulation (and cryptographic) protocol that provides privacy and security between communicating applications over the Internet. The OS-E uses TLS to authenticate SIP users and to encrypt/decrypt SIP traffic across participating carrier and enterprise SIP applications.

For a complete description of the TLS protocol, refer to the following RFCs:

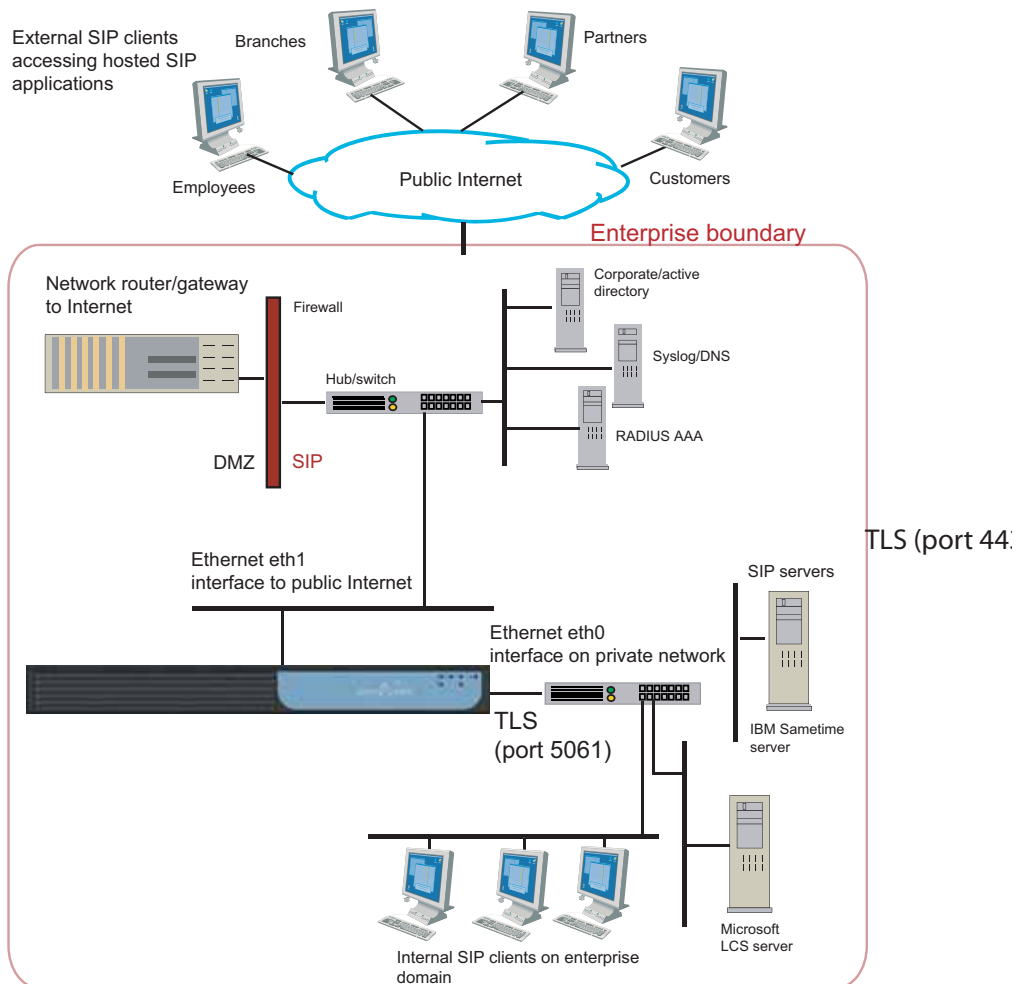
- RFC 2246, The TLS Protocol Version 1.0
- RFC 3261, Session Initiation Protocol (see Section 26.3.1)

The image below illustrates a sample network running TLS on Ethernet interfaces to both the private network and the public Internet.

Steps to Configuring TLS

To configure the private and public network interfaces in the image below, with TLS you need to perform the following steps:

1. If not already done, configure the management interfaces, network routes, protocols, and services using the **cluster/box**, **master-services**, and **services** objects.
2. If not already done, install a signed certificate from a valid Certificate Authority (CA). Go the section, “Before Configuring TLS.”.
3. Configure the certificate using the **tls/vsp** configuration object. Go to the section, “Configuring the Certificate on the OS-E.”
4. Configure the SIP protocol on each interface to use the installed certificate. Go to the section, “Configuring TLS on Ethernet Interfaces.”





Note: If you are operating with Microsoft Live Communications Server (LCS), refer to the *Net-Net OS-E – System Administration Guide* for information on installing, importing, and exporting certificates.

Before Configuring TLS

You will need to install the required X.509 certificate(s) for the TLS protocol and SIP session establishment. A certificate includes the *.cer* certificate file name and the encrypted keys, mathematically related private and public data keys indexed by a unique name. A private key is kept secure—never displayed and never transmitted over the network. A public key, when bound to a fully qualified domain name (FQDN) by an authorized certification authority (CA), becomes an X.509 certificate.

If you do not have a certificate and encrypted key for your network, use this section to create and install a certificate. See the following table below for a summary of required steps.

Task	See this section	CLI command
1. Using the OS-E software, create a self-signed X.509 certificate and encrypted key.	<i>Creating a self-signed certificate and key pair from the OS-E</i>	cert-gen
2. Using the self-signed certificate that you created in Step 1, generate a Certification Signing Request (CSR) in PEM format.	<i>Generating a Certification Signing Request (CSR)</i>	cert-request

Task	See this section	CLI command
<p>3. Sign the CSR using one of these two methods:</p> <ul style="list-style-type: none">• Use a valid CA, like VeriSign (required if a “trusted” certificate is necessary) to sign the CSRor• Use OpenSSL to sign the CSR	<i>Signing a CSR using either a valid CA or OpenSSL</i>	N/A
<p>4. When you receive the signed certificate, use the OS-E software to load the signed certificate onto the system.</p>	<i>Updating the self-signed certificate</i>	cert-update

Step 1. Creating a Self-Signed Certificate and Key Pair from the OS-E

Use the OS-E software to generate a cryptographic key pair and a self-signed X.509 certificate in PKCS#12 format. Once you create a self-signed certificate, you can generate the Certification Signing Request, a portion of which will be required by the CA upon submission of their form.

Under **Actions**, select **cert-gen** from list. The following image illustrates the OS-E Management System **Generate new key and certificate** page.

cert-gen

Generate 1024 bit RSA private key and associated X509 certificate.

* keyFile	<input type="text"/>	Browse System Files
* passphrase	<input type="password"/>	
* alias	<input type="text"/>	
* common-name	<input type="text"/>	
days-valid	<input type="text" value="365"/>	
country	enter <input type="text" value="US"/> or select from <input type="text" value="US"/> (United States)	
alternate-name	<input type="text"/>	
organization	<input type="text"/>	
organizational-unit	<input type="text"/>	
state	<input type="text"/>	
locality	<input type="text"/>	

Important: You must specify the same FQDN for the *alias* and *common name* fields. The values of these two fields must match in order to generate the certificate.

Complete the fields on the **Generate new key and certificates** page, as follows:

keyFile—Specify the name and directory path of the resulting key name that you want to use, along with the p12 or .pfx file extension. This is a mandatory field.

Example: /cxc/certs/myNetworkKey.p12

passphrase—Specify a password to be associated with the self-signed certificate. The text that you specify will be encrypted in the certificate.

alias—Specify the FQDN of the OS-E system using this certificate, such as *nn2610.acmepacket.com*. Omit HTTP:// and HTTPS://. This allows the certificate to be referenced.



Note: The value (FQDN) you enter for the **alias** field must be identical to the value you enter for the **common-name** field.

common-name—Specify the FQDN of the OS-E system using this certificate, such as *nn2610.acmepacket.com*. Omit HTTP:// and HTTPS://. Do not use your personal name in this field. The common name is a component attribute of the certificate's *distinguished name*.

days-valid—Enter the number of days for which the certificate is valid. If your certificate is effective for one year, then enter the number 365

country—Select the ISO country code: US (United States), AU (Australia), IN (India), IT (Italy), UK (United Kingdom), CA (Canada). The country is a component attribute of the certificate's *distinguished name*.

alternate-name—Optional; this usually a name that complies with the ASN.1 specification, such as a DNS name, IP address, URI, etc.

organization—Optional. Enter the name under which your business is legally registered. The listed organization must be the legal registrant of the domain name in the certificate request. If you are enrolling as a small business/sole proprietor, enter the certificate requestor's name in the "Organization" field, and the DBA (doing business as) name in the "Organizational Unit" field. The organization is a component attribute of the certificate's *distinguished name*.

organizational-unit—Optional. Use this field to differentiate between divisions within an organization. For example, "Engineering" or "Human Resources." If applicable, you may enter the DBA (doing business as) name in this field. The organizational unit is a component attribute of the certificate's *distinguished name*.

state—Optional; if in the US, enter one of the fifty state names in full where your organization is located, such as Massachusetts; if outside the US, enter the full name of a province or region.

locality—Optional; enter the name of a city.

When you are finished filling out the fields, click **Invoke**. The message line on the **Generate new key and certificate** page should report “Success.”

Viewing the Certificate

To view the self-signed certificate, select the **Keys** tab from the main menu bar, then select the keyFile that you just created from the Key Stores list on the left. Click View to display the Certificate Properties page, as shown in the following image.



Step 2. Generating a Certification Signing Request (CSR)

After you create the self-signed certificate from Step 1, you need to generate a certification signing request (CSR) that you can submit to the CA for the X.509 certificate. Select the **request** action.

The following image illustrates the Generate Certificate Signing Request page and the resulting certificate signing request. Enter the password that you created in Step 1 in the passphrase text box and click on **Generate Certificate Signing Request**.

The top screenshot shows the Eclipse Key Stores interface. The user is logged in as 'guest'. The 'Keys' tab is selected. Under 'Key Stores', the 'netCert' store is selected. The 'Generate Certificate Signing Request' button is visible.

The bottom screenshot shows the 'Certificate Signing Request for from keystore netCert' page. It displays the CSR text, which is a Base64-encoded string. The text is as follows:

```
-----BEGIN CERTIFICATE REQUEST-----
MIIBZDCBzgIBADAnMQswCQYDVQQGEwJVZsEYMBYGA1UEAxMPd3d3LmNhbXBhbnku
Y291MIGMA0GCSqGSIb3DQEBAQUAA4GNADCBiQKBgQCKmFPpBtxe3YnFtQVDbqJ
NU3R0L9WoORoR5xYTK1nO1rkNtwOCVApHzbBM1J51m+Lc6u3mw7aSRG5AU+smeBG
V8gGGwe9Vh5+cc2wWWRID13Qe6fYTGIAA559K03UzwaA641489FB5cQZJNmYdAMC
Rk9soetED44PRy71k6tulbQIDAQABMA0GCSqGSIb3DQEBAQUAA4GBAAFP9PTJz1d7
7THqVDC1BvAdA6boS6fmX64ikeTjghbk9rLuVwD7yDQ2VCGrR6mUq5h6uOvp
ZC7BEqNSW4Ffwlc8DiiNjGR1MPZLNETNQBuxVbixzKISjgO4I+WSGydjW2h3x1e
n4L8eg3n9/91zxW0F56tNIH+Rb5995VO -----END CERTIFICATE REQUEST-----
```

Follow the instructions on the Certificate Signing Request page to copy and paste the text into the certificate application form provided by the CA.

If you choose to create a CSR in a PEM-formatted file, select the **cert-request** action. The file will contain the same request as shown in the following image.

The screenshot shows the Eclipse Action console interface. At the top, there is a navigation bar with tabs: Home, Configuration, Status, Call Logs, Event Logs, Actions, Services, Keys, Access, Tools, and Portal. The 'Actions' tab is selected. On the left, there is a list of actions: archive, arp-delete, asterisk, authentication-cache-flush, autonomous-ip-lookup, call-control, call-lookup, cert-gen, cert-request, and cert-update. The 'cert-request' action is selected. The main area displays the configuration for the 'cert-request' action. It includes four input fields: 'key-file', 'passphrase', 'alias', and 'csr-file'. Each field has a 'Browse System Files' button next to it. Below the input fields is an 'Invoke' button.

* key-file	<input type="text"/>	Browse System Files
* passphrase	<input type="text"/>	
* alias	<input type="text"/>	
* csr-file	<input type="text"/>	Browse System Files

Invoke

Complete the fields on the **Generate Certification Request** page, using the same settings that you invoked from Step 1, as follows:

key-file—Specify the name and OS-E directory path of the resulting key name that you want to use, along with the p12 or .pfx file extension. This is a mandatory field. Example: /cxc/certs/myNetworkKey.p12

passphrase—Specify a password to be associated with the certificate issued by the CA. The text that you specify will be encrypted in the CSR.

alias—Optional. However, the value you enter for the **alias** field must be identical to the value you enter for the **common-name** field.

csr-file—Specify the name and directory path of the resulting CSR file. This is the file from which you will cut and paste the required information for the CA at the time that you submit the certificate request. By default, the CSR file resides in the directory named /cxc/certs.

When you are finished filling out the fields, click **Invoke**. The message line on the Generate Certification Request page should report “Success.”

Viewing the .CSR File

Since the .cer file is in PEM format, you can open the view the file using a text editor.

Step 3. Signing a CSR Using Either a Valid CA or OpenSSL

After you generate the CSR, you need to sign the CSR using *one* of two methods. You can either:

- Sign the CSR using a well-known CA, for example, VeriSign. (*See the instructions below*).

or

- Sign the CSR using OpenSSL.

This section describes how to sign the CSR using either method.



Note: If your network requires a “trusted” certificate, then follow the instructions below to sign the CSR using a valid, well-known CA.

Using a Certification Authority to Sign the CSR (Method 1)

You get the signed X.509 certificate from a valid CA, such as VeriSign. The CA issues a certificate stating and guaranteeing that the key contained in the certificate belongs to the person or organization noted in the certificate. The CA verifies the identity of the applicant's so that users can trust certificates issued by that CA to belong to the people and data identified in it, and not to an imposter

Certificate Formats

The OS-E certificate file can be in the following formats:

- PKCS#12—Public Key Cryptography Standard #12 format from Microsoft IIS Version 5 (binary)
- PEM—Privacy-enhanced mail (PEM) encoded format from any OpenSSL-based Web server (ASCII)

Using OpenSSL to Sign the CSR (Method 2)

This section provides information on how you can generate a self-signed certificate for testing TLS with the OS-E using OpenSSL. This is an alternative method to using a valid CA to sign the CSR.

This section describes how to do the following things:

- Create an OpenSSL Certificate Authority (CA).
- Generate a private key and CSR on the OS-E system and sign in with the OpenSSL CA.
- Generate a Private Key and CSR without the OS-E system (not supported).
- Use OpenSSL to convert an X.509 certificate and/or RSA key to a Public-Key Cryptography Standard #12 (PKCS#12) format.



Note: Before using this method, download the OpenSSL program and install it on a Unix/Linux or Windows system. You also need to add the location of the OpenSSL executables to the PATH. In a Windows environment, this will need to do this manually, requiring a reboot to take effect.

Creating an OpenSSL Certificate Authority (CA)

To create an Open SSL Certificate Authority (CA) on a Unix/Linux system, perform all steps as “root.” On a Windows system, perform all steps as “Administrator.”

1. Create directories to store certificates.

The main CA folder is the directory where the Certificate Authority files will reside. The “private” directory stores the private keys. The “certs” directory stores the certificates (or public keys). The “csrs” directory stores the Certificate Signing Requests.

On Unix:

```
mkdir /CA
mkdir /CA/private
mkdir /CA/csrs
mkdir /CA/certs
```

Windows (cmd):

```
mkdir C:\CA
mkdir C:\CA\private
mkdir C:\CA\csrs
mkdir C:\CA\certs
```

2. Create files to support the generation process.

Create the “index.txt” file with no contents. This is the database to which OpenSSL keeps track of generated certificates generated. Create the “serial” file with a number so that each generated certificate is labeled with a number for tracking purposes.

Unix:

```
touch /CA/index.txt
echo 01 > /CA/serial
```

Windows (cmd):

```
copy con C:\CA\index.txt
echo 01 > C:\CA\serial
```

3. Create the OpenSSL configuration file.**Unix:**

Using a text editor, create “/CA/openssl.cnf.”

```
[ ca ]
default_ca      = local_ca

[ local_ca ]
dir             = /CA
certificate     = $dir/certs/ca.cer
database       = $dir/index.txt
new_certs_dir  = $dir/certs
private_key    = $dir/private/ca.key
serial         = $dir/serial

default_crl_days    = 365
default_days        = 365
default_md          = md5

policy             = local_ca_policy
x509_extensions    = local_ca_extensions

[ local_ca_policy ]
commonName        = supplied
```

```

stateOrProvinceName      = optional
countryName              = optional
emailAddress              = optional
organizationName         = optional
organizationalUnitName   = optional

[ local_ca_extensions ]
basicConstraints          = CA:true
nsCertType                = server

[ root_ca_extensions ]
basicConstraints          = CA:true
nsCertType                = server

[ req ]
default_bits              = 2048
default_keyfile            = /CA/private/ca.key
default_md                 = md5

prompt                    = yes
distinguished_name        = root_ca_distinguished_name
x509_extensions            = root_ca_extensions

[ root_ca_distinguished_name ]
countryName                = Country Name (2 letter code)
countryName_default        = US
countryName_min            = 2
countryName_max            = 2

stateOrProvinceName        = State or Province Name (full name)
stateOrProvinceName_default = MA

localityName                = Locality Name (eg, city)
localityName_default        = Maynard

0.organizationName          = Organization Name (eg, company)
0.organizationName_default  = Acme Packet, Inc.

organizationalUnitName      = Organizational Unit Name
                             (eg, section)
organizationalUnitName_default = Support

commonName                  = Common Name (eg, YOUR name)
commonName_max              = 64

emailAddress                = Email Address
emailAddress_default         = jgentile@acmepacket.com

```

```

emailAddress_max           = 64

[ req_attributes ]
challengePassword          = A challenge password
challengePassword_min      = 4
challengePassword_max      = 20

unstructuredName           = An optional company name

```

Windows:

Using a text editor, create “C:\CA\openssl.cnf.”

```

[ ca ]
default_ca      = local_ca

[ local_ca ]
dir             = C:\CA
certificate      = $dir\certs\ca.cer
database        = $dir\index.txt
new_certs_dir   = $dir\certs
private_key      = $dir\private\ca.key
serial          = $dir\serial

default_crl_days    = 365
default_days        = 365
default_md          = md5

policy            = local_ca_policy
x509_extensions    = local_ca_extensions

[ local_ca_policy ]
commonName        = supplied
stateOrProvinceName = optional
countryName       = optional
emailAddress      = optional
organizationName   = optional
organizationalUnitName = optional

[ local_ca_extensions ]
basicConstraints    = CA:false
nsCertType         = server

[ root_ca_extensions ]
basicConstraints    = CA:true

```

```
nsCertType                = server

[ req ]
default_bits              = 2048
default_keyfile            = C:\CA\private\ca.key
default_md                 = md5

prompt                    = yes
distinguished_name        = root_ca_distinguished_name
x509_extensions            = root_ca_extensions

[ root_ca_distinguished_name ]
countryName                = Country Name (2 letter code)
countryName_default       = US
countryName_min            = 2
countryName_max            = 2

stateOrProvinceName       = State or Province Name (full name)
stateOrProvinceName_default = MA

localityName               = Locality Name (eg, city)
localityName_default       = Maynard

0.organizationName         = Organization Name (eg, company)
0.organizationName_default = Acme Packet, Inc.

organizationalUnitName     = Organizational Unit Name (eg,
                           section)
organizationalUnitName_default = Support

commonName                 = Common Name (eg, YOUR name)
commonName_max             = 64

emailAddress               = Email Address
emailAddress_default       = jgentile@acmepacket.com
emailAddress_max           = 64

[ req_attributes ]
challengePassword          = A challenge password
challengePassword_min      = 4
challengePassword_max      = 20

unstructuredName           = An optional company name
```

4. Generate the CA's private key and Master Certificate (public key).

This step will generate two files:

- **CA/private/ca.key** (C:\CA\private\ca.key on Windows) – This is the CA's private key used to sign certificates. Keep this secure. If this key is compromised, it can be used to create certificates for malicious purposes.
- **CA/private/ca.cer** (C:\CA\private\ca.cer on Windows) – This is the CA's certificate (public key). This is the file that would be distributed to client's "Trusted Root" stores to trust any certificates signed by this CA's private key.

Unix:

```
openssl req -x509 -new -config /CA/openssl.cnf -days 3000 -out /CA/certs/ca.cer
```

Windows (cmd):

```
openssl req -x509 -new -config C:\CA\openssl.cnf -days 3000 -out C:\CA\certs\ca.cer
```

The **ca.key** is created automatically based on the configuration file.

Enter a strong passphrase for the CA key. Remember it, as this helps protect the security of your CA.

Fill in the following fields:

```
Country Name (2 letter code) [US]: <your country>
State or Province Name (full name) [MA]: <your state/province>
Locality Name (eg, city) [Maynard]: <your locale>
Organization Name (eg, company) [Acme Packet]: <your company>
Organizational Unit Name (eg, section) [Support]: <your department>
Common Name (eg, YOUR name) []: <Use the FQDN of the CA system
running OpenSSL>
Email Address []: <your email address>
```



Note: The "Common Name" field is the most important. This is the name that will be provided to the CA, so use the Fully Qualified Domain Name (FQDN) of the system on which you are running OpenSSL.

5. Change permissions on the CA's key to only allow "root" access:

Unix:

```
chmod 700 /CA/private/ca.key
```

Windows (cmd):

```
echo y | cacls C:\CA\private\ca.key /G %COMPUTERNAME%\Administrator:F
```



Note: You should only need to complete the process for setting up the CA once, while the processes for signing Certificates must be repeated every time a certificate needs to be generated.

Generating a Private Key and Certificate Signing Request (CSR) with the OS-E

To generate a private key and CSR on the OS-E and sign in with the OpenSSL CA, perform the following steps:

1. Create a CSR on the OS-E.

Refer to the section in the chapter, “Before Configuring TLS.”:

- Use the **cert-gen** utility to generate a Self-Signed Certificate (known as a private key) in PKCS#12 format. In this example, the file name is *cxc.pfx*.
- Use the **cert-request** utility to generate a Certificate Signing Request (CSR) in PEM format on the appropriate OS-E system. In this example, the file name is *cxc.csr*.



Note: The “common-name” field on the “cert-gen” page is the most important. This is the name that will be used to validate the certificate. Use the Fully Qualified Domain Name (FQDN) of the appropriate OS-E system, such as *nnose.acmepacket.com*.

Currently, some phones, such as Eyebeam do not support wildcard certificates where the common-name uses an asterisk character (*) in the domain name, such as **.acmepacket.com*.

These files are created in the */cxc/certs/* directory on the OS-E.

2. Copy the CSR to the OS-E.

Download the .csr file generated on the OS-E, and then copy it to the CA system into the /CA/csrs/ directory. For a Windows system, copy it to the C:\CA\csrs\ directory.

3. Sign the CSR with your OpenSSL CA.

Unix

```
openssl ca -config /CA/openssl.cnf -in /CA/csrs/cxc.csr -out /CA/certs/cxc.pem
```

Windows

```
openssl ca -config C:\CA\openssl.cnf -in C:\CA\csrs\cxc.csr -out C:\CA\certs\cxc.pem
```

Enter the pass phrase for the CA key

Respond “y” to the questions to generate and commit.

4. Update the private key (cxc.pfx) with the signed public key (cxc.pem) on the system.

Upload the newly generated *cxc.pem* file back to the OS-E , as covered earlier in this chapter. Refer to the section in the chapter, “Before Configuring TLS.”

- Use the **cert-update** utility to update the “/cxc/certs/cxc.pfx” file on the OS-E with the “/cxc/certs/cxc.pem” file.
- Configure a TLS certificate, as covered earlier in this chapter. Be sure to associate it with the SIP protocol on the appropriate network interface.



Note: You can use the /CA/certs/ca.cer (C:\CA\certs\ca.cer on Windows) file to import into a “Trusted Root Store.” For example, you can install this in Windows (Internet Explorer) for use with Soft Phones, such as Eyebeam. If you deploy the ca.cer file to multiple systems into the “Trusted Root Store”, then those systems will “trust” any certificates signed by this CA.

Generating a Private Key and Certificate Signing Request (CSR) without the OS-E

Instead of generating the private key and CSR on the OS-E, you can generate it using OpenSSL exclusively. This is not the supported method.

1. Create a CSR and Private Key for the OS-E System

Unix:

```
openssl req -new -config /CA/openssl.cnf -out /CA/csrs/cxc_csr.pem  
-keyout /CA/certs/cxc_pk.pem
```

Windows (cmd:)

```
openssl req -new -config C:\CA\openssl.cnf -out  
C:\CA\csrs\cxc_csr.pem -keyout C:\CA\certs\cxc_pk.pem
```

Use the OpenSSL “req” utility to generate a Self-Signed Certificate (private key) and the Certificate Signing Request (CSR) in PEM format. In this example, the file names are *cxc_pk.pem* for the private key, and *cxc_csr.pem* for the CSR.

Enter a pass phrase for the CA key, and complete the following fields::

```
Country Name (2 letter code) [US]: <your country>  
State or Province Name (full name) [MA]: <your state/province>  
Locality Name (eg, city) [Maynard]: <your locale>  
Organization Name (eg, company) [Acme Packet]: <your company>  
Organizational Unit Name (eg, section) [Support]: <your department>  
Common Name (eg, YOUR name) []: <Use the FQDN of the CXC>  
Email Address []: <your email address>
```



Note: The “common-name” field is the most important entry. This is the name that will be used to validate the certificate. Use the Fully Qualified Domain Name (FQDN) of the appropriate OS-E system, such as *nnose.acmepacket.com*.

Currently, some phones, such as Eyebeam do not support wildcard certificates where the common-name uses an asterisk character (*) in the domain name, such as **.acmepacket.com*

2. Sign the CSR with your OpenSSL CA.**Unix**

```
openssl ca -config /CA/openssl.cnf -in /CA/csrs/cxc_csr.pem -out /  
CA/certs/cxc.pem
```

Windows

```
openssl ca -config C:\CA\openssl.cnf -in C:\CA\csrs\cxc_csr.pem
```

```
-out C:\CA\certs\cxc.pem
```

Enter the pass phrase for the CA key, then respond “y” to the questions to generate and commit.

3. Merge the Private Key and Signed Public Key into one file.

Unix

```
cat /CA/certs/cxc.pem /CA/certs/cxc_pk.pem > /CA/certs/cxc.list.pem
```

Windows (cmd)

```
copy /CA/certs/cxc.pem + /CA/certs/cxc_pk.pem /CA/certs/  
cxc.list.pem
```

4. Upload the newly generated *cxc.list.pem* file back to the OS-E, then configure a TLS certificate, as covered earlier in this chapter. Be sure to associate it with the SIP protocol on the appropriate network interface.



Note: You can use the */CA/certs/ca.cer* (C:\CA\certs\ca.cer on Windows) file to import into a “Trusted Root Store.” For example, you can install this in Windows (Internet Explorer) for use with Soft Phones, such as Eyebeam. If you deploy the *ca.cer* file to multiple systems into the “Trusted Root Store”, then those systems will “trust” any certificates signed by this CA.

Using OpenSSL to Convert X.509 and RSA Keys

This section describes how to use OpenSSL to convert an X.509 certificate and/or RSA key to a Public-Key Cryptography Standard #12 (PKCS#12) format.

Requirements

You must have a working installation of the OpenSSL software and be able to execute OpenSSL from the command line.

Refer to “CTX106627 - How to Install the OpenSSL Toolkit,” for more information on obtaining and installing OpenSSL.

The PKCS#12 specifies a portable format for storing and transporting certificates, private keys, and miscellaneous secrets. It is the preferred format for many certificate handling operations and is supported by most browsers and recent releases of the Windows family of operating systems. It has the advantage of being able to store the certificate and corresponding key, root certificate, and any other certificates in the chain in a single file.

Procedure

1. Ensure that the certificate(s) and key are in PEM format.

- **To convert a certificate from DER to PEM:**

```
x509 -in input.crt -inform DER -out output.crt -outform PEM
```

- **To convert a key from DER to PEM:**

```
rsa -in input.key -inform DER -out output.key -outform PEM
```

- **To convert a key from NET to PEM:**

```
rsa -in input.key -inform NET -out output.key -outform PEM
```



Note: The obsolete NET (Netscape server) format is encrypted using an unsalted RC4 symmetric cipher so a passphrase will be requested. If you do not have access to this passphrase it is unlikely you will be able to recover the key

2. Use the **openssl** command to read the PEM encoded certificate(s) and key and export to a single PKCS#12 file as follows:

```
openssl pkcs12 -export -in input.crt -inkey input.key -out  
bundle.p12
```



Note: By default, the key will be encrypted with Triple DES so you will be prompted for an export password (which may be blank).

The PEM formatted root certificate and any other certificates in the chain can be merged into a single file such as root.crt, and included in the PKCS#12 file as follows:

```
openssl pkcs12 -export -in input.crt -inkey input.key -certfile  
root.crt -out bundle.p12
```

Step 4. Updating the Self-Signed Certificate

The **cert-update** action allows you to load the signed certificate that you receive from the CA. Once you have received the file, perform the following steps:

1. Upload the file to the OS-E using the **Tools/Upload file** function to browse for CA's certificate. Specify the destination path on the OS-E system, such as `/cxc/certs`, and specify the destination name of the certificate, as illustrated in the following image.

The screenshot shows the Eclipse web interface. At the top, there is a navigation bar with tabs: Home, Configuration, Status, Call Logs, Event Logs, Actions, Services, Keys, Access, Tools, and Portal. The 'Tools' tab is selected. Below the navigation bar, the 'Tools' section is active, displaying a list of actions on the left: Update Software, Retrieve License, Upload License File, Upload File, Download File, Download Saved Configuration File, and View Call. The main content area is titled 'Upload A File To Eclipse' and contains the following text: 'You can upload a file from your computer to Eclipse. You can optionally provide a new name for the file. If no name is specified, the original name of the file uploaded is used.' Below this text are four input fields: 'File:' with a 'Browse...' button, 'Destination Path:' with the value '/cxc', 'Overwrite Existing File:' with a checkbox, and 'Destination Name:' with a highlighted yellow input field. An 'Upload' button is located at the bottom right of the form.

2. Select the **Keys** tab and select the appropriate key from the Key Stores list to display the Manage Key Store page.
3. Click **Update** to browse for the file that you uploaded in Step 1.
4. Click **Update** to load the signed certificate to the CXC.

If you choose to update the certificate using the **cert-update** action rather than from the **Keys** tab, complete the fields as follows:

keyFile—Specify the name and directory path of the key that you want to update.

Example: `/cxc/certs/myNetworkKey.p12`

alias—Optional. Specify the alias for the keyFile name, if previously created.

password—Specify the password associated with the keyFile, as specified previously.

certFile—Specify the name and directory path of the signed certificate that you received from the CA and uploaded to the OS-E using the OS-E Management System **Tools/Upload File** function or other file transfer mechanism.

Configuring the Certificate on the Net-Net OS-E

Once you have imported the certificate to a directory on the OS-E system, configure the settings that control how the OS-E uses the certificate.

CLI session

The following CLI session sets the directory and certificate destination file name path, specifies the passphrase, and whether to allow SSL Version 2 operability.

```
NNOS-E> config vsp
config vsp> config tls
config tls> config certificate myNetworkCert.pfx
Creating 'certificate myNetworkCert.pfx'
config certificate myNetworkCert.pfx> set allow-ssl2 true
config certificate myNetworkCert.pfx> set allow-null-cipher enabled
config certificate myNetworkCert.pfx> set certificate-file /cxc/certs/
    myNetworkCert.pfx
config certificate myNetworkCert.pfx> set passphrase-tag pass
```

By default, the OS-E only supports SSLv3 or TLSv1. If you require SSLv2 for interoperability, set this property **true**. Specify the **passphrase-tag** associated with the certificate file. Use this property if the certificate file is encrypted to have its private key information protected. This **passphrase-tag** must match the string with which the certificate was encrypted.

Displaying the Certificates Installed on the OS-E

Use the **show certificates** command to display the list of installed certificates on the system.

Other TLS Certificate Settings

Using Certificate vs. Default-Outgoing-Settings

The OS-E uses a certificate configuration to identify the certificate file and the characteristics of the certificate. There are two types of certificate configuration—a named certificate entry that can be applied to specific TLS connects and a default certificate settings for use when a specific entry was not identified.

The entry created by the **certificate** object is used when the OS-E functions as a server in a TLS connection. Or, it can be used in an OS-E-as-client setup, if you have configured the connection to use a specific certificate. For example, when you set the connection type to the LDAP server to TLS in the **directory** object, you are required to enter a named certificate.

The entry created by the **default-outgoing-settings** object is used when the OS-E is a client with an unspecified certificate. For example, if you set the protocol that the DNS resolver server uses to TLS, you are not prompted for a certificate name. In this case, the OS-E uses either:

- The certificate identified in the **sip-settings** object, if the session matched a configured policy.
- The **default-outgoing-settings** if the session did not match a configured policy or the policy did not have a certificate specified.

Refer to the *Net-Net OS-E – Objects and Properties Reference* for detailed information on the default-outgoing-settings object under TLS.

Verifying Peer Certificates

The OS-E allows you to verify peer certificates. By default, the OS-E accepts all peer certificates. However, you can configure the OS-E to reject a connection if a peer's certificate does not meet the requirements of the network. Basic verification checks that the certificate's chain is valid, that it was signed by a trusted CA, and that the certificate has not expired.

To verify a peer's certificate, the appropriate CA file must be installed on the OS-E. For example, to connect to an LCS server, there are four requirements,

1. A client certificate that Session Presents presents to LCS at connection time,

2. A CA file (in PEM or PKCS#12) to verify the server's certificate when it is presented to the OS-E,
3. A Certificate Revocation List (CRL) in PEM format, a list of certificates that a CA has revoked, and thus can no longer be trusted. If any of the certificates in the chain presented to the OS-E appear in the CRL, the OS-E rejects the connection. This is an optional step. And,
4. A valid, verifiable host name that is presenting the certificate. If the host name doesn't match what the OS-E expects, the OS-E rejects the connection, even if the chain is valid.

CLI Session

The following CLI session defines multiple default CA files, and multiple default CRL files:

```
NNOS-E> config vsp tls
config tls> config default-ca
config default-ca> set ca-file /cxc/certs/ca1.pem tag1
config default-ca> set ca-file /cxc/certs/ca2.pem tag2
config default-ca> return
config tls> config default-crl
config default-crl> set crl-file /cxc/certs/crl1.pem tag3
config default-crl> set crl-file /cxc/certs/crl2.pem tag4
config default-crl>
```

Enabling Peer Certificate Verification

The **peer-certificate-verification** property allows you to control whether the OS-E validates a peer's certificate.

```
NNOS-E> config vsp tls
config tls> config certificate myNetworkCert.pfx
config myNetworkCert.pfx> set peer-certificate verification {none |
    if-presented | required}
```

None—The OS-E will not request a certificate from the peer, and will verify a certificate if presented with one. This is the default setting.

IfPresented—If a peer presents a certificate, the OS-E verifies it, or rejects the connection if the certificate fails verification. If no certificate is presented, the OS-E allows the connection.

Required—If a peer presents a certificate, the OS-E verifies it, or rejects the connection if the certificate fails verification. If no certificate is presented, the OS-E rejects the connection.



Note: TLS treats clients (initiators) and servers (answerers) differently. In a typical TLS connection, only the server presents a certificate; the client is only allowed to present a certificate if it is requested to do so by the server. Therefore, the **IfPresented** option applies only for a client connection.

Controlling the CA Files and CRLs to Apply to the Certificate

Configure each certificate entry to use or ignore the default CA and CRL settings.

```
config> config vsp tls certificate myNetworkCert.pfx
config certificate myNetworkCert.pfx> set use-default-ca true
config certificate myNetworkCert.pfx> set use-default-crl false
```

Optionally, you can configure each certificate entry to use an extra CA and an extra CRL, independent of the default settings, using the file path and passphrase tag.

```
config certificate myNetworkCert> set specific-ca-file /cxc/certs/
ca9.pem tag9
config certificate myNetworkCert> set specific-crl-file /cxc/certs/
crl9.pem tag10
```

Setting the Required Peer Name

The **required-peer-name** property specifies the name that appears in the presented certificate.

- If you do not configure a peer name, then the OS-E does not check the presented name.
- If you do configure a peer name, then that name must appear in the DNS field of the **alternateName** field, or in the **commonName** field for the certificate.

The **required-peer-name** can include wildcards, such as `".acmepacket.com"`. If the presented name does not match the required name, the OS-E rejects the connection.

Configuring TLS on Ethernet Interfaces

Referring to the network illustrated in the “Steps to Configuring TLS,” section, note that one Ethernet interface is connected to public Internet on port 443, and other Ethernet interface connects to the enterprise or service provider’s private network on the known TLS port 5061. Using port 443 on the public side of the network allows HTTPS requests to pass through the network firewall to the OS-E system.

CLI Session

The following CLI session configures IP on the public and private OS-E interfaces, and the SIP protocol, ports, and TLS certificate destination name references.

```
NNOS-E> config cluster
config cluster> config box 1
config box 1> config interface eth0
config interface eth0> config ip private
Creating 'ip private'
config ip private> set ip-address static 10.1.1.1/24
config ip private> config sip
config sip> set udp-port 5060
config sip> set tcp-port 5060
config sip> set tls-port 5061
config sip> set certificate vsp tls certificate myNetworkCert.pfx
Creating 'vsp\tls\certificate myNetworkCert.pfx'
config sip> return
config ip public> return
config interface eth0> return
config box 1>

config box 1> config interface eth1
config interface eth1> config ip public
Creating 'ip public'
config ip public> set ip-address static 216.1.1.1/24
config ip public> config sip
config sip> set udp-port 5060
config sip> set tcp-port 5060
config sip> set tls-port 443
config sip> set certificate vsp tls certificate myNetworkCert.pfx
Creating 'vsp\tls\certificate myNetworkCert.pfx'
config sip> return
config ip public> return
config interface eth1> return
config box 1>
```

Chapter 6. Configuring Secure Media (SRTP) Sessions

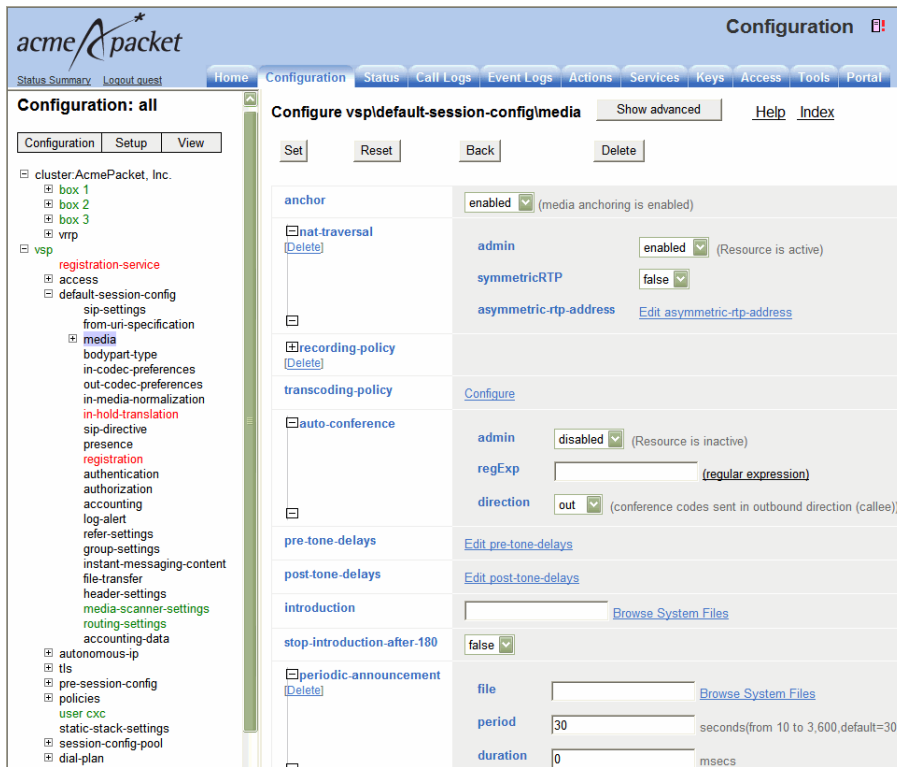
About This Chapter

This chapter provides information on configuring inbound and outbound encryption on SIP media sessions anchored by the OS-E.

Anchoring Media Sessions

Media anchoring forces the SIP media session to traverse the OS-E system. The **auto** setting enables conditional anchoring where the OS-E uses its auto-anchoring algorithms to determine anchoring necessity based on a variety of criteria, including whether you have configured smart anchoring via the **autonomous-ip** object and whether the calling devices are behind a firewall.

The following image shows an OS-E Management System session where you enable media anchoring in the default-session-config.



Configuring Inbound and Outbound Encryption

For secure inbound and outbound media sessions, you need to configure OS-E **in-encryption** and **out-encryption** settings. Inbound encryption handles the portion of the call from the initiator to the OS-E using a specified encryption method. Similarly, outbound encryption handles the portion of the call from the OS-E to the call recipient using a specified encryption method.

The following image shows the inbound encryption configuration page.

Status Summary Logout guest

Configuration

Home Configuration Status Call Logs Event Logs Actions Services Keys Access Tools Portal

Configuration: all

Configuration Setup View

cluster:asterisk

- box 1
- box 2
- box 3
- vrp

vsp

- registration-service
- access
- default-session-config
 - sip-settings
 - from-uri-specification
 - media
 - in-encryption
 - bodypart-type
 - in-codec-preferences
 - out-codec-preferences
 - in-media-normalization
 - sip-directive
 - presence
 - authentication

Configure vspdefault-session-config-in-encryption

Show basic Help Index

Set Reset Back Delete

mode	none	(Do not allow encryption)
type	RFC-3711	(RFC-3711 compliant SRTP)
priority-AES-128-CM-HMAC-SHA1-32	1	(from 0 to 5, default=1)
priority-AES-128-CM-HMAC-SHA1-80	2	(from 0 to 5, default=2)
require-tls	false	
mki-length	0	(from 0 to 4, default=0)

Set Reset Back

Help Index

Inbound Encryption Mode and Type

Set the inbound encryption mode to one of the following settings:

- none**—The OS-E disables the encryption put forth by the incoming endpoint. (That is, it responds “no” to the encryption portion of the authentication handshake.) If the outbound endpoint requires encryption, then the call is dropped.
- allow**—The OS-E passes the call through, leaving the encryption setting unchanged.
- require**—The call must come in with encryption specified or the OS-E drops it.

Set the inbound encryption type to one of the following settings:

- RFC-1889**—Use encryption as defined in RFC 1889, RTP: A Transport Protocol for Real-Time Applications. This mode is used for compatibility with Windows Messenger and Microsoft Office Communicator, neither of which currently support RFC-3711 encryption. Instead, it uses a DES-CBC encryption of the entire UDP payload (including RTP headers) with no authentication.
- RFC-3711**—Use encryption as defined in RFC 3711, The Secure Real-time Transport Protocol (SRTP). This is the same encryption as used in the OS-E setting.

- **Linksys**—Use Linksys/Sipura encryption over Linksys phones. Refer to Linksys Encryption for more information

The following image shows the inbound encryption configuration page.

The screenshot displays the Net-Net OS-E Configuration interface. At the top, there's a navigation bar with tabs: Home, Configuration, Status, Call Logs, Event Logs, Actions, Services, Keys, Access, Tools, and Portal. Below this, a sub-navigation bar shows 'Configuration: all' with sub-tabs: Configuration, Setup, and View. The main content area is titled 'Configure vspdefault-session-configout-encryption'. It features a left sidebar with a tree view showing the configuration hierarchy: cluster:asterisk > box 1 > box 2 > box 3 > vrp > vsp > registration-service > access > default-session-config > sip-settings > from-un-specification > media > in-encryption. The main panel contains a form with the following fields: 'mode' (dropdown set to 'none'), 'type' (dropdown set to 'RFC-3711'), 'priority-AES-128-CM-HMAC-SHA1-32' (text input '0'), 'priority-AES-128-CM-HMAC-SHA1-80' (text input '1'), 'require-tls' (checkbox set to 'false'), and 'mki-length' (text input '0'). Buttons for 'Set', 'Reset', 'Back', and 'Delete' are present. A 'Show basic' button and 'Help'/'Index' links are also visible.

Outbound Encryption Mode, Type, and Require-TLS Setting

Set the out-encryption mode to one of the following settings:

- **none**—The OS-E disables the encryption put forth by the outbound endpoint. (That is, it responds “no” to the encryption portion of the authentication handshake.) If the inbound endpoint requires encryption, then the call is dropped.
- **offer**—The OS-E changes or establishes the encryption type to the value specified in the **type** property, below.
- **follow**—If the inbound endpoint offered encryption, the OS-E offers that type to the outbound endpoint.
- **require**—The call must come in with encryption specified or the OS-E drops it.

Set the out-encryption type to one of the following settings:

- **RFC-1889**—Use encryption as defined in RFC 1889, RTP: A Transport Protocol for Real-Time Applications. This mode is used for compatibility with Windows Messenger and Microsoft Office Communicator, neither of which currently support RFC-3711 encryption. Instead, it uses a DES-CBC encryption of the entire UDP payload (including RTP headers) with no authentication.

- **RFC-3711**—Use encryption as defined in RFC 3711, The Secure Real-time Transport Protocol (SRTP). This is the same encryption as used in the OS-E setting.
- **Linksys**—Use Linksys/Sipura encryption over Linksys phones. Refer to Linksys Encryption for more information.



Note: Because the OS-E does not always know on the outbound leg the encryption method expected by the recipient (because that recipient isn't in the registry), you must manually set the type of encryption to offer.

Require TLS

The **require-tls** property specifies the requirements of the signaling protocol for a call's outbound leg. That is, it defines whether the OS-E offers SRTP over a non-secure (TCP or UDP) signaling connection. The action of this property depends on the setting of the mode property. When this property is set to:

- **true**—The OS-E only offers encryption when talking to a TLS client. If TLS and SRTP are required (**mode** is set to **require**), the OS-E fails calls going to TCP/UDP clients. If the mode property is set to **offer** or **follow**, the OS-E forwards the call without SRTP.
- **false**—The OS-E offers SDP messages according to the mode setting without regard for the signaling transport. This allows keys to be exchanged in an insecure message.

Most phones follow [RFC 4568, SDP Security Descriptions for media Streams](#), and thus require that this property be set to *true*.

Linksys Encryption

The **linksys** action allows you to generate a Linksys/Sipura mini-certificate and private key which, after loaded into the phone, will be used to exchange the symmetric key. You must execute this action and load the result into both phone parties.

Linksys equipment supports a proprietary version of SRTP. It uses SIP INFO messages to exchange credentials (in mini-certificates) and securely distribute the key used to encrypt/decrypt the RTP packets. The RTP encryption is a variation of RFC-3711; the encryption algorithm is the same (AES-CM-128), but uses HMAC-MD5 instead of HMAC-SHA1 for authentication.

The CLI syntax for the **linksys mini-certificate** action is:

```
linksys mini-certificate user-id display-name expires [filename]
```

The following image shows the linksys mini-certificate page.

The screenshot shows the Acme Packet web interface. The top navigation bar includes links for Home, Configuration, Status, Call Logs, Event Logs, Actions, Services, Keys, Access, Tools, and Portal. The main content area is titled "linksys" and "Generate or check Linksys/Sipura SRTP encryption parameters". It features a form with the following fields:

- * cert**: A dropdown menu set to "mini-certificate" with a tooltip that reads "(Generate Linksys/Sipura mini-certificate and phone private key)".
- * cert_type**: A dropdown menu set to "mini-certificate".
- * user-id**: A text input field.
- * display-name**: A text input field.
- * expires**: A text input field with a tooltip example: "23:05:45 2004-11-25".
- filename**: A text input field with a "Browse System Files" link.

An "Invoke" button is located at the bottom right of the form.

The **linksys** action provides three tools:

- **mini-certificate**—Creates a mini-certificate, which will later be used by a Linksys phone to exchange an encrypted symmetric key. When both phones in a call support cryptographic exchange, use this action to create a mini-certificate that is sent in an INFO message to the other phone. (You must execute this action for both phones.) After exchanging mini-certificate, the phones can then exchange an encrypted symmetric key.

Enter the following fields to generate a mini-certificate:

- **userID**—A name that identifies this phone (subscriber) to the other party. The user ID can be up to 32 characters.
- **displayName**—A name used by the caller to verify that the callee is the intended call recipient. Enter the user ID field in the Request URI of the INVITE message sent to the proxy server by the caller UAC when making a call to this subscriber (UAS). The display name can be up to 16 characters.
- **expiration**—The date and time at which this mini-certificate expires. Enter the date in the format *hh:mm:ss yyyy-mm-dd*.

- **filename**—A name for an output file that will contain the mini-certificate and private key. If you do not specify a file name, the output is not written to a file.

Once you execute this option, the OS-E returns the content of the mini-certificate and the SRTP private key. You can copy and paste each of these fields into your phones Web GUI (or other software interface), as well as test the certificate using the **check-mini-cert** option.

- **generate-ca-key**—Generates a Linksys/Sipura CA key. This is the public/private key pair that acts as the Sipura certificate authority. It is needed to generate the mini-certificates for each phone and during the key exchange.

The key is stored in **/cxc/certs/linksys_ca.pem**. When executing this action, you can specify whether to overwrite any previous CA key. The default setting, **false**, does not overwrite the key. Set the field to **true** to force an overwrite.

- **check-mini-cert**—Verifies the contents of a certificate created with the mini-certificate option. When executed, the OS-E checks the expiration date and signature of the certificate. Enter the content of the mini-certificate to invoke this option.



Note: You must have a root certificate loaded on the OS-E system for this action to be successful. The default location for the root certificate is **/cxc/certs/linksys_ca.pem**.

The following CLI session generates the mini-certificate and private key for the Linksys phones.

CLI Session

```
NNOS-E> linksys mini-certificate ?
```

```
Generate or load Linksys/Sipura SRTP encryption parameters
```

```
syntax: linksys mini-certificate user-id display-name expires  
[filename]  
        linksys generate-ca-key [force]  
        linksys check-mini-cert minicert
```

```
NNOS-E> linksys mini-certificate 9577 9577-display "23:05:45  
2004-11-25"
```

```
Mini Certificate:
```

```
OTU3Ny1kdWVyb2QAAAAAAAAAAAAAAAAAAAAAAAAAAAAA5NTc3AAAAAAAAAAAAAAAAAMDMwNT
Q1MjYxMTA0ybYgcmG8IeaYz225Grs7sDJflnfyJxARPEhQ+CO6WisAZ77U2zBi8TCapI
wqcDhNXwgYKZxljAET3dFnzAxs2ze1/
kEHCqvUmDIEjaYL+1WTySaIlTGKy15FbyZb6dQXtbPF+fXiRP//
caFFKUBTUuwtjExxaAz0H3u8Tc2YT/wH7a0+snpUTFeK/
Sv9vd7aAUbufSxewlL2GeTdOu0v2i4R25/
RH6iOHYChGpVt2EJ3BHAlLgXTfJibiwwkrMSelgrSibsCy0D825ezAt66AVKTA/
hOmSBvdZvdamJIsbP89vnAJPiOfWNet8T40/wOYyylAE5JDJ/2+G/
MDyc5ImzFTvifKvIQ55T7Jr5E0RUbacDZilHy5oW+x4sfawCiQZunnb1lqlAgYhvOeuo
4f3JGUKJAld0GRjHfvjRhb3c=
```

SRTP Private Key:

```
Oxq38oJqjhe++yBTtTotoMndnZXulkgnnxFQPD0v96oc8lIZ5dug9Szob9ZYQXsPkWAXSb
Oxq38oJqjhe++BVpyxz2P2qtZEg==
```

NNOS-E> **linksys check-mini-cert**

```
OTU3NwAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA5NTc3AAAAAAAAAAAAAAAA
AAAMTU1ODQ4MTEyNTA0z1TBkpXzjmR6PFX5K4S7G5SxdpozH460T14KpwOxZ8
ly4KWpFlcC2rTTWEU6WnOufcj5Bfif7cdsAF/
89kZu83NFceK2ZBRGrJ4cbxREtuPwy1FqkXpBQczTTFXjeyFaq8K7OESebQay
FetBEceIupuzxfedlJPRsMRhsHNluKpomc/
tdJFHJhxszn+fx+GTACrXQEHzi+oDL+iQvzhJ1zk/
gXTGuk761kJG2XLvSvdjTp8RjQX/F5h0GnBa02d3bQ51n7IBvJnTeaGKp/U/
e5pQvW5u6vD/uHkqkTGkZDZzOyIISIdgWVxdjA9cpaSa2D5nPhr8G/
WhOadLZ08fmb0kPwEFjJ0h0dojjknjNJp/
qVjR5NEEzuj5kH7Q1vxk2510MThhydCYpbxShy2GSno7apnyCA02YBQCRlGBO
s=
```

Certificate has expired

NNOS-E> **linksys generate-ca-key**

Unable to overwrite Linksys CA key

Chapter 7. Performing Maintenance and System Upgrades to the NN2600

About This Chapter

This chapter describes the Net-Net OS-E 2610 and 2620 hardware maintenance and upgrade tasks that you can perform at your installation site. You do not need onsite assistance from Acme Packet personnel to perform these tasks.

Before performing any type of maintenance or upgrade activity, make sure that you first read the Warnings and Safety Cautions sections at the beginning of this chapter.

Warnings

System Power On/Off

The power button DOES NOT turn off the system AC power. To remove power from system, you must unplug the AC power cord from the wall outlet. Make sure the AC power cord is unplugged before you open the chassis, add, or remove any components.

Hazardous Conditions, Devices and Cables

Hazardous electrical conditions may be present on power, telephone, and communication cables. Turn off the server and disconnect the power cord, telecommunications systems, networks, and modems attached to the server before opening it. Otherwise, personal injury or equipment damage can result.

Electrostatic Discharge (ESD) and ESD Protection

ESD can damage disk drives, boards, and other parts. We recommend that you perform all procedures in this chapter only at an ESD workstation. If one is not available, provide some ESD protection by wearing an antistatic wrist strap attached to chassis ground — any unpainted metal surface—on your server when handling parts.

Refer to *Attaching an ESD Strap* for more information.

ESD and Handling Boards

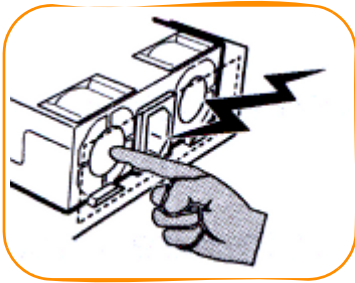
Always handle boards carefully. They can be extremely sensitive to ESD. Hold boards only by their edges. After removing a board from its protective wrapper or from the server, place the board component side up on a grounded, static free surface. Use a conductive foam pad if available but not the board wrapper. Do not slide board over any surface.

Installing or Removing Jumpers

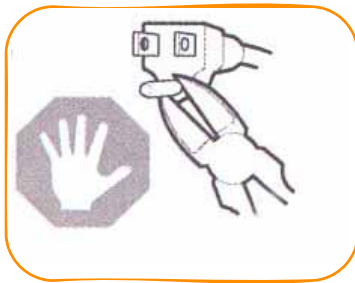
A jumper is a small plastic encased conductor that slips over two jumper pins. Some jumpers have a small tab on top that you can grip with your fingertips or with a pair of fine needle nosed pliers. If your jumpers do not have such a tab, take care when using needle nosed pliers to remove or install a jumper; grip the narrow sides of the jumper with the pliers, never the wide sides. Gripping the wide sides can damage the contacts inside the jumper, causing intermittent problems with the function controlled by that jumper. Take care to grip with, but not squeeze, the pliers or other tool you use to remove a jumper, or you may bend or break the stake pins on the board.

Safety Cautions

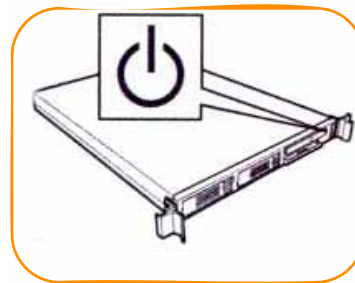
Read all caution and safety statements in this document before performing any of the instructions.



The power supply in this product contains no user-serviceable parts. Refer servicing only to qualified Acme Packet support personnel.



Do not attempt to modify or use the supplied AC power cord if it is not the exact type required. A product with more than one power supply will have a separate AC power cord for each supply.



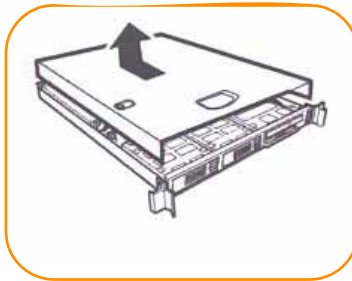
The power button on the system does not turn off system AC power. To remove AC power from the system, you must unplug each AC power cord from the wall outlet or power supply.

The power cord(s) is considered the disconnect device to the main (AC) power. The socket outlet that the system plugs into shall be installed near the equipment and shall be easily accessible



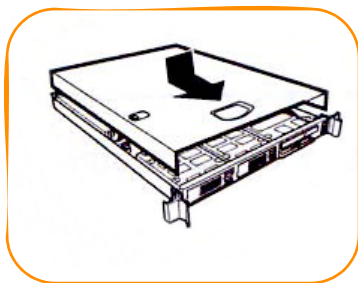
SAFETY STEPS: Whenever you remove the chassis covers to access the inside of the system, follow these steps:

1. Turn off all peripheral devices connected to the system.
2. Turn off the system by pressing the power button.
3. Unplug all AC power cords from the system or from wall outlets.
4. Label and disconnect all cables connected to I/O connectors or ports on the back of the system.
5. Provide some electrostatic discharge (ESD) protection by wearing an antistatic wrist strap attached to chassis ground of the system—any unpainted metal surface—when handling components.
6. Do not operate the system with the chassis covers removed.



After you have completed the six SAFETY steps above, you can remove the system covers. To do this:

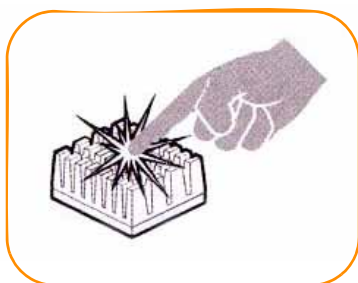
1. Unlock and remove the padlock from the back of the system if a padlock has been installed.
2. Remove and save all screws from the covers.
3. Remove the covers.



For proper cooling and airflow, always reinstall the chassis covers before turning on the system. Operating the system without the covers in place can damage system parts.

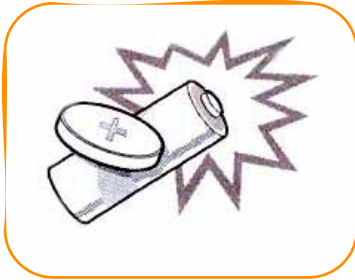
To install the covers:

1. Check first to make sure you have not left loose tools or parts inside the system.
2. Check that cables, add-in boards, and other components are properly installed.
3. Attach the covers to the chassis with the screws removed earlier, and tighten them firmly.
4. Insert and lock the padlock to the system to prevent unauthorized access inside the system.
5. Connect all external cables and the AC power cord(s) to the system.



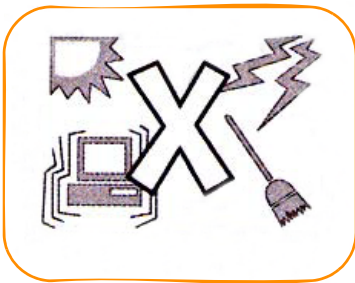
A microprocessor and heat sink may be hot if the system has been running. Also, there may be sharp pins and edges on some board and chassis parts

Contact should be made with care.
Consider wearing protective gloves.



Danger of explosion if the battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the equipment manufacturer.

Dispose of used batteries according to manufacturer's instructions.



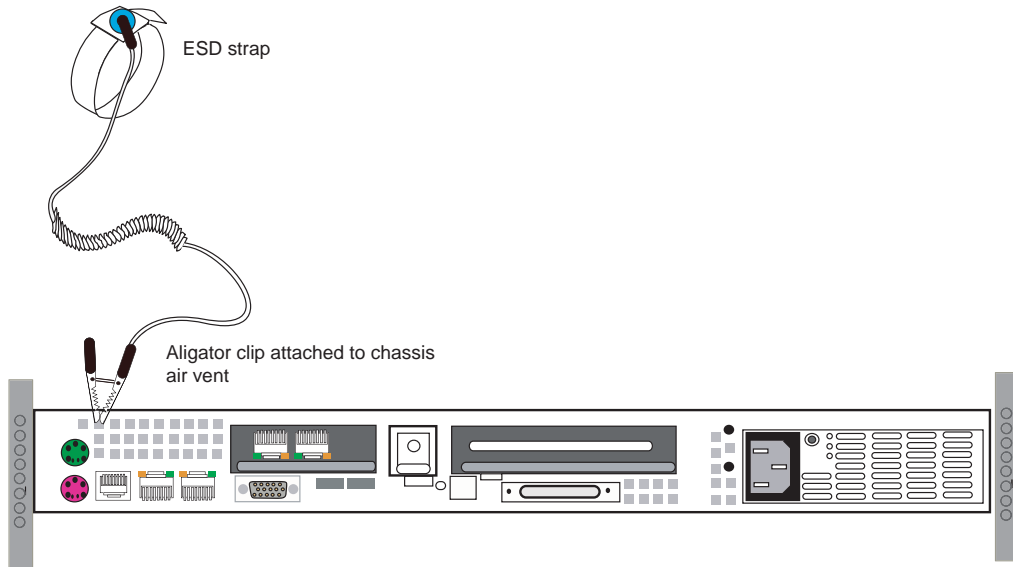
The system is designed to operate in a typical office, service provider, or Telco environment.

Choose a site that is:

- Clean and free of airborne particles (other than normal room dust.
- Well ventilated and away from sources of heat including direct sunlight.
- Away from sources of vibration and shock.
- Isolated from strong electromagnetic fields produced by electrical forces.
- In regions that are susceptible to electrical storms, we recommend you plug your system into a surge suppressor and disconnect telecommunication lines during an electrical storm.
- Provided with a properly grounded wall outlet.
- Provided with sufficient space at access the power supply cord(s), because they serve as the product's main power disconnect.

Attaching an ESD Strap

Make sure that you attach an electrostatic discharge (ESD) strap to the system anytime you perform any maintenance that involves removing the top cover. ESD straps usually have an alligator-style clip that allows you to easily attach the strap to the system sheet metal. Air vents holes in the sheet metal allow for easy attachment of an ESD strap, as illustrated in the following image.



Installing the Racking Mounting Brackets

On NN2610 and NN2620 Systems

NN 2610 and NN 2620 systems include rack mounting brackets that secure the front bezel and to allow installation in a rack. You will need a #2 Phillips screwdriver to install the brackets.

If you have not already installed the brackets (as described in Chapter 2, “Installing the NN2610 and NN2620 Series Systems”), locate the two brackets and the four screws in the accessory box included in the shipping container. Install the brackets at the front sides of the chassis, using two screws required for each bracket.

The following image illustrates the bracket. Note that both brackets are identical, so you can start with either bracket on the either side.



Installing and Removing the Front Bezel

On NN2610 and NN2620 Systems

OS-E Series systems have a removable front bezel. The bezel snaps into the rack mounting brackets at front of the chassis and is secured with a keyed lock, illustrated in the following image. OS-E Series systems can operate with or without the front bezel.

Removing the bezel allows you to access the system control panel and the hard disk drives on the front of the system. Installing the bezel provides a way to protect the system from unwanted intrusion and manipulation of the system.

Bezel lock; unlock using supplied key



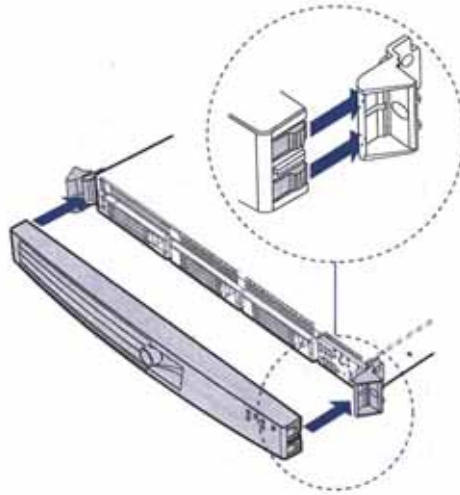
NN 2610 with front bezel

bezel

To install the front bezel, perform the following steps:

1. At each end of the bezel, line up the center notch on the bezel with the center guide on the rack handles.
2. Push the bezel onto the front of the chassis until it clicks into place.

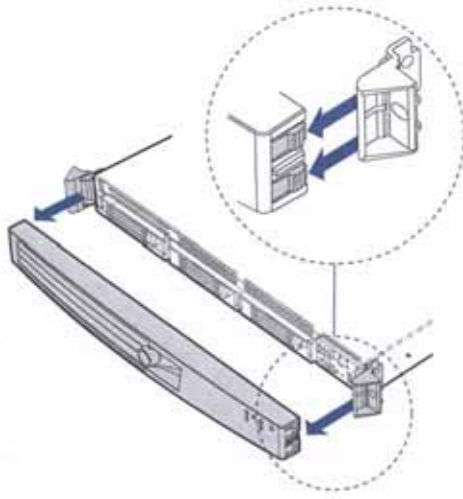
3. Connect any necessary cables to the front control panel area at the right side of the chassis.
4. Lock the bezel using the supplied key.



To remove the bezel, perform the following steps:

1. Unlock the bezel using the supplied key.
2. Remove any cables that are attached to the front of the system.

3. Pull on the left- and right-most edges of the bezel to pop it out.



Removing and Installing the Chassis Cover

On the NN2610

Removing the Chassis Cover

The NN 2610 must have the top cover in place to ensure proper cooling. You will need to remove the top cover to add or replace components inside of the platform. Before removing the top cover, power down the server and unplug all peripheral devices and the AC power cable. None of the components inside the chassis are hot-swappable.

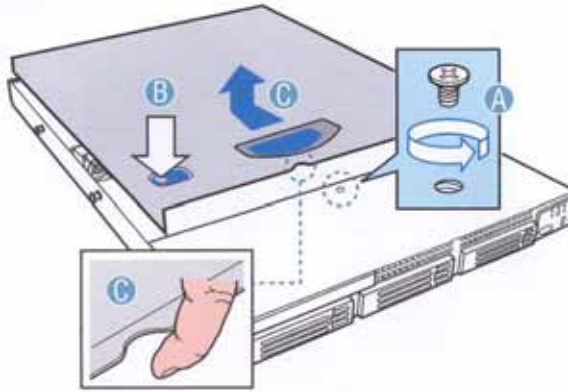


Note: A nonskid surface or a stop behind the chassis may be needed to prevent the chassis from sliding on your work surface.

Perform the following steps:

1. Observe the warnings and cautions covered at the beginning of this chapter.
2. Turn off all peripheral devices connected to the NN 2610, then turn off the NN 2610.

3. Disconnect the AC power cord.
4. Remove the shipping screw (if installed). See letter “A” in the figure below.
5. While holding in the blue button at the top of the chassis in (see letter “B”), slide the top cover back until it stops (See letter “C”).
6. Lift the cover upward to remove it.

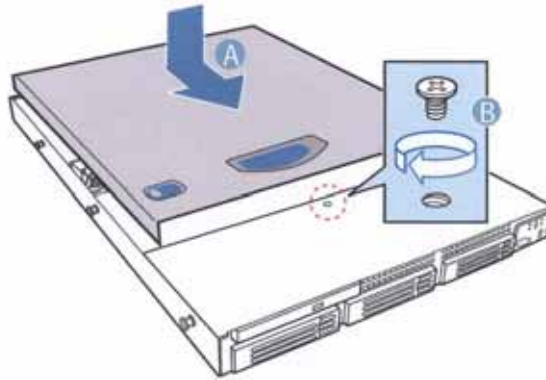


Installing the Chassis Cover on the NN2610

Perform the following steps:

1. Place the cover over the chassis so that the side edges of the cover sit just inside the chassis sidewalls.
2. Slide the cover forward until it clicks into place. See letter “A” in the figure below.
3. (Optional) Insert the shipping screw at the center of the top cover. See letter “B” in the figure.

4. Reconnect all peripheral devices and the AC power cord.



On the NN2620

Removing the Chassis Cover

The NN 2620 must have the top cover in place to ensure proper cooling. You will need to remove the top cover to add or replace components inside of the chassis. Before removing the top cover, power down the server and unplug all peripheral devices and the AC power cable. Except for the redundant power supply, none of the components inside the chassis are hot-swappable.

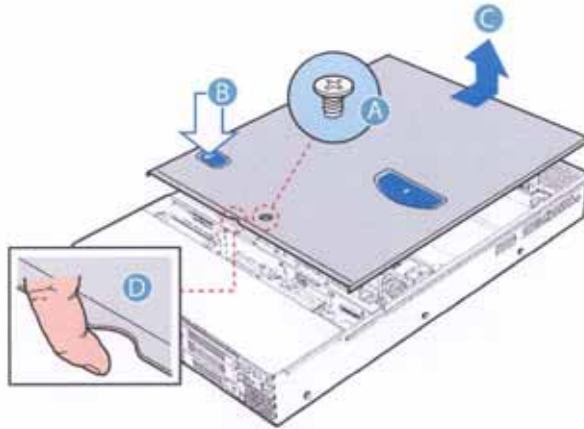


Note: A nonskid surface or a stop behind the chassis may be needed to prevent the chassis from sliding on your work surface.

Perform the following steps:

1. Observe the safety and ESD precautions at the beginning of this book. See “Safety Information.”
2. Turn off all peripheral devices connected to the NN 2620, then turn off the NN 2620.
3. Disconnect the AC power cord.
4. Remove the shipping screw (if installed). See letter “A” in the figure below.
5. While holding in the blue button at the top of the chassis in (see letter “B”), slide the top cover back until it stops (see letter “C”).

6. Lift the cover upward and remove it. A notch in the cover is provided to help lift it upward to remove it (see letter “D”).

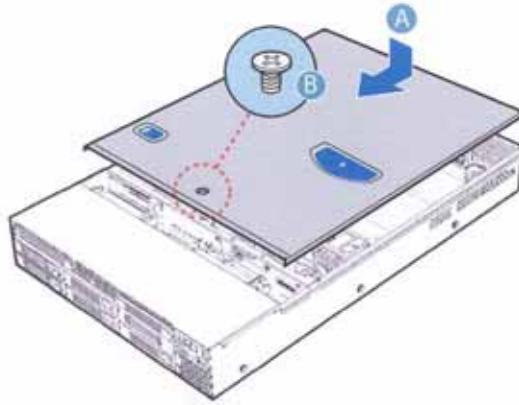


Installing the Chassis Cover on the NN2620

Perform the following steps:

1. Place the cover over the chassis so that the side edges of the cover sit just inside the chassis sidewalls.
2. Slide the cover forward until it clicks into place. See letter “A” in the figure below.
3. (Optional): Insert the shipping screw at the center of the top cover. See letter “B” in the figure.

4. Reconnect all peripheral devices and the AC power cord.



Replacing a System Fan

On NN 2620 systems only



Note: For NN 2610 fan replacement, refer servicing to qualified Acme Packet support personnel.

The system fans at the front of the NN 2620 can be individually replaced if one of them fails. You must have four fans installed in the back four positions of the fan module.

The chassis also allows you to install four redundant fans. The redundant fans must be installed as a set of four and are installed in the four front fan sockets of the fan module. The instructions for installing a redundant fan are the same as the instructions for installing a replacement fan, except that when you are first installing the redundant set of fans, you do not need to remove any fans.

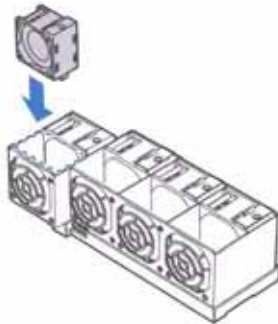
The fans that are integrated into the power supply cannot be replaced separately. If one of these fans fails, the power supply module must be replaced.

To replace a system fan, perform the following instructions. To install the redundant fans, perform the following instructions, but disregard step 4.



Caution: Fans are NOT hot swappable. Before removing or replacing a fan, you must first take the server out of service, turn off all peripheral devices connected to the system, turn off the system by pressing the power button, and unplug the AC power cord from the system or wall outlet.

1. Observe the warnings and cautions covered at the beginning of this chapter.
2. Power down the server system and unplug all peripheral devices and the AC power cable.
3. Remove the chassis cover. For instructions, see Removing and Installing the Chassis Cover.
4. There are no screws to loosen. Lift the failed fan from the module. An LED should indicate the failed fan(s).
5. Position the fan so the connector on the fan is at the right and pointing down.
6. With the fan oriented correctly, insert the fan into the fan module, engaging the connector on the fan into the matching connector on the fan module.
7. Install the chassis cover. For instructions, see Removing and Installing the Chassis Cover.



Installing or Replacing a Hot-Swap Power Supply

On NN2620 Systems Only

The power supply can be replaced if it, or one of the fans integrated into it, fails. If your server uses a redundant power supply, you do not need to power down your system to replace the failed power supply, as long as the remaining power supply is plugged into an AC power source and is functioning. If you do not have a redundant power supply installed, you must power down your server system before replacing the power supply.

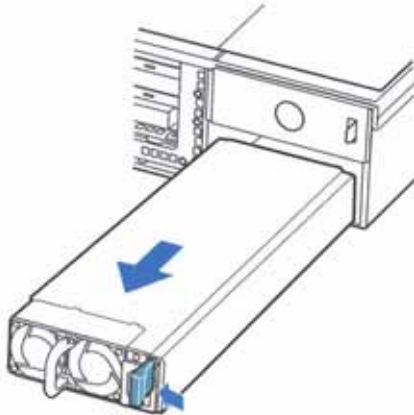


Note: For NN 2610 power supply replacement, refer servicing to qualified Acme Packet support personnel.

Removing a Hot-Swap Power Supply

To replace the power supply, perform the following steps.

1. (Non-redundant power supply only) Power down the server.
2. Remove the AC power cable from the failed power supply.
3. Press the green latch at the rear of power supply and pull the power supply from the chassis.



Installing a Hot-Swap Power Supply

To install a replacement power supply or to add a redundant power supply, use the following instructions.

1. (Replacing power supply only) Remove the failed power supply. For instructions, see Removing a Hot-Swap Power Supply.
2. (Installing redundant power supply only): Remove the filler panel from the upper power supply bay by pulling it out.
3. Slide the new power supply into the opening until it clicks into place. The latch on the rear of the power supply must be at the right.
4. Plug in the AC power cable for the new power supply.

Installing and Removing a Hard Disk Drive

On NN2610 and NN2620 Systems

The NN 2610 supports up to three SATA hot-swap hard drives, and the NN 2620 supports up to six SATA hard drives.



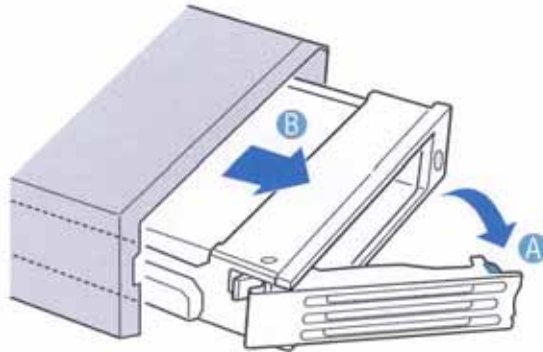
Caution: If you need to replace one or more disk drives, contact your Acme Packet sales representative for ordering information. Disk drives provided by Acme Packet are the only compatible models. Do not install disk drives that are not supplied by Acme Packet.

Removing a SATA Hot-Swap Hard Disk Drive

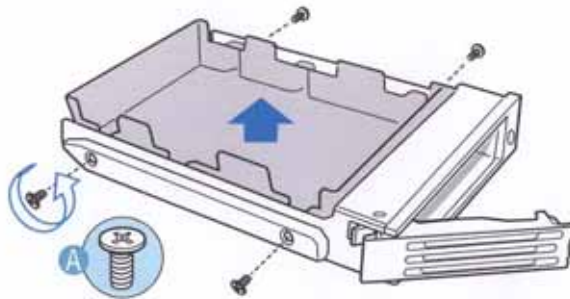
Perform the following steps:

1. Remove the front bezel if it is installed. For instructions, see Installing and Removing the Front Bezel.
2. Press in on the green latch at the front of the hard drive carrier. See letter “A” in the image below

3. Pull out on the black lever and slide the carrier from the chassis. See letter “B” in the figure below.



4. Remove the four screws that attach the plastic retention device or the previously installed hard drive to the drive carrier. Two screws are at each side of the retention device or the hard drive. If required, store the plastic retention device for future use.

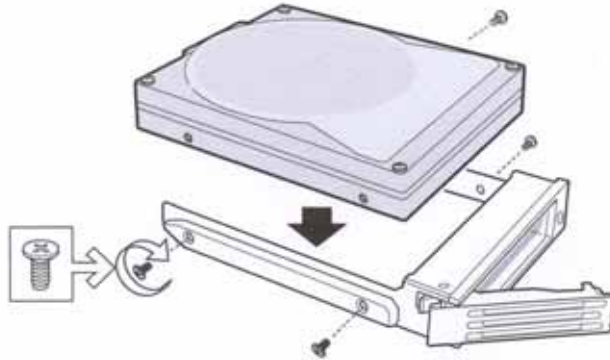


Installing a SATA Hot-Swap Hard Disk Drive

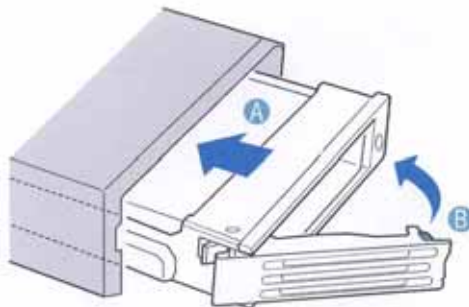
Perform the following steps:

1. Remove the hard drive from its wrapper and place it on an antistatic surface.
2. Set any jumpers and/or switches on the drive according to the drive manufacturer's instructions.
3. With the drive circuit-side down, position the connector end of the drive so that it is facing the rear of the drive carrier. See the image below.

4. Align the holes in the drive to the holes in the drive carrier and attach it to the carrier with the screws that were attached to the plastic retention device.



5. With the black lever in the fully open position, slide the drive assembly into the chassis. The green latch at the front of the drive carrier must be to the right. Do not push on the black drive carrier lever until the lever begins to close by itself.
6. When the black drive carrier lever begins to close by itself, push on it to lock the drive assembly into place.



7. (Optional) Install the front bezel. For instructions, see Installing and Removing the Front Bezel.

Appendix A. Technical Specifications

NEBS/ETSI

- Bellcore GR-63, Physical Protection Requirements
- Bellcore GR-1089, Electromagnetic Compatibility and Electrical Safety Req.
- ETSI 300 386, Telecommunication Network, Electromagnetic Compatibility
- ETSI 300 019, Environmental Conditions and Environmental Tests
- ETSI 753, Acoustic Noise

AC Power Cords






North America, Europe, United Kingdom, Japan, China, Korea, Australia

Safety and EMC Regulatory Compliance (Class A)

Country	Certification (Safety and/or EMC)	Regulatory Mark (Safety and/or EMC)
Argentina	IRAM	Not applicable
Australia/New Zealand	ACA, MED	C-Tick
Belarus	Bellis	Not applicable
Canada	UL / Industry Canada	cURus / ICES
China	CNCA	CCC
Europe	European Directives	CE
Germany	GS	GS
International	CB Repor / CISPR 22	Not applicable
Japan	VCCI	VCCI
Korea	RRL	MIC
Russia	GOST	GOST
Taiwan	BSMI RPC	BSMI
United States	UL / FCC	CULus / FCC

Product Regulatory Compliance Markings

This product is marked with the following Product Certification Markings:

Regulatory Compliance	Country	Marking
cULus Listing Marks	USA/Canada	
GS Mark	Germany	 
CE Mark	Europe	
FCC Marking (Class A)	USA	This device complies with Part 15 of the FCC Rules. Operation of this device is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation. Manufactured by Intel Corporation
EMC Marking (Class A)	Canada	CANADA ICES-003 CLASS A CANADA NMB-003 CLASSE A
VCCI Marking (Class A)	Japan	この装置は、クラス A 情報技術装置です。この装置を家庭環境で使用すると電波妨害を引き起こすことがあります。この場合には使用者が適切な対策を講ずるよう要求されることがあります。VCCI-A
C-Tick	Australia	 N12213

Regulatory Compliance	Country	Marking
BSMI Certification Number & Class A Warning	Taiwan	
		警告使用者： 這是甲類的資訊產品，在居住的環境中使用時，可能會造成射頻干擾，在這種情況下，使用者會被要求採取某些適當的對策
GOST R Marking	Russia	
RRL MIC Mark	Korea	
China Compulsory Certification Mark	China	

Electromagnetic Compatibility Notices FCC (USA)

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
 For questions related to the EMC performance of this product, contact:

Intel Corporation
 5200 N.E. Elam Young Parkway
 Hillsboro, OR 97124
 1-800-628-8686

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.

- Increase the separation between the equipment and the receiver.
- Connect the equipment to an outlet on a circuit other than the one to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment. The customer is responsible for ensuring compliance of the modified product.

Only peripherals (computer input/output devices, terminals, printers, etc.) that comply with FCC Class A or B limits may be attached to this computer product. Operation with noncompliant peripherals is likely to result in interference to radio and TV reception.

All cables used to connect to peripherals must be shielded and grounded. Operation with cables, connected to peripherals, that are not shielded and grounded may result in interference to radio and TV reception.

Industry Canada (ICES-003)

Cet appareil numérique respecte les limites bruits radioélectriques applicables aux appareils numériques de Classe A prescrites dans la norme sur le matériel brouilleur: "Appareils Numériques", NMB-003 édictée par le Ministre Canadien des Communications.

English translation of the notice above:

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the interference-causing equipment standard entitled "Digital Apparatus," ICES-003 of the Canadian Department of Communications.

Europe (CE Declaration of Conformity)

This product has been tested in accordance too, and complies with the Low Voltage Directive (73/23/EEC) and EMC Directive (89/336/EEC). The product has been marked with the CE Mark to illustrate its compliance.

VCCI (Japan)

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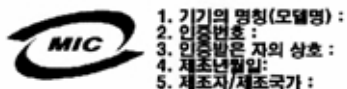
This is a Class A product based on the standard of the Voluntary Control Council for Interference (VCCI) from Information Technology Equipment. If this is used near a radio or television receiver in a domestic environment, it may cause radio interference. Install and use the equipment according to the instruction manual.

BSMI (Taiwan)

警告使用者：
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The BSMI Certification Marking and EMC warning is located on the outside rear area of the product.

Korean RRL Compliance



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Brian Wellington

- <http://www.xbill.org/dnsjava/dnsjava-current/README>

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bash, binutils, coreutils, diffutils, ethtool, glibc, grep, grub, libgcc-3.4.3, libstdc++ 3.4.3, libtool, OpenIPMI, popt, psmisc, Unix ODBC, xfsprogs

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attr, cpio, cracklib, mpfr, syslog4j

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zlib.h -- interface of the 'zlib' general purpose compression library
version 1.2.2, October 3rd, 2004

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Notes on the development process

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Kai Toedler

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iputils

By Linux Foundation - November 19, 2009

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Written by: Philip Hazel

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Python was created in the early 1990s by Guido van Rossum at Stichting Mathematisch Centrum (CWI, see <http://www.cwi.nl>) in the Netherlands as a successor of a language called ABC. Guido remains Python's principal author, although it includes many contributions from others.

In 1995, Guido continued his work on Python at the Corporation for National Research Initiatives (CNRI, see <http://www.cnri.reston.va.us>) in Reston, Virginia where he released several versions of the software.

In May 2000, Guido and the Python core development team moved to BeOpen.com to form the BeOpen PythonLabs team. In October of the same year, the PythonLabs team moved to Digital Creations (now Zope Corporation, see <http://www.zope.com>). In 2001, the Python Software Foundation (PSF, see <http://www.python.org/psf/>) was formed, a non-profit organization created specifically to own Python-related Intellectual Property. Zope Corporation is a sponsoring member of the PSF.

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Release compatible?	Derived (1)	Year 0.9.0 thru 1.2	Owner 1991-1995	GPL- from CWI	yes
1.3 thru 1.5.2	1.2	1995-1999	CNRI	yes	
1.6	1.5.2	2000	CNRI	no	
2.0	1.6	2000	BeOpen.com	no	
1.6.1	1.6	2001	CNRI	yes (2)	
2.1	2.0+1.6.1	2001	PSF	no	
2.0.1	2.0+1.6.1	2001	PSF	yes	
2.1.1	2.1+2.0.1	2001	PSF	yes	
2.2	2.1.1	2001	PSF	yes	
2.1.2	2.1.1	2002	PSF	yes	
2.1.3	2.1.2	2002	PSF	yes	
2.2.1	2.2	2002	PSF	yes	
2.2.2	2.2.1	2002	PSF	yes	
2.2.3	2.2.2	2003	PSF	yes	
2.3	2.2.2	2002-2003	PSF	yes	
2.3.1	2.3	2002-2003	PSF	yes	
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2.3.4	2.3.3	2004	PSF	yes	
2.3.5	2.3.4	2005	PSF	yes	
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jseward@acm.org

bzip2/libbzip2 version 1.0.2 of 30 December 2001.

crash

- http://people.redhat.com/anderson/crash_whitepaper/#GFDL

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Michael H. Kay 27 January 2010

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 3ln5fd0pC

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 iFlv6YfyR820aNvNNI+AdtgWYRPVHocVNOOrZcmu7IADO8hlU//

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<one line to give the program's name and a brief idea of what it does.>

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```
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```

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