CONFIGURATION GUIDE

RUCKUS FastIron Management Configuration Guide, 08.0.70

Supporting FastIron Software Release 08.0.70

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Document Conventions

The following table lists the text conventions that are used throughout this guide.

TABLE 1 Text Conventions

Convention	Description	Example
`monospace`	Identifies command syntax examples	`device(config)# interface ethernet 1/1/6`
bold	User interface (UI) components such as screen or page names, keyboard keys, software buttons, and field names	On the **Start** menu, click **All Programs**.
italics	Publication titles	Refer to the *RUCKUS Small Cell Release Notes* for more information.

Notes, Cautions, and Safety Warnings

Notes, cautions, and warning statements may be used in this document. They are listed in the order of increasing severity of potential hazards.

NOTE

A NOTE provides a tip, guidance, or advice, emphasizes important information, or provides a reference to related information.

ATTENTION

An ATTENTION statement indicates some information that you must read before continuing with the current action or task.



CAUTION

A CAUTION statement alerts you to situations that can be potentially hazardous to you or cause damage to hardware, firmware, software, or data.



DANGER

A DANGER statement indicates conditions or situations that can be potentially lethal or extremely hazardous to you. Safety labels are also attached directly to products to warn of these conditions or situations.

Command Syntax Conventions

Bold and italic text identify command syntax components. Delimiters and operators define groupings of parameters and their logical relationships.

Convention	Description
bold text	Identifies command names, keywords, and command options.

Convention	Description
italic text	Identifies a variable.
[ ]	Syntax components displayed within square brackets are optional. Default responses to system prompts are enclosed in square brackets.
{ **x** | **y** | **z** }	A choice of required parameters is enclosed in curly brackets separated by vertical bars. You must select one of the options.
x | **y**	A vertical bar separates mutually exclusive elements.
< >	Nonprinting characters, for example, passwords, are enclosed in angle brackets.
...	Repeat the previous element, for example, *member*[*member*...].
\	Indicates a "soft" line break in command examples. If a backslash separates two lines of a command input, enter the entire command at the prompt without the backslash.

Document Feedback

RUCKUS is interested in improving its documentation and welcomes your comments and suggestions.

You can email your comments to RUCKUS at #Ruckus-Docs@commscope.com.

When contacting us, include the following information:

- Document title and release number
- Document part number (on the cover page)
- Page number (if appropriate)

For example:

- RUCKUS SmartZone Upgrade Guide, Release 5.0
- Part number: 800-71850-001 Rev A
- Page 7

RUCKUS Product Documentation Resources

Visit the RUCKUS website to locate related documentation for your product and additional RUCKUS resources.

Release Notes and other user documentation are available at https://support.ruckuswireless.com/documents. You can locate the documentation by product or perform a text search. Access to Release Notes requires an active support contract and a RUCKUS Support Portal user account. Other technical documentation content is available without logging in to the RUCKUS Support Portal.

White papers, data sheets, and other product documentation are available at https://www.ruckuswireless.com.

Online Training Resources

To access a variety of online RUCKUS training modules, including free introductory courses to wireless networking essentials, site surveys, and products, visit the RUCKUS Training Portal at https://training.ruckuswireless.com.

Contacting RUCKUS Customer Services and Support

The Customer Services and Support (CSS) organization is available to provide assistance to customers with active warranties on their RUCKUS products, and customers and partners with active support contracts.

For product support information and details on contacting the Support Team, go directly to the RUCKUS Support Portal using https://support.ruckuswireless.com, or go to https://www.ruckuswireless.com and select **Support**.

What Support Do I Need?

Technical issues are usually described in terms of priority (or severity). To determine if you need to call and open a case or access the self-service resources, use the following criteria:

- Priority 1 (P1)—Critical. Network or service is down and business is impacted. No known workaround. Go to the **Open a Case** section.
- Priority 2 (P2)—High. Network or service is impacted, but not down. Business impact may be high. Workaround may be available. Go to the **Open a Case** section.
- Priority 3 (P3)—Medium. Network or service is moderately impacted, but most business remains functional. Go to the **Self-Service Resources** section.
- Priority 4 (P4)—Low. Requests for information, product documentation, or product enhancements. Go to the **Self-Service Resources** section.

Open a Case

When your entire network is down (P1), or severely impacted (P2), call the appropriate telephone number listed below to get help:

- Continental United States: 1-855-782-5871
- Canada: 1-855-782-5871
- Europe, Middle East, Africa, Central and South America, and Asia Pacific, toll-free numbers are available at https://support.ruckuswireless.com/contact-us and Live Chat is also available.
- Worldwide toll number for our support organization. Phone charges will apply: +1-650-265-0903

We suggest that you keep a physical note of the appropriate support number in case you have an entire network outage.

Self-Service Resources

The RUCKUS Support Portal at https://support.ruckuswireless.com offers a number of tools to help you to research and resolve problems with your RUCKUS products, including:

- Technical Documentation—https://support.ruckuswireless.com/documents
- Community Forums—https://forums.ruckuswireless.com/ruckuswireless/categories
- Knowledge Base Articles—https://support.ruckuswireless.com/answers
- Software Downloads and Release Notes—https://support.ruckuswireless.com/#products_grid
- Security Bulletins—https://support.ruckuswireless.com/security

Using these resources will help you to resolve some issues, and will provide TAC with additional data from your troubleshooting analysis if you still require assistance through a support case or RMA. If you still require help, open and manage your case at https://support.ruckuswireless.com/case_management.

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Supported hardware

This guide supports the following Ruckus products:

- RUCKUS ICX 7750 Series
- RUCKUS ICX 7650 Series
- RUCKUS ICX 7450 Series
- RUCKUS ICX 7250 Series
- RUCKUS ICX 7150 Series

For information about what models and modules these devices support, see the hardware installation guide for the specific product family.

What's new in this document

The following table includes descriptions of new information added to this guide for the FastIron 08.0.70 software release.

TABLE 2 Summary of enhancements in FastIron release 08.0.70 version 7

Feature	Description	Described in
General updates	Minor editorial updates	Throughout the guide

TABLE 3 Summary of enhancements in FastIron release 08.0.70 version 6

Feature	Description	Described in
General updates	Minor editorial updates	Throughout the guide

TABLE 4 Summary of enhancements in FastIron release 08.0.70 version 5

Feature	Description	Described in
Link dampening and alarms	The **linkdampen** command is introduced for ICX 7150 devices.	Configuring link dampening and alarms on ICX 7150 devices on page 58
PoE updates and related Syslog messages	PoE functionality on some ports will not be available when device (PoE chip) fails during operation. These ports show up as internal hardware fault in the **show inline power** command output. A syslog message is generated that shows the specific ports that are offline due to device failure.	Troubleshooting on page 183

TABLE 5 Summary of enhancements in FastIron release 08.0.70 version 4

Feature	Description	Described in
General updates	Minor editorial updates	Throughout the guide

TABLE 6 Summary of enhancements in FastIron release 08.0.70 version 3

Feature	Description	Described in
Coupling of PoE with datalink operations	Although PoE and datalink operations are functionally independent of each other, some datalink operations affect the operational behavior of PoE ports. To overcome this limitation, data link operation is decoupled with inline power by default. In the default state, the datalink operational behavior on a PoE port does not affect the power state of the powered device that is connecting to the port. From 08.0.70b release onwards, user can override the default behavior of datalink decoupling using the **inline power couple-datalink** command.	Decoupling and coupling of PoE with datalink operations on page 170

TABLE 7 Summary of enhancements in FastIron release 08.0.70 version 2

Feature	Description	Described in
General updates	Minor editorial updates	Throughout the guide

TABLE 8 Summary of enhancements in FastIron release 08.0.70

Feature	Description	Location
Power management enhancement	Power management is enhanced to enable the port and also power up the legacy PD or Class 1, Class 2, or Class 3 PDs even if the available power is less than 30 Watts.	Refer to Power class on page 167.
Auto Firmware download	PoE firmware is bundled with FastIron image and is automatically installed or upgraded as part of unit bootup. That is, manual intervention is not required to choose the corresponding firmware version for each FasIron image version.	Refer to Auto Firmware download on page 169.
Auto enabling of PoE	PoE is enabled by default and power is automatically allocated to all PoE-capable ports on bootup. As the 'inline power' configuration is applied on all PoE-capable ports by default, PD is powered up as soon as it is connected to the port.	Refer to Auto enabling of PoE on page 170.
Multiple PoE controller support	ICX device can support multiple vendor PoE chip set and initialize PoE functionality if a supported chipset vendor is detected.	Refer to Multiple PoE controller support on page 172.
Console log redirection	Console logging feature captures all the console prints generated on the system to a RAMFS file and upon certain triggers copies the RAMFS file to the flash memory.	Refer to Terminal logging on page 91.
MAC movement information in supportsave	The MAC address movement information made available in the **supportsave** output.	Refer to Viewing MAC address movement statistics for the interval history on page 76.

How Command Information is Presented in this Configuration Guide

For all new content supported in FastIron release 08.0.20 and later, command information is documented in a standalone command reference guide.

In the *RUCKUS FastIron Command Reference*, the command pages are in alphabetical order and follow a standard format to present syntax, parameters, mode, usage guidelines, examples, and command history.

NOTE
Many commands introduced before FastIron release 08.0.20 are also included in the guide.

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Management port overview

The management port is an out-of-band (OOB) port that customers can use to manage their devices without interfering with the in-band ports. The management port is widely used to download images and configurations, for Telnet sessions and for Web management.

The MAC address for the management port is derived from the base MAC address of the unit, plus the number of ports in the base module. For example, on a 48-port standalone device, the base MAC address is 0000.0034.2200. The management port MAC address for this device would be 0000.0034.2200 plus 0x30, or 0000.0034.2230. The 0x30 in this case equals the 48 ports on the base module.

The MAC address for the management port is derived as if the management port is the last port on the management module where it is located. For example, on a 2 X 10G management module, the MAC address of the management port is that of the third port on that module.

NOTE

In previous releases, the OOB management port could not be a member of the management VRF or VLAN. When a management VLAN was configured, the OOB interface was disabled, disabling switch access. This posed a risk to managing the switch if in-band ports were busy forwarding packets at line rate. Now if a management VLAN is configured, the OOB management interface is automatically part of the management VLAN (treated as an untagged port). Support is also provided for traffic over the management VRF. This provides secure management access to the device through outbound traffic through a VRF that is specified as global management VRF, thereby isolating management traffic from network data traffic.

NOTE
Refer to "Configuring the OOB management port to be a member of a management VRF" and "Configuring the OOB management port to be a member of a management VLAN."

Only packets that are specifically addressed to the management port MAC address or the broadcast MAC address are processed by the Layer 2 switch or Layer 3 switch. All other packets are filtered out. No packet received on a management port is sent to any in-band ports, and no packets received on in-band ports are sent to a management port.

For ICX devices, all features that can be configured from the global configuration mode can also be configured from the interface level of the management port. Features that are configured through the management port take effect globally, not on the management port itself.

For switches, any in-band port may be used for management purposes. A router sends Layer 3 packets using the MAC address of the port as the source MAC address.

For stacking devices, each stack unit has one OOB management port. Only the management port on the active controller will actively send and receive packets. If a new active controller is elected, the new active controller management port will become the active management port. In this situation, the MAC address of the old active controller and the MAC address of the new controller will be different.

Displaying information about management ports

Management port information can be displayed using several command-line interface (CLI) command options.

Before entering the commands in this task, ensure that the management port is configured.

The steps in this task can be performed in any order.

1. To display the current management port configuration use the **show running-config interface management** command with a specified port number.

```
device> show running-config interface management 1

interface management 1
ip address 10.44.9.64 255.255.255.0
```

2. To display more detailed interface configuration information about the management port, use the **show interfaces management** command with a specified port number.

```
device(config)# show interfaces management 1

GigEthernetmgmt1 is up, line protocol is up
 Port up for 4 day(s) 1 hour(s) 43 minute(s) 8 second(s)
 Hardware is GigEthernet, address is 0000.0076.544a (bia 0000.0076.544a)
 Configured speed auto, actual 1Gbit, configured duplex fdx, actual fdx
 Configured mdi mode AUTO, actual none
(output truncated)
```

3. To display summary management interface information, enter the **show interfaces brief management** command with a specified port number.

```
device# show interfaces brief management 1

Port    Link  State  Dupl  Speed  Trunk  Tag  Pri  MAC             Name
mgmt1   Up    None   Full  1G     None   No   0    0000.0076.544a
```

4. To display management port statistics, enter the **show statistics management** command with a specified port number.

```
device# show statistics management 1

Port   Link  State  Dupl  Speed  Trunk  Tag  Pvid Pri  MAC             Name
mgmt1  Up    None   Full  1G     None   No   None 0    0000.0076.544a

Port mgmt1 Counters:
        InOctets      3210941          OutOctets    1540
          InPkts        39939         OutPackets      22
 InBroadcastPkts         4355   OutbroadcastPkts       0
  InMultiastPkts        35214   OutMulticastPkts       6
   InUnicastPkts          370     OutUnicastPkts      16
(output truncated)
```

5. To display summary management interface statistics, enter the **show statistics brief management** command with a specified port number.

```
device# show statistics brief management 1

Port In  Packets Out  Packets Trunk  In Errors  Out Errors
mgmt1    39946        22             0             0
Total    39945        22             0             0
```

Web Management Interface

The Web Management Interface is a browser-based interface that allows administrators to manage and monitor a single RUCKUS device or a group of RUCKUS devices connected together.

For many of the features on a RUCKUS device, the Web Management Interface can be used as an alternate to the CLI for creating new configurations, modifying existing ones, and monitoring the traffic on a device.

For more information on how to log in and use the Web Management Interface, refer to the *RUCKUS FastIron Web Management Interface User Guide*.

Management VRFs

Virtual routing and forwarding (VRF) allows routers to maintain multiple routing tables and forwarding tables on the same router. A management VRF can be configured to control the flow of management traffic as described in this section.

> **NOTE**
> For information on configuring Multi-VRF, sometimes called VRF-Lite or Multi-VRF CE, refer to the *RUCKUS FastIron Layer 3 Routing Configuration Guide*.

A management VRF is used to provide secure management access to the device by sending inbound and outbound management traffic through the VRF specified as a global management VRF and through the out-of-band management port, thereby isolating management traffic from the network data traffic.

By default, the inbound traffic is unaware of VRF and allows incoming packets from any VRF, including the default VRF. Outbound traffic is sent only through the default VRF. The default VRF consists of an out-of-band management port and all the LP ports that do not belong to any other VRFs.

Any VRF, except the default VRF, can be configured as a management VRF. When a management VRF is configured, the management traffic is allowed through the ports belonging to the specified VRF and the out-of-band management port. The management traffic through the ports belonging to the other VRFs and the default VRF are dropped, and the rejection statistics are incremented.

If the management VRF is not configured, the management applications follows default behavior. The management VRF is configured the same way for IPv4 and IPv6 management traffic.

The management VRF is supported by the following management applications:

- SNMP server
- SNMP trap generator
- Telnet server
- SSH server
- Telnet client
- RADIUS client
- TACACS+ client
- TFTP
- SCP
- Syslog

NOTE
Any **ping** or **traceroute** commands use the VRF specified in the command or the default VRF if no VRF is specified.

Source interface and management VRF compatibility

A source interface must be configured for management applications. When a source interface is configured, management applications use the lowest configured IP address of the specified interface as the source IP address in all the outgoing packets. If the configured interface is not part of the management VRF, the response packet does not reach the destination. If the compatibility check fails while either the management VRF or the source interface is being configured, the following warning message is displayed. However, the configuration command is accepted.

```
The source-interface for Telnet, TFTP is not part of the management-vrf
```

Management Applications Supporting Management VRFs

This section explains the management VRF support provided by the management applications.

SNMP Server

When the management VRF is configured, the SNMP server receives SNMP requests and sends SNMP responses only through the ports belonging to the management VRF and through the out-of-band management port.

Any change in the management VRF configuration becomes immediately effective for the SNMP server.

SNMP Trap Generator

When the management VRF is configured, the SNMP trap generator sends traps to trap hosts through the ports belonging to the management VRF and through the out-of-band management port.

Any change in the management VRF configuration takes effect immediately for the SNMP trap generator.

NOTE
The SNMP source interface configuration command **snmp-server trap-source** must be compatible with the management VRF configuration.

SSH Server

When the management VRF is configured, the incoming SSH connection requests are allowed only from the ports belonging to the management VRF and from the out-of-band management port. Management VRF enforcement occurs only while a connection is established.

To allow the incoming SSH connection requests only from the management VRF and not from the out-of-band management port, enter the following command.

```
device(config)# ip ssh strict-management-vrf
```

The **ip ssh strict-management-vrf** command is applicable only when the management VRF is configured. If not, the command issues the following warning message.

```
Warning - Management-vrf is not configured.
```

NOTE
For the SSH server, changing the management VRF configuration or configuring the **ip ssh strict-management-vrf** command does not affect the existing SSH connections. The changes are be applied only to new incoming connection requests.

Telnet Client

To allow the incoming Telnet connection requests only from the management VRF and not from the out-of-band management port, enter the following command.

```
device(config)# telnet strict-management-vrf
```

RADIUS Client

When the management VRF is configured, the RADIUS client sends RADIUS requests or receives responses only through the ports belonging to the management VRF and through the out-of-band management port.

Any change in the management VRF configuration takes effect immediately for the RADIUS client.

NOTE
The RADIUS source interface configuration command **ip radius source-interface** must be compatible with the management VRF configuration.

TACACS+ Client

When the management VRF is configured, the TACACS+ client establishes connections with TACACS+ servers only through the ports belonging to the management VRF and the out-of-band management port.

For the TACACS+ client, a change in the management VRF configuration does not affect the existing TACACS+ connections. The changes are applied only to new TACACS+ connections.

NOTE
The TACACS+ source interface configuration command **ip tacacs source-interface** must be compatible with the management VRF configuration.

TFTP

When the management VRF is configured, TFTP sends or receives data and acknowledgments only through ports belonging to the management VRF and through the out-of-band management port.

Any change in the management VRF configuration takes effect immediately for TFTP. You cannot change in the management VRF configuration while a TFTP file transfer is in progress.

NOTE
The TFTP source interface configuration command **ip tftp source-interface** must be compatible with the management VRF configuration.

SCP

SCP uses SSH as the underlying transport. The behavior of SCP is similar to the SSH server.

Syslog

When the management VRF is configured, the Syslog module sends log messages only through the ports belonging to the management VRF and the out-of-band management port.

Any change in the management VRF configuration takes effect immediately for Syslog.

NOTE
The Syslog source interface configuration command **ip syslog source-interface** must be compatible with the management VRF configuration.

Configuring a global management VRF

To configure a VRF as a global management VRF, enter the following command.

```
device(config)# management-vrf mvrf
```

Syntax: [no] management-vrf *vrf-name*

The *vrf-name* parameter must specify the name of a pre-configured VRF. If the VRF is not pre-configured, command execution fails, and the following error message is displayed.

```
Error - VRF <vrf-name>
 doesn't exist
```

When the management VRF is configured, the following Syslog message is displayed.

```
SYSLOG: VRF <vrf-name>
 has been configured as management-vrf
```

Enter the **no** form of the command to remove the management VRF. When the management VRF is deleted, the following Syslog message is displayed.

```
SYSLOG: VRF <vrf-name>
 has been un-configured as management-vrf
```

Configuration notes

Consider the following configuration notes:

- If a management VRF is already configured, you must remove the existing management VRF configuration before configuring a new one. If not, the system displays the following error message.

```
device(config)# management-vrf  red
Error - VRF mvrf already configured as management-vrf
```

- If you try to delete a management VRF that was not configured, the system displays the following error message.

```
device(config)# no management-vrf red
Error - VRF red is not the current management-vrf
```

- If a VRF is currently configured as the management VRF, it cannot be deleted or modified. Attempting to do so causes the system to return the following error message.

```
device(config)# no vrf mvrf
Error - Cannot modify/delete a VRF which is configured as management-vrf
```

Configuring the OOB management port to be a member of a management VRF

This task configures the out-of-band (OOB) management port to be member of a user-specified (nondefault) management VRF.

1. Enter global configuration mode.

```
device# configure terminal
device (config)#
```

2. In global configuration mode, create a nondefault VRF instance and exit.

```
device(config)# vrf MGMT_IP
defice(config-vrf-MGMT_IP)# exit-vrf
device(config)#
```

3. In global configuration mode, enter the **management-vrf** command and specify the VRF instance.

```
device(config)# management-vrf MGMT_IP
device(config)#
```

4. In global configuration mode, enter the **interface management** command and specify the only supported interface number.

```
device(config)# interface management 1
device(config-if-mgmt-1)#
```

5. In management interface configuration mode, enter the **vrf forwarding** command and specify the management VLAN, to enable VRF forwarding on the OOB management port.

```
device(config-if-mgmt-1)# vrf forwarding MGMT_IP
```

Displaying management VRF information

To display IP Information for a specified VRF, enter the following command at any level of the CLI.

```
device(config)# show vrf mvrf
VRF mvrf, default RD 1100:1100, Table ID 11
Configured as management-vrf
IP Router-Id: 1.0.0.1
  Interfaces:
    ve3300 ve3400
```

```
  Address Family IPv4
    Max Routes: 641
    Number of Unicast Routes: 2
  Address Family IPv6
    Max Routes: 64
    Number of Unicast Routes: 2
```

Syntax: show vrf *vrf-name*

The *vrf-name* parameter specifies the VRF for which you want to display IP information.

TABLE 9 show vrf output descriptions

This field	Displays
VRF *vrf-name*	The name of the VRF.
default RD	The default route distinguisher for the VRF.
Table ID	The table ID for the VRF.
Routes	The total number of IPv4 and IPv6 Unicast routes configured on this VRF.
Configured as management-vrf	Indicates that the specified VRF is configured as a management VRF.
IP Router-Id	The 32-bit number that uniquely identifies the router.
Number of Unicast Routes	The number of Unicast routes configured on this VRF.

The **show who** command displays information about the management VRF from which the Telnet or SSH connection has been established.

```
device(config)# show who
Console connections:
        established, monitor enabled, privilege super-user, in config mode
        1 minutes 47 seconds in idle
Telnet server status: Enabled
Telnet connections (inbound):
 1      established, client ip address 10.53.1.181, user is lab, privilege super-user
        using vrf default-vrf.
        2 minutes 46 seconds in idle
 2      established, client ip address 10.20.20.2, user is lab, privilege super-user
        using vrf mvrf.
        16 seconds in idle
 3      closed
 4      closed
 5      closed
Telnet connections (outbound):
 6      established, server ip address 10.20.20.2, from Telnet session 2, , privilege super-user
        using vrf mvrf.
        12 seconds in idle
 7      closed
 8      closed
 9      closed
 10     closed
SSH server status: Enabled
SSH connections:
 1      established, client ip address 10.53.1.181, privilege super-user
        using vrf default-vrf.
        you are connecting to this session
        3 seconds in idle
 2      established, client ip address 10.20.20.2, privilege super-user
        using vrf mvrf.
        48 seconds in idle
 3      closed
 4      closed
 5      closed
 6      closed
 7      closed
 8      closed
 9      closed
 10     closed
 11     closed
```

```
 12     closed
 13     closed
 14     closed
 15     closed
 16     closed
```

Syntax: show who

To display packet and session rejection statistics due to failure in management VRF validation, enter the following command.

```
device(config)# show management-vrf

 Management VRF name : sflow
 Management Application       Rx Drop Pkts      Tx Drop Pkts
  SNMP Engine                            0                11
  RADIUS Client                          0                 0
  TFTP Client                            0                 0
  Traps                                  -                 0
  SysLogs                                -                 0

 TCP Connection rejects:
  Telnet            :          0
  SSH       (Strict):        685
  TACACS+ Client    :          0
```

Syntax: show management-vrf

TABLE 10 show management-vrf output descriptions

This field	Displays
Management VRF name	Displays the configured management VRF name.
Management Application	Displays the management application names.
Rx Drop Pkts	Displays the number of packets dropped in the inbound traffic.
Tx Drop Pkts	Displays the number of packets dropped in the outbound traffic.
TCP Connection rejects	Displays the number of TCP connections per application rejected due to management VRF validation.

Make sure that the management VRF is configured before executing the **show management-vrf** command. If not, the system displays the following error message.

```
Error - Management VRF is not configured.
```

To clear the management VRF rejection statistics, enter the following command.

```
device(config)# clear management-vrf-stats
```

Syntax: clear management-vrf-stats

Additional OOB management configuration options

The following features are introduced with FastIron 8.0.50.

Configuring an IPv6 default gateway to support OOB management

An IPv6 default gateway can be configured globally as well as on a management VLAN, with the latter configuration supporting multiple gateways. Both options are illustrated.

A default gateway is the first hop to the network in which management devices are located. In addition to an IPv4 default gateway (whose IP address is configured by means of the **ip default-gateway** command), an IPv6 default gateway is recommended for the following reasons:

- Although IPv6 discovers neighbors and routes dynamically, in some cases Router Advertisement (RA) and Router Solicitation (RS) operations are disabled and a default gateway is required to send traffic.
- Management devices (for example, TFTP servers, Telnet or SSH clients) are not members of the same subnet as the management IPv6 address.

If a management VLAN is not configured, the device can have only one IPv6 default gateway in the global configuration.

If a management VLAN is configured (by means of the **default-ipv6-gateway** command in VLAN configuration mode), the device can have a maximum of 5 IPv6 default gateways with a metric (1 through 5) under the management VLAN.

Multiple gateways can have the same metric value.

The best default gateway is first chosen as the device whose neighbors are reachable (in the sequence of metric values). Otherwise, the gateway with the highest priority (the lowest metric value) is chosen.

If a static default gateway is configured, that gateway takes precedence over the best default gateway configured by means of RA. If the static default-gateway configuration is removed, the best default gateway learned by RA is restored.

Configured gateway addresses and the default gateway address must be in same subnet.

To configure a global (single) IPv6 default gateway without the management VLAN configuration, by means of the **ipv6 default-gateway** command in global configuration mode:

```
device# configure terminal
device(config)# ipv6 default-gateway 2620:100:c:fe23:10:37:65:129
```

To configure the maximum of 5 IPv6 default gateways with the management VLAN configuration, and specify metrics for each, by means of the **default-ipv6-gateway** command in VLAN configuration mode:

```
device# configure terminal
device(config)# vlan 66
device(config-vlan-66)# default-ipv6-gateway 2620:100:c:fe23:10:37:65:129 3
device(config-vlan-66)# default-ipv6-gateway 2620:100:c:fe23:10:37:65:129 2
device(config-vlan-66)# default-ipv6-gateway 2620:100:c:fe23:10:37:65:130 2
device(config-vlan-66)# default-ipv6-gateway 2620:100:c:fe23:10:37:65:131 1
device(config-vlan-66)# default-ipv6-gateway 2620:100:c:fe23:10:37:65:132 5
```

Controlling traffic on management ports in a VLAN or VRF

Prior to FastIron 8.0.50, management traffic on both in-band and out-of-band (OOB) management interfaces depended on membership in the management VLAN or VRF. Now you can exclude these interfaces for management traffic, which includes IPv6 Router Advertisement (RA) traffic on a Layer 2 image, and IPv6 RA, HTTP, NTP, SSH, and Telnet traffic on a Layer 3 image.

Use the **management exclude** command in global configuration mode to exclude traffic types as in the following examples.

To exclude inband IPv6 RA traffic on a switch image:

```
device(config)# management exclude ipv6ra inband
```

To exclude OOB IPv6 RA traffic on a switch image:

```
device(config)# management exclude ipv6ra oob
```

To exclude all OOB traffic on a switch or router image:

```
device(config)# management exclude all inband
```

To exclude SSH OOB traffic on a router image:

```
device(config)# management exclude ssh oob
```

Use the **show management traffic exclusion** command to confirm a configuration, as in the following example:

```
device# show management traffic exclusion
Port                App
Inband              all
oob                 all
```

NOTE

The **management exclude** command is mutually exclusive with respect to either the **ip ssh strict-management-vrf** or the **telnet strict-management-vrf** commands. If the **management exclude** command is also configured, outbound SSH or Telnet connections are not blocked. If the management interface VRF and the management VRF are the same, then the **ip ssh strict-management-vrf** and **telnet strict-management-vrf** commands do not stop a connection initiated from an OOB management interface. In this case, the user must execute the **management exclude all oob**, **management exclude ssh oob**, or **management exclude telnet oob** command, as appropriate, to stop a connection.

Configuring the OOB management port to be a member of a management VLAN

This task configures the out-of-band (OOB) management port to be member of a user-specified (nondefault) VLAN.

1. Enter global configuration mode.

```
device# configure terminal
device(config)#
```

2. In global configuration mode, create a VLAN and enter VLAN configuration mode.

```
device(config)# vlan 20
device(config-vlan-20)#
```

3. In VLAN configuration mode, enter the **management-vlan** command to specify this VLAN as the OOB management VLAN and automatically assign it as an untagged interface.

```
device(config-vlan-20)# management-vlan
Out of band management interface untagged with VLAN 100
Management VLAN Configured. Clearing IPv4 ARP, IPv6 Neighbor
```

System clock

On a RUCKUS device, you can manually set the system clock with the time and date you specify. The system clock settings are retained across power cycles.

The operation of the device does not depend on the date and time. A RUCKUS device will function properly despite incorrect date and time value. However, since logging, error detection, and troubleshooting use the date and time, you should set the clock correctly. Time values are limited to between January 1, 1970 and December 31, 2035.

If NTP servers are configured, the NTP server automatically updates and overrides the system clock.

Daylight saving time

Some countries around the world have adopted adding an extra hour of daylight to the evenings during the summer time to make use of extra light. The extra hour is removed at the start of the winter. Daylight saving is more effective in countries further away from equator.

By default, the RUCKUS device does not change the system time for daylight savings time, you must manually configure the summer-time settings. When used, daylight savings are implemented in three sets of dates and times:

- USA—Summer time starts at 2:00am on the second Sunday of March and ends at 2:00am on the first Sunday of November.
- Europe—Summer time starts at 2:00am on the last Sunday of March and ends at 2:00am on the last Sunday of October.
- Rest of the world—Summer time starts at 2:00am on the last Sunday of March and ends at 2:00am on the last Sunday of October, but some countries have different start and end dates depending on the longitude.

Daylight Saving Time, for the U.S. and its territories, is not observed in Hawaii, Guam, Puerto Rico, the Virgin Islands and the state of Arizona (not the Navajo Indian Reservation, which does observe). Navajo Nation participates in the Daylight Saving Time policy, due to its large size and location in three states.

Due to variations in the dates when daylight savings time is implemented, you can manually configure the date and time of the start and end of summer-time. An offset of minutes can also be configured.

Time zones

Time zone settings affect the local time and potential summer time changes for a specific region. Time zones are measured by the time ahead or behind Greenwich Mean Time (GMT) and expressed as Universal Time Coordinated (UTC) with a positive or negative sign and a number representing hours.

The time zone setting has the following characteristics:

- The time zone setting does not adjust for Daylight Savings Time; the summer-time settings must be manually configured.
- Changing the time zone on a device updates the local time zone setup and is reflected in local time calculations.
- By default, all devices are in the Greenwich Mean Time (GMT) time zone (0,0).
- Time zone settings persist across failover for high availability.
- Time zone settings are not affected by Network Time Protocol (NTP) server synchronization.

The usual GMT plus or minus hours configuration is supported. To make time zone configuration simpler, some geographical regions have been assigned a time zone identifier. The following tables display the time zone identifiers with their descriptions for Europe, USA, and Australian time zones.

TABLE 11 European Time Zones

Time Zone	Description
GMT	Greenwich Mean Time, UTC

TABLE 11 European Time Zones (continued)

Time Zone	Description
BST	British Summer Time, UTC + 1 hour
IST	Irish Summer Time, UTC + 1 hour
WET	Western Europe Time, UTC
WEST	Western Europe Summer Time, UTC + 1 hour
CET	Central Europe Time, UTC + 1 hour
CEST	Central Europe Summer Time, UTC + 2 hours
EET	Eastern Europe Time, UTC + 2 hour
EEST	Eastern Europe Summer Time, UTC + 3 hours
MSK	Moscow Standard Time, UTC + 3 hours
MSD	Moscow Summer Time, UTC + 4 hours

TABLE 12 USA Time Zones

Time Zone	Description
eastern	Eastern Standard Time, UTC + 5 hours
michigan	UTC + 5 hours
central	Central Standard Time, UTC + 6 hours
east-indiana	UTC + 6 hours
mountain	Mountain Standard Time, UTC + 7 hours
arizona	UTC + 7 hours
pacific	Pacific Standard Time, UTC + 8 hours
alaska	Alaska Standard Time, UTC + 9 hours
aleutian	UTC + 10 hours
hawaii	Hawaii Standard Time, UTC + 13 hours
samoa	UTC - 11 hours

TABLE 13 Australian Time Zones

Time Zone	Description
WST	Western Standard Time, UTC + 8 hours
CST	Central Standard Time, UTC + 9.5 hours
EST	Eastern Standard Time, UTC + 10 hours

Setting the clock parameters for the device

The date and time values set on a device are used for logging, error detection, and troubleshooting.

The following procedure sets the local clock date and time. An active NTP server, if configured, automatically updates and overrides the local clock time. Time values are limited to between January 1, 1970 and December 31, 2035.

NOTE
You should set the clock only if there are no NTP servers configured. Time synchronization from NTP servers overrides the local clock.

1. In Privileged EXEC mode, set the clock date and time.

```
device# clock set 09:57:35 07-28-16
```

The time and date are entered in the format hours:minutes:seconds month-day-year. In this example, the clock is set to 9:57am on July 28, 2016.

2. Enter Privileged EXEC mode.

```
device# configure terminal
```

3. Set the time zone for the device.

```
device(config)# clock timezone us mountain
```

The time zone is set by geographical area and then region. In this example, the time zone is set to the USA mountain standard time zone.

4. Optionally set the summer-time start and end dates for the selected time zone.

```
device(config)# clock summer-time zone us mountain start 02-28-16 02:00:00 end 10-30-16 02:00:00
offset 30
```

In this example, summer time starts at 2:30am on February 28 , 2016 and ends at 2:30am on October 30, 2016

5. To display clock and time zone settings, use the **show clock** command.

```
device# show clock

09:59:38.863 Mountain Thu Jul 28 2016
Time source is Set Clock
Summer time starts 02:00:00 Mountain Sun Feb 28 2016 offset 30 mins
Summer time ends 02:00:00 Mountain Sun Oct 30 2016 offset 30 mins
```

Basic system parameter configuration

RUCKUS devices are configured at the factory with default parameters that allow you to begin using the basic features of the system immediately. However, many of the advanced features such as VLANs or routing protocols for the device must first be enabled at the system (global) level before they can be configured. If you use the Command Line Interface (CLI) to configure system parameters, you can find these system level parameters at the global configuration mode of the CLI.

NOTE
Before assigning or modifying any router parameters, you must assign the IP subnet (interface) addresses for each port.

NOTE
For information about configuring IP addresses, DNS resolver, and other IP-related parameters, refer to the "IP Addressing" or "IPv6 Addressing" chapters in the *RUCKUS FastIron Layer 3 Routing Configuration Guide*.

NOTE
For information about the Syslog buffer and messages, refer to the Syslog messages chapter of the *RUCKUS FastIron Monitoring Configuration Guide*.

Entering system administration information

You can configure a system name, contact, and location for a RUCKUS device and save the information locally in the configuration file for future reference. This information is not required for system operation but is suggested. When you configure a system name, the name replaces the default system name in the CLI command prompt.

The name, contact, and location each can be up to 255 alphanumeric characters.

Here is an example of how to configure a system name, system contact, and location.

```
device(config)# hostname zappa
device(config)# snmp-server contact Support Services
device(config)# snmp-server location Centerville
device(config)# end
device# write memory
```

Syntax:hostname *string*

Syntax: snmp-server contact *string*

Syntax: snmp-server location *string*

The text strings can contain blanks. The SNMP text strings do not require quotation marks when they contain blanks but the host name does.

NOTE
The **chassis name** command does not change the CLI prompt. Instead, the command assigns an administrative ID to the device.

User-login details in Syslog messages and traps

RUCKUS devices send Syslog messages and SNMP traps when a user logs into or out of the User EXEC or Privileged EXEC level of the CLI. The feature applies to users whose access is authenticated by an authentication-method list based on a local user account, RADIUS server, or TACACS/TACACS+ server.

To view the user-login details in the Syslog messages and traps, you must enable the **logging enable user-login** command.

```
device(config)# logging enable user-login
```

Syntax: [no] logging enable user-login

NOTE
The Privileged EXEC level is sometimes called the "Enable" level, because the command for accessing this level is **enable**.

Examples of Syslog messages for CLI access

When a user whose access is authenticated by a local user account, a RADIUS server, or a TACACS or TACACS+ server logs into or out of the CLI User EXEC or Privileged EXEC mode, the software generates a Syslog message and trap containing the following information:

- The time stamp
- The user name
- Whether the user logged in or out
- The CLI level the user logged into or out of (User EXEC or Privileged EXEC level)

NOTE
Messages for accessing the User EXEC level apply only to access through Telnet. The device does not authenticate initial access through serial connections but does authenticate serial access to the Privileged EXEC level. Messages for accessing the Privileged EXEC level apply to access through the serial connection or Telnet.

The following examples show login and logout messages for the User EXEC and Privileged EXEC levels of the CLI.

```
device# show logging
Syslog logging: enabled (0 messages dropped, 0 flushes, 0 overruns)
Buffer logging: level ACDMEINW, 12 messages logged
level code: A=alert C=critical D=debugging M=emergency E=error
I=informational N=notification W=warning
Static Log Buffer:
Dec 15 19:04:14:A:Fan 1, fan on right connector, failed
Dynamic Log Buffer (50 entries):
Oct 15 18:01:11:info:dg logout from USER EXEC mode
Oct 15 17:59:22:info:dg logout from PRIVILEGE EXEC mode
Oct 15 17:38:07:info:dg login to PRIVILEGE EXEC mode
Oct 15 17:38:03:info:dg login to USER EXEC mode
```

Syntax: show logging

The first message (the one on the bottom) indicates that user "dg" logged in to the CLI User EXEC level on October 15 at 5:38 PM and 3 seconds (Oct 15 17:38:03). The same user logged into the Privileged EXEC level four seconds later.

The user remained in the Privileged EXEC mode until 5:59 PM and 22 seconds. (The user could have used the CONFIG modes as well. Once you access the Privileged EXEC level, no further authentication is required to access the CONFIG levels.) At 6:01 PM and 11 seconds, the user ended the CLI session.

Removing user-login details from the Syslog messages and traps

If you want to disable the logging of user-login details from the system log, enter the following commands.

```
device(config)# no logging enable user-login
device(config)# write memory
device(config)# end
device# reload
```

Cancelling an outbound Telnet session

If you want to cancel a Telnet session from the console to a remote Telnet server (for example, if the connection is frozen), you can terminate the Telnet session by doing the following.

1. At the console, press **Ctrl+^** (Ctrl+Shift-6).
2. Press the **X** key to terminate the Telnet session.

   Pressing **Ctrl+^** twice in a row causes a single **Ctrl+^** character to be sent to the Telnet server. After you press **Ctrl+^** , pressing any key other than **X** or **Ctrl+^** returns you to the Telnet session.

Displaying and modifying system parameter default settings

RUCKUS devices have default table sizes for the system parameters shown in the following display outputs. The table sizes determine the maximum number of entries the tables can hold. You can adjust individual table sizes to accommodate your configuration needs.

The tables you can configure, as well as the default values and valid ranges for each table, differ depending on the RUCKUS device you are configuring. To display the adjustable tables on your RUCKUS device, use the show **default values** command. The following shows example outputs.

System default settings configuration considerations

- Changing the table size for a parameter reconfigures the device memory. Whenever you reconfigure the memory on a RUCKUS device, you must save the change to the startup-config file, then reload the software to place the change into effect.
- Configurable tables and their defaults and maximum values differ on RUCKUS IPv4 devices versus IPv6-capable devices.

Modifying system parameter default values

Information for the configurable tables appears under the columns that are shown in bold type in the above examples. To simplify configuration, the command parameter you enter to configure the table is used for the table name. For example, to increase the capacity of the IP route table, enter the following commands.

```
device(config)# system-max ip-route 120000
device(config)# write memory
device(config)# exit
device# reload
```

Syntax: system-max ip-route *num*

The *num* parameter specifies the maximum number of routes in the IP route table. The minimum value is 4096. The maximum value is 15168. The default is 12000 IP routes.

NOTE

If you accidentally enter a value that is not within the valid range of values, the CLI will display the valid range for you.

To increase the number of IP subnet interfaces you can configure on each port on a device running Layer 3 code from 24 to 64, enter the following commands.

```
device(config)# system-max ip-subnet-port 64
device(config)# write memory
device(config)# exit
device# reload
```

Syntax: system-max ip-subnet-port *num*

The *num* parameter specifies the maximum number of subnet addresses per port and can be from 24 - 128. The default is 24.

Displaying system parameter default values

To display the configurable tables and their defaults and maximum values, enter the **show default values** command at any level of the CLI.

The following shows an example output of the **show default values** command on a FastIron Layer 2 device.

```
device#show default values
sys log buffers:50         mac age time:300 sec       telnet sessions:5
System Parameters    Default    Maximum    Current  Configured
igmp-max-group-addr  4096       8192       1024
ip-filter-sys        2048       4096       4096
l3-vlan              32         1024       1024
mac                  32768      32768      32768
vlan                 64         4095       4095
spanning-tree        32         255        255
mac-filter-port      32         256        256
mac-filter-sys       64         512        512
view                 10         65535      65535
rmon-entries         1024       32768      32768
mld-max-group-addr   8192       32768      32768
igmp-snoop-mcache    512        8192       8192
mld-snoop-mcache     512        8192       8192
```

The following shows an example output of the **show default values** command on a FastIron Layer 2 ICX 7450 device.

```
device#show default values
sys log buffers:50         mac age time:300 sec       telnet sessions:5
System Parameters    Default    Maximum    Current
igmp-max-group-addr  4096       8192       4096
ip-filter-port       2045       2045       2045
ip-filter-sys        2048       8192       2048
l3-vlan              32         1024       32
mac                  65536      65536      65536
vlan                 64         4095       64
spanning-tree        32         254        32
mac-filter-port      32         256        32
mac-filter-sys       64         512        64
view                 10         65535      10
rmon-entries         1024       32768      1024
mld-max-group-addr   8192       32768      8192
igmp-snoop-mcache    512        8192       512
mld-snoop-mcache     512        8192       512
```

The following shows an example output on a FastIron IPV4 device running Layer 3 software.

```
device#show default values
sys log buffers:50         mac age time:300 sec       telnet sessions:5
ip arp age:10 min          bootp relay max hops:4     ip ttl:64 hops
ip addr per intf:24
when multicast enabled :
igmp group memb.:260 sec   igmp query:125 sec         hardware drop: enabled
when ospf enabled :
ospf dead:40 sec           ospf hello:10 sec          ospf retrans:5 sec
ospf transit delay:1 sec
when bgp enabled :
bgp local pref.:100        bgp keep alive:60 sec      bgp hold:180 sec
bgp metric:10              bgp local as:1             bgp cluster id:0
bgp ext. distance:20       bgp int. distance:200      bgp local distance:200
System Parameters    Default    Maximum    Current
ip-arp               6000       64000      6000
ip-static-arp        512        6000       512
multicast-route      64         8192       64
dvmrp-route          2048       32000      2048
dvmrp-mcache         512        4096       512
pim-mcache           1024       4096       1024
igmp-max-group-addr  4096       8192       4096
ip-cache             10000      32768      10000
ip-filter-port       1015       1015       1015
ip-filter-sys        2048       8192       2048
l3-vlan              32         1024       32
ip-qos-session       1024       16000      1024
mac                  16384      32768      16384
ip-route             80000      262144     80000
ip-static-route      64         2048       64
vlan                 64         4095       64
spanning-tree        32         255        32
mac-filter-port      16         256        16
mac-filter-sys       32         512        32
ip-subnet-port       24         128        24
session-limit        65536      160000     65536
view                 10         65535      10
virtual-interface    255        512        255
hw-ip-next-hop       2048       6144       2048
hw-logical-interface 4096       4096       4096
hw-ip-mcast-mll      1024       4096       1024
hw-traffic-condition 50         1024       50
rmon-entries         2048       32768      2048
mld-max-group-addr   8192       32768      8192
igmp-snoop-mcache    512        8192       512
mld-snoop-mcache     512        8192       512
msdp-sa-cache        4096       8192       4096
```

The following shows an example output on a FastIron IPV4 ICX 7450 device running Layer 3 software.

```
device#show default values
sys log buffers:50         mac age time:300 sec       telnet sessions:5

ip arp age:10 min          bootp relay max hops:4     ip ttl:64 hops
ip addr per intf:24

when multicast enabled :
igmp group memb.:260 sec   igmp query:125 sec         hardware drop: enabled

when ospf enabled :
ospf dead:40 sec           ospf hello:10 sec          ospf retrans:5 sec
ospf transit delay:1 sec

when bgp enabled :
bgp local pref.:100        bgp keep alive:60 sec      bgp hold:180 sec
bgp metric:10              bgp local as:1             bgp cluster id:0
bgp ext. distance:20       bgp int. distance:200      bgp local distance:200

System Parameters    Default    Maximum    Current
ip-arp               4000       64000      64000
ip-static-arp        512        6000       6000
multicast-route      64         8192       8192
pim-mcache           1024       4096       4096
igmp-max-group-addr  4096       8192       8192
ip-cache             10000      32768      32768
ip-filter-port       2045       2045       2045
ip-filter-sys        2048       8192       8192
l3-vlan              32         1024       1024
ip-qos-session       1024       16000      16000
mac                  65536      65536      65536
ip-route             5120       7168       6500
ip-static-route      64         2048       2048
vlan                 64         4095       4095
spanning-tree        32         254        254
mac-filter-port      16         256        256
mac-filter-sys       32         512        512
ip-subnet-port       24         128        128
session-limit        8192       16384      16384
view                 10         65535      65535
virtual-interface    255        512        512
hw-traffic-condition 896        896        896
rmon-entries         1024       32768      32768
mld-max-group-addr   8192       32768      32768
igmp-snoop-mcache    512        8192       8192
mld-snoop-mcache     512        8192       8192
ip6-route            580        1348       187
ip6-static-route     37         269        37
ip6-cache            93         674        93
gre-tunnels          16         64         64
hw-ip-route-tcam     8192       8192       8192
```

The following shows an example output on a ICX 7750 device.

```
device# show default values
sys log buffers:50         mac age time:300 sec       telnet sessions:5

ip arp age:10 min          bootp relay max hops:4     ip ttl:64 hops
ip addr per intf:24

when multicast enabled :
igmp group memb.:260 sec   igmp query:125 sec         hardware drop: enabled

when ospf enabled :
ospf dead:40 sec           ospf hello:10 sec          ospf retrans:5 sec
ospf transit delay:1 sec

when bgp enabled :
bgp local pref.:100        bgp keep alive:60 sec      bgp hold:180 sec
bgp metric:10              bgp local as:1             bgp cluster id:0
```

```
bgp ext. distance:20       bgp int. distance:200      bgp local distance:200

System Parameters    Default    Maximum    Current    Configured
ip-arp               8192       64000      64000      64000
ip-static-arp        512        1024       512        512
ip-cache             8192       32768      32768      32768
ip-filter-port       2047       2047       2047       2047
ip-filter-sys        3072       8192       3072       3072
l3-vlan              32         1024       32         32
ip-qos-session       1024       16000      1024       1024
mac                  32768      32768      32768      32768
ip-route             98304      131072     98304      98304
ip-static-route      64         2048       64         64
vlan                 64         4095       4095       4095
spanning-tree        128        254        254        254
mac-filter-port      32         256        32         32
mac-filter-sys       64         512        64         64
ip-subnet-port       24         128        24         24
session-limit        65536      160000     65536      65536
view                 10         65535      10         10
virtual-interface    255        512        255        255
hw-ip-next-hop       17408      17408      17408      17408
hw-traffic-condition 50         1024       50         50
rmon-entries         2048       32768      2048       2048
igmp-snoop-mcache    512        6144       6144       6144
mld-snoop-mcache     512        6144       6144       6144
ip6-route            5120       7168       5120       5120
ip6-static-route     64         1024       64         64
ip6-cache            1024       2048       1024       1024
msdp-sa-cache        1024       4096       1024       1024
gre-tunnels          16         64         16         16
ip-vrf               128        128        128        128
ip-route-default-vrf 65536      131072     10000      10000
ip6-route-default-vr 2048       7168       310        310
ip-route-vrf         4096       131072     1500       1500
ip6-route-vrf        1024       7168       800        800
pim-hw-mcache        1024       6144       6144       6144
pim6-hw-mcache       512        2048       1024       1024
igmp-snoop-group-add 4096       8192       8192       8192
mld-snoop-group-addr 4096       8192       8192       8192
mac-notification-buf 4000       16000      4000       4000
```

The following table defines the system parameters in the **show default values** command output.

TABLE 14 System parameters in show default values command

Parameter	Definition
dvmrp-mcache	PIM and DVMRP multicast cache flows stored in CAM
dvmrp-route	DVMRP routes
hw-ip-mcast-mll	Multicast output interfaces (clients)
hw-ip-next-hop	IP next hops and routes, including unicast next hops and multicast route entries
hw-logical-interface	Hardware logical interface pairs (physical port and VLAN pairs)
hw-traffic-conditioner	Traffic policies
ip-arp	ARP entries
ip-cache	IP forwarding cache entries
ip-filter-port	IP ACL entries per port
ip-filter-sys	IP ACL entries per system
ip-qos-session	Layer 4 session table entries
ip-route	Learned IP routes

TABLE 14 System parameters in show default values command (continued)

Parameter	Definition
ip-static-arp	Static IP ARP entries
ip-static-route	Static IP routes
ip-subnet-port	IP subnets per port
l3-vlan	Layer 3 VLANs
mac	MAC entries
mac-filter-port	MAC address filter entries per port
mac-filter-sys	MAC address filter entries per system
multicast-route	Multicast routes
pim-mcache	PIM multicast cache entries
rmon-entries	RMON control table entries
session-limit	Session entries
spanning-tree	Spanning tree instances
view	SNMP views
virtual-interface	Virtual routing interfaces
vlan	VLANs
mld-max-group-addr	MLD group limit
igmp-snoop-mcache	IGMP snooping cache entries
mld-snoop-mcache	MLD snooping cache entries

Basic port parameter configuration

All RUCKUS ports are pre-configured with default values that allow the device to be fully operational at initial startup without any additional configuration. However, in some cases, changes to the port parameters may be necessary to adjust to attached devices or other network requirements.

About port regions

This section describes port regions on FastIron devices.

ICX 7650 device port regions

ICX 7650 device has only one port region. All ports belong to region 0.

ICX 7150 device port regions

ICX 7150 device has only one port region. All ports belong to region 0.

ICX 7250 device port regions

ICX 7250 device has only one port region. All ports belong to region 0.

ICX 7450 device port regions

ICX 7450 24 port has only one port region.

ICX 7450 48 port has two port regions.

ICX 7750 device port regions

ICX 7750 device has only one port region.

ICX 7750 has only one port region. All ports belong to region 0.

Specifying a port address

You can specify a port address for an uplink (data) port, stacking port, or a management port.

Specifying a data port

The port address format is unit/slot/port, where:

- *unit*—Specifies the unit ID . If the device is not part of a stack, the unit ID is 1.
- *slot*—Specifies the slot number.
- *port*—Specifies the port number in the slot.

This example shows how to specify port 2 in slot 1 of a device that is not part of a stack:

```
device(config)# interface ethernet 1/1/2
```

Specifying a stacking port

The port address format is stack unit/slot/port, where:

- *unit*—Specifies the stack unit ID. Range is usually from 1 to 8.
- *slot*—Specifies the slot number. Stacking ports are in slot 2.
- *port*—Specifies the port number in the slot. Dedicated stacking ports are 1, 2, 6, and 7.

This example shows how to specify stacking port 2 in slot 2 of unit 3 in a stack:

```
device(config)# interface ethernet 3/2/2
```

Specifying a management port

The management port number is always 1. This example shows how to specify the management port from global configuration mode:

```
device(config)# interface management 1
```

Static MAC entry configuration

Static MAC addresses can be assigned to RUCKUS devices.

You can manually input the MAC address of a device to prevent it from being aged out of the system address table.

This option can be used to prevent traffic for a specific device, such as a server, from flooding the network with traffic when it is down. Additionally, the static MAC address entry is used to assign higher priorities to specific MAC addresses.

You can specify traffic priority (QoS) and VLAN membership (VLAN ID) for the MAC Address as well as specify the device type of either router or host.

The default and maximum configurable MAC table sizes can differ depending on the device. To determine the default and maximum MAC table sizes for your device, display the system parameter values. Refer to the Displaying and modifying system parameter default settings section.

Multi-port static MAC address

Many applications, such as Microsoft NLB, Juniper IPS, and Netscreen Firewall, use the same MAC address to announce load-balancing services. As a result, a switch must be able to learn the same MAC address on several ports. Multi-port static MAC allows you to statically configure a MAC address on multiple ports using a single command.

Multi-port static MAC address configuration notes

- This feature is applicable for Layer 2 traffic.
- This feature can be used to configure unicast as well as IPv4 and IPv6 multicast MAC addresses on one or more ports. However, when a multicast MAC address is configured, the corresponding MAC address entry cannot be used for IGMP snooping. For IPv4 multicast addresses (range 0100.5e00.000 to 0100.5e7f.ffff) and IPv6 multicast addresses (range 3333.0000.0000 to 3333.ffff.ffff), use IGMP/MLD snooping. Other multicast addresses can also be configured on the ports using this feature.
- FastIron devices support a maximum of 15 multi-port static MAC addresses.
- Hosts or physical interfaces normally join multicast groups dynamically, but you can also statically configure a host or an interface to join a multicast group.

Configuring a multi-port static MAC address

For example, to add a static entry for a server with a MAC address of 0000.0063.67ff and a priority of 7, enter the following command. If the system has only default VLAN, the command has to be issued from the global configuration mode.

```
device(config)# static-mac-address 0000.0063.67ff ethernet 1/4/2 ethernet 1/4/3 ethernet 1/4/4 priority 7
```

If the system has multiple VLANs, the command has to be issued from the VLAN configuration mode.

```
device(config-vlan-30)# static-mac-address 0000.0063.67ff ethernet 1/1/1
```

To specify a range of ports, enter the following command.

```
device(config)# static-mac-address 0000.0063.67ff ethernet 1/4/2 to 1/4/6 priority 7
```

Syntax: [no] static-mac-address mac-addr ethernet [*slotnum***/**]*portnum* **ethernet** [*slotnum***/**]*portnum* **ethernet** [*slotnum***/**]*portnum***....**[**priority** *num*]

or

Syntax: [no] static-mac-address mac-addr ethernet [*slotnum***/**]*portnum* **to ethernet** [*slotnum***/**]*portnum* [**priority***num*]

The **slotnum** parameter is required on chassis devices.

The **portnum** parameter is a valid port number.

The **priority** *num* is optional and can be a value from 0 - 7 (0 is lowest priority and 7 is highest priority). The default priority is 0.

Assigning port names

You can assign text strings as port names, which help you identify ports with meaningful names. You can assign port names to individual ports or to a group of ports. You can assign a port name to physical ports, virtual interfaces, and loopback interfaces.

Assigning a port name

To assign a name to a port, enter commands such as the following:

```
device(config)# interface ethernet 2
device(config-if-e1000-2)# port-name Marsha
```

Syntax: port-name *text*

The *text* parameter is an alphanumeric string. The name can be up to 255 characters long. The name can contain blanks. You do not need to use quotation marks around the string, even when it contains blanks. The port name can contain special characers as well, but the percentage character (%), if it appears at the end of the port name, is dropped.

Assigning the same name to multiple ports

To assign a name to a range of ports, enter commands such as the following:

```
device(config)# interface ethernet 1/1/1 to 1/1/10
device(config-mif-1/1/1-1/1/10)# port-name connected-to-the nearest device
```

Syntax: [no] port-name *text*

To remove the assigned port name, use **no** form of the command.

The *text* parameter is an alphanumeric string, up to 255 characters long. The name can contain blanks. You do not need to use quotation marks around the string, even when it contains blanks.

You can also specify the individual ports, separated by space.

To assign a name to multiple specific ports, enter commands such as the following:

```
device(config)# interface ethernet 1/1/1 ethernet 1/1/5 ethernet 1/1/7
device(config-mif-1/1/1, 1/1/5, 1/1/7)# port-name connected-to-the nearest device
```

Displaying the port name for an interface

You can use the **show interface brief** command to display the name assigned to the port. If any of the ports have long port names, they are truncated. To show full port names, use the show interfaces brief wide command.

```
device# show interfaces brief
Port    Link    State   Dupl Speed Trunk Tag Pvid Pri
MAC                                                                    Name
1/1/23  Up      Forward Full 1G    None  No  1    0   748e.f82d.7a16 connected-
1/1/47  Up      Forward Full 1G    None  No  1    0   748e.f82d.7a2e
mgmt1   Up      None    Full 1G    None  No  None 0   748e.f82d.7a00
```

In this output, the port name for interface 1/1/23 is truncated.

Use the **show interface brief wide** command to avoid truncating long port names.

To display the complete port name for an interface, enter the following command.

```
device# show interface brief wide
Port    Link    State   Dupl Speed Trunk Tag Pvid Pri
MAC                                                                    Name
1/1/23  Up      Forward Full 1G    None  No  1    0   748e.f82d.7a16 connected-
```

```
to-the nearest device
1/1/47  Up      Forward Full 1G    None  No  1    0   748e.f82d.7a2e
mgmt1   Up      None    Full 1G    None  No  None 0   748e.f82d.7a00
```

Syntax: show interface brief [**wide**] [**ethernet** *stack-unit/slot/port* | **loopback** *port* | **management** *port* | **slot** *port* | **tunnel** *port* | **ve** *port*]

The *ethernet stack-unit/slot/port* parameter specifies the Ethernet port for which you want to display the interface information.

The *loopback* option specifies the loopback port for which you want to display the interface information.

The *management* option specifies the management port for which you want to display the interface information.

The *slot* option specifies all the ports in a slot for which you want to display the interface information.

The *tunnel* option specifies the tunnel port for which you want to display the interface information.

The *ve* option specifies the virtual routing (VE) port for which you want to display the interface information.

The following table describes the output parameters of the **show interface brief wide** command.

TABLE 15 Output parameters of the show interface brief wide command

Field	Description
Port	Specifies the port number.
Link	Specifies the link state.
Port-State	Specifies the current port state.
Speed	Specifies the link speed.
Tag	Specifies if the port is tagged or not.
Pvid	Specifies the port VLAN ID.
Pri	Specifies the priority.
MAC	Specifies the MAC address.
Name	Specifies the port name.

To display the complete port name for an Ethernet interface, enter a command such as the following.

```
device# show interface brief wide ethernet 1/1/23
PPort    Link    State   Dupl Speed Trunk Tag Pvid Pri MAC             Name
1/1/23      Up      Forward Full 1G    None  No  1    0   748e.f82d.7a16  connected-to-ICX
```

Syntax: show interface brief wide ethernet *stack-unit/slot/port*

Port speed and duplex mode modification

The Gigabit Ethernet copper ports are designed to auto-sense and auto-negotiate the speed and duplex mode of the connected device. If the attached device does not support this operation, you can manually enter the port speed to operate at either 10, 100, or 1000 Mbps. This configuration is referred to as force mode. The default and recommended setting is 10/100/1000 auto-sense. Port duplex mode and port speed are modified by the same command

NOTE
You can modify the port speed of copper ports only; this feature does not apply to fiber ports.

NOTE
For optimal link operation, copper ports on devices that do not support 803.3u must be configured with like parameters, such as speed (10,100,1000), duplex (half, full), MDI/MDIX, and Flow Control.

Port speed and duplex mode configuration

The following example sets the port speed of copper interface 8 on a FastIron device to 100 Mbps operating in full-duplex mode using the **speed-duplex** *value* command.

```
device(config)# interface ethernet 1/1/8
device(config-if-e1000-1/1/8)# speed-duplex 100-full
```

Use the **no** form of the command to restore the default.

NOTE

On all ICX 7xxx devices, **speed-duplex 1000-full** must be configured on both of the SFP sides for the front 4x10G module to link-up the port as 1G speed.

TABLE 16 Port speed matrix

	auto[1]	10-half	10-full[2]	100-half	100-full	1000-full	1000-full-master[3]	1000-full-slave[3]	2500-full	2500-full-master[3]	2500-full-slave[3]	5G-full	5G-full-master	5G-full-slave	10G-full
1G Cu (fixed ports)	Y (default)	Y[4]	Y	Y[4]	Y	Y	Y	Y	N	N	N	N	N	N	N
2.5G Cu (fixed ports)[5]	N	N	N	N	Y[6 7]	Y	Y	Y	Y[8]	Y	Y	N	N	N	N
10G Cu (fixed ports)	Y (default)	N	N	N	Y	Y	Y	Y	Y[8]	Y[8]	Y[8]	Y[8]	Y[8]	Y[8]	Y
1G Fiber + GBIC SFP	Y (default)	N	Y	N	Y	Y	N	N	N	N	N	N	N	N	N
10G Fiber + GBIC SFP	N	N	N	N	N	Y (default)	N	N	N	N	N	N	N	N	N
1G Fiber + 100-fx	N	N	N	N	Y (default)	N	N	N	N	N	N	N	N	N	N
1G Fiber + 1G SFP	N	N	N	N	N	Y (default)	N	N	N	N	N	N	N	N	N

[1] If a port is configured with speed auto and the peer port is configured for (non autoneg) full-duplex, "duplex mismatch" occurs resulting in the local port selecting half-duplex mode. In this case, packet collisions and receive errors will occur. In the case of ICX 7250, in the event of a duplex mismatch, the local port will force to full duplex instead of half duplex.
[2] In the case of speed mismatch i.e. connecting ports are set to different forced mode speeds like (100-full and 10-full) or (100-half and 10-half), the ports might not come up. This configuration is invalid.
[3] In the case of specific master/slave selection, if the local port is selected as master, the peer port should either be set to slave (and vice-versa) or auto.
[4] On ICX 7150 and ICX 7250, 1G copper uplink ports do not support half duplex.
[5] In ICX 7450-32ZP, 2.5G ports can be configured only in pairs or set of pairs e.g. (1/1/25 -1/1/26) (1/1/27 -1/1/28) (1/1/25-1/1/32) etc.
[6] ICX MultiGig ports can connect to other ICX MultiGig ports at 100 Mbps when "speed-duplex 100-full" is configured on both sides. MultiGig ports are copper ports that support 2.5G and or 5G speeds.
[7] ICX MultiGig ports can connect to 1G copper ports on ICX switches at 100 Mbps when "speed-duplex 100-full" is configured on both sides and the 1G copper ports have EEE enabled.
[8] On ICX 7450-32ZP, default speed is 2500-full on MultiGig ports. Support NBaseT

On ICX 7150-48ZP, default speed is auto on MultiGig ports and they advertise 100/1000/2500Mbps speeds by default. Support 802.3bz and NBase-T

On ICX 7650-48ZP, default speed is auto on MultiGig ports and they advertize 100Mbps/1G/2.5G/5G/10G speeds by default. Support 802.3bz and NBaseT

TABLE 16 Port speed matrix (continued)

	auto[1]	10-half	10-full[2]	100-half	100-full	1000-full	1000-full-master[3]	1000-full-slave[3]	2500-full	2500-full-master[3]	2500-full-slave[3]	5G-full	5G-full-master	5G-full-slave	10G-full
1G Fiber + 10G SFPP (avoid)	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N
10G Fiber + SFPP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y (default)

Enabling auto-negotiation maximum port speed advertisement

NOTE

For optimal link operation, link ports on devices that do not support 802.3u must be configured with like parameters, such as speed (10,100,1000), duplex (half, full), MDI/MDIX, and Flow Control.

Maximum Port speed advertisement is an enhancement to the auto-negotiation feature, a mechanism for accommodating multi-speed network devices by automatically configuring the highest performance mode of inter-operation between two connected devices.

Maximum port speed advertisement enables you to configure an auto-negotiation maximum speed that Gbps copper ports on the RUCKUS device will advertise to the connected device. You can configure a port to advertise a maximum speed of either 100 Mbps or 10 Mbps. When the maximum port speed advertisement feature is configured on a port that is operating at 100 Mbps maximum speed, the port will advertise 10/100 Mbps capability to the connected device. Similarly, if a port is configured at 10 Mbps maximum speed, the port will advertise 10 Mbps capability to the connected device.

The maximum port speed advertisement feature operates independently of logical LAG configurations. Although RUCKUS recommends that you use the same cable types and auto-negotiation configuration on all members of a LAG, you could utilize the auto-negotiation features conducive to your cabling environment. For example, in certain circumstances, you could configure each port in a LAG to have its own auto-negotiation maximum port speed advertisement configuration.

Maximum port speed advertisement application notes

- The maximum port speed advertisement works only when auto-negotiation is enabled (CLI command **speed-duplex auto**). If auto-negotiation is OFF, the device will reject the maximum port speed advertisement configuration.
- When the maximum port speed advertisement is enabled on a port, the device will reject any configuration attempts to set the port to a forced speed mode (100 Mbps or 1000 Mbps).
- When maximum port speed advertisement is enabled on a port, the device will reject any configuration attempts to set the port to a forced speed mode (100 Mbps or 1000 Mbps).

[1] If a port is configured with speed auto and the peer port is configured for (non autoneg) full-duplex, "duplex mismatch" occurs resulting in the local port selecting half-duplex mode. In this case, packet collisions and receive errors will occur. In the case of ICX 7250, in the event of a duplex mismatch, the local port will force to full duplex instead of half duplex.
[2] In the case of speed mismatch i.e. connecting ports are set to different forced mode speeds like (100-full and 10-full) or (100-half and 10-half), the ports might not come up. This configuration is invalid.
[3] In the case of specific master/slave selection, if the local port is selected as master, the peer port should either be set to slave (and vice-versa) or auto.

Configuring maximum port speed advertisement

NOTE
This feature is not supported on ICX 7750.

To configure a maximum port speed advertisement of 10 Mbps on a port that has auto-negotiation enabled, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)
# link-config gig copper autoneg-control 10m ethernet 1
```

To configure a maximum port speed advertisement of 100 Mbps on a port that has auto-negotiation enabled, enter the following command at the Global CONFIG level of the CLI.

```
device(config)
# link-config gig copper autoneg-control 100m ethernet 2
```

Syntax: [no] link-config gig copper autoneg-control { **100m-auto** | **10m-auto** } **ethernet** *stack-id/slot/port* [**to** *stack-id/slot/port* | [**ethernet** *stack-id/slot/port* **to** *stack-id/slot/port* | **ethernet** *stack-id/slot/port*] ...]

You can enable maximum port speed advertisement on one or two ports at a time.

To disable maximum port speed advertisement after it has been enabled, enter the **no** form of the command.

Force mode configuration

You can manually configure a 10/100 Mbps port to accept either full-duplex (bi-directional) or half-duplex (uni-directional) traffic.

NOTE
You can modify the port duplex mode of copper ports only. This feature does not apply to fiber ports.

Port duplex mode and port speed are modified by the same command.

Force mode configuration syntax

To change the port speed of interface 1/1/8 from the default of 10/100/1000 auto-sense to 10 Mbps operating at full-duplex, enter the following.

```
device(config)# interface ethernet 1/1/8
device(config-if-e1000-1/1/8)# speed-duplex 10-full
```

Syntax: speed-duplex *value*

NOTE
On ICX 7450 and ICX 7250-24G, the command options **10-half** and **100-half** are not supported on 1G fiber ports with mini-GBIC (SFPs) for copper.

Force Mode Configuration Considerations

The following considerations apply to the force mode configuration.

- When a local partner issues a **speed-dup 100-full** or **speed-dup 10-full** command, if the remote partner does not issue the same commands it becomes 100-half or 10-half, and may receive collision errors. The local partner may receive InErrors such as CRC, Fragment or Bad packets.
- When a local partner issues a **speed-dup 100-full** or **speed-dup 10-full** command, if the remote partner issues the same command, the port may or may not come up, since both sides enter the force mode and want to force the partner to accept these conditions. If both sides come up, they may not receive any In or Out Errors.

- When a local partner is a force mode configuration such as 100-full/half or 10-full-half and the remote partner is also a force mode configuration, if another force mode in a local or remote partner such as 10-full is entered, the remote or local partner link may or may not come up. This is an IEEE force mode standard. To resolve force mode changing, it is recommended that you change to auto mode first on one side before switching to another force mode configuration.

MDI and MDIX configuration

RUCKUS devices support automatic Media Dependent Interface (MDI) and Media Dependent Interface Crossover (MDIX) detection on all Gbps Ethernet Copper ports.

MDI/MDIX is a type of Ethernet port connection using twisted pair cabling. The standard wiring for end stations is MDI, whereas the standard wiring for hubs and switches is MDIX. MDI ports connect to MDIX ports using straight-through twisted pair cabling. For example, an end station connected to a hub or a switch uses a straight-through cable. MDI-to-MDI and MDIX-to-MDIX connections use crossover twisted pair cabling. So, two end stations connected to each other, or two hubs or switches connected to each other, use crossover cable.

The auto MDI/MDIX detection feature can automatically correct errors in cable selection, making the distinction between a straight-through cable and a crossover cable insignificant.

MDI and MDIX configuration notes

- This feature applies to copper ports only.
- The **mdi-mdix mdi** and **mdi-mdix mdix** commands work independently of auto-negotiation. Thus, these commands work whether auto-negotiation is turned ON or OFF.

MDI and MDIX configuration syntax

The auto MDI/MDIX detection feature is enabled on all Gbps copper ports by default. For each port, you can disable auto MDI/MDIX, designate the port as an MDI port, or designate the port as an MDIX port.

To turn off automatic MDI/MDIX detection and define a port as an MDI only port.

```
device(config-if-e1000-2)# mdi-mdix mdi
```

To turn off automatic MDI/MDIX detection and define a port as an MDIX only port.

```
device(config-if-e1000-2)# mdi-mdix mdix
```

To turn on automatic MDI/MDIX detection on a port that was previously set as an MDI or MDIX port.

```
device(config-if-e1000-2)# mdi-mdix auto
```

Syntax: mdi-mdix[**mdi** | **mdix** | **auto**]

After you enter the **mdi-mdix** command, the RUCKUS device resets the port and applies the change.

To display the MDI/MDIX settings, including the configured value and the actual resolved setting (for mdi-mdix auto), enter the command **show interface** at any level of the CLI.

Disabling or re-enabling a port

A port can be made inactive (disable) or active (enable) by selecting the appropriate status option. The default value for a port is enabled.

To disable port 1/1/8 of a device, enter the following.

```
device(config)# interface ethernet 1/1/8
device(config-if-e1000-1/1/8)# disable
```

You also can disable or re-enable a virtual interface. To do so, enter commands such as the following.

```
device(config)# interface ve v1
device(config-vif-1)# disable
```

To re-enable a virtual interface, enter the **enable** command in the interface configuration mode.

```
device(config-vif-1)# enable
```

Enabling and disabling support for 100BaseFX

Some RUCKUS devices support 100BaseFX fiber transceivers. After you physically install a 100BaseFX transceiver, you must enter a CLI command to enable it. For information about supported SFP and SFP+ transceivers on ICX devices, refer to the *Ruckus Optics Family Datasheet* on the Ruckus website.

Enabling and disabling 100BaseFX on Chassis-based and stackable devices

> **NOTE**
> The following procedure applies to Stackable devices and to Chassis-based 100/1000 Fiber interface modules only. The CLI syntax for enabling and disabling 100BaseFX support on these devices differs than on a Compact device. Make sure you refer to the appropriate procedures.

FastIron devices support the following types of SFPs for 100BaseFX:

- *Multimode SFP*—maximum distance is 2 kilometers
- *Long Reach (LR)*—maximum distance is 40 kilometers
- *Intermediate Reach (IR)* —maximum distance is 15 kilometers

For information about supported SFP and SFP+ transceivers on FastIron devices, refer to the *Ruckus Optics Family Datasheet*.

> **NOTE**
> Connect the 100BaseFX fiber transceiver after configuring both sides of the link. Otherwise, the link could become unstable, fluctuating between up and down states.

To enable support for 100BaseFX on a fiber port or on a stackable switch, enter commands such as the following.

```
device(config)# interface ethernet 1/1/6
device(config-if-1/1/6)# 100-fx
```

The above commands enable 100BaseFX on port 6 in slot 1.

Syntax: [no] 100-fx

To disable 100BaseFX support on a fiber port, enter the **no** form of the command. You must disable 100BaseFX support before inserting a different type of module In the same port. Otherwise, the device will not recognize traffic traversing the port.

Changing the Gbps fiber negotiation mode

The globally configured Gbps negotiation mode is the default mode for all Gbps fiber ports. You can override the globally configured default and set individual ports to the following:

- neg-full-auto—The port first tries to perform a handshake with the other port to exchange capability information. If the other port does not respond to the handshake attempt, the port uses the manually configured configuration information (or the defaults if an administrator has not set the information). This is the default.
- auto-gig—The port tries to perform a handshake with the other port to exchange capability information.

- neg-off—The port does not try to perform a handshake. Instead, the port uses configuration information manually configured by an administrator.

To change the mode for individual ports, enter commands such as the following.

```
device(config)# interface ethernet 1/1/1 to 1/1/4
device(config-mif-1/1/1-1/1/4)# gig-default auto-gig
```

This command overrides the global setting and sets the negotiation mode to auto-Gbps for ports 1 - 4.

NOTE
When Gbps negotiation mode is turned off using the **gig-default neg-off** command, the RUCKUS device may inadvertently take down both ends of a link. This is a hardware limitation for which there is currently no workaround.

Configuration considerations for Gbps fiber negotiation mode

For Fiber ports, the configuration is considered invalid if the Gbps negotiation mode is enabled on one end of the link and Gbps negotiation mode is turned off at the other end.

The following tables provide a list of invalid configurations on fiber ports.

TABLE 17 List of invalid configurations

ICX 7450 / ICX 7250 (1G fiber port) configuration	Link Partner - ICX 7450 / ICX 7250 configuration
100-fx	1000-full
100-fx	neg-off

TABLE 18 List of invalid configurations

ICX 7450 / ICX 7750 (10G fiber port) configuration	Link Partner - ICX 7450 / ICX 7250 (1G fiber port) configuration
1000-full + neg-off	1000-full
1000-full (with default auto-gig)	neg-off

TABLE 19 List of invalid configurations

ICX 7450 / ICX 7750 (10G fiber port) configuration	Link Partner - ICX 7450 / ICX 7750 / ICX 7250 (10G fiber port) configuration
1000-full (with default auto-gig)	1000-full and neg-off

Flow control configuration

Flow control (802.3x) is a QoS mechanism created to manage the flow of data between two full-duplex Ethernet devices. Specifically, a device that is oversubscribed (is receiving more traffic than it can handle) sends an 802.3x PAUSE frame to its link partner to temporarily reduce the amount of data the link partner is transmitting. Without flow control, buffers would overflow, packets would be dropped, and data retransmission would be required.

All FastIron devices support asymmetric flow control, meaning they can receive PAUSE frames but cannot transmit them. In addition, devices also support symmetric flow control, meaning they can both receive and transmit 802.3x PAUSE frames.

Flow control configuration notes

- Auto-negotiation of flow control is not supported on 10 Gbps and 40 Gbps ports, fiber ports, and copper or fiber combination ports.
- When any of the flow control commands are applied to a port that is up, the port will be disabled and re-enabled.
- For 10 Gbps and 40 Gbps ports, the **show interface** command with the appropriate parameters shows whether Flow Control is enabled or disabled, depending on the configuration.

- When flow-control is enabled, the hardware can only advertise PAUSE frames. It does not advertise Asym.
- On ICX 7750 devices the default packet-forwarding method is cut-through, in which port flow control (IEEE 802.3x) is not supported but priority-based flow control (PFC) is supported. You can configure the **store-and- forward** command in global configuration mode to enable the store-and-forward method for packet-forwarding.

NOTE
You must save the configuration and reload for the change to take effect. See the description of the **store-and-forward** command in the *FastIron Command Reference* for more information.

Disabling or re-enabling flow control

You can configure the RUCKUS device to operate with or without flow control. Flow control is enabled by default globally and on all full-duplex ports. You can disable and re-enable flow control at the Global CONFIG level for all ports. When flow control is enabled globally, you can disable and re-enable it on individual ports.

To disable flow control, enter the **no flow-control** command.

```
device(config)# no flow-control
```

To turn the feature back on, enter the **flow-control** command.

```
device(config)# flow-control
```

Syntax: [no] flow-control

NOTE
For optimal link operation, link ports on devices that do not support 803.3u must be configured with like parameters, such as speed (10,100,1000), duplex (half, full), MDI/MDIX, and Flow Control.

Negotiation and advertisement of flow control

By default, when flow control is enabled globally and auto-negotiation is on, flow control is enabled, and advertised on 10/100/1000M ports. If auto-negotiation is off or if the port speed was configured manually, then flow control is not negotiated with or advertised to the peer.

To disable flow control capability on a port, enter the following commands.

```
device(config)# interface ethernet 1/1/21
device(config-if-e1000-1/1/21)# no flow-control
```

To enable flow control negotiation, enter the following commands.

```
device(config)# interface ethernet 1/1/21
device(config-if-e1000-1/1/21)# flow-control neg-on
```

After flow control negotiation is enabled using the **flow-control neg-on** command option, flow control is enabled or disabled depending on the peer advertisement.

Commands may be entered in interface (single port) or multiple interface (multiple ports at once) mode.

```
device(config)# interface ethernet 1/1/21
device(config-if-e1000-1/1/21)# no flow-control
```

This command disables flow control on port 1/1/21.

```
device(config)# interface ethernet 1/1/11 to 1/1/15
device(config-mif-1/1/11-1/1/15)# no flow-control
```

This command disables flow control on ports 1/1/11 to 1/1/15.

Displaying flow-control status

The **show interface** command with the appropriate parameters displays configuration, operation, and negotiation status where applicable.

For example, on a FastIron Stackable device, issuing the command for 10/100/1000M port 1/1/21 displays the following output.

```
device# show interfaces ethernet 1/1/21

GigabitEthernet1/1/21 is up, line protocol is up
Port up for 30 minutes 20 seconds
Hardware is GigabitEthernet, address is 0000.0004.4014 (bia 0000.0004.4014)
  Configured speed auto, actual 100Mbit, configured duplex fdx, actual fdx
  Configured mdi mode AUTO, actual MDIX
  Member of L2 VLAN ID 1, port is untagged, port state is LISTENING
  BPDU Guard is disabled, Root Protect is disabled
  STP configured to ON, priority is level0
  Flow Control is config enabled, oper enabled, negotiation disabled
  Mirror disabled, Monitor disabled
  Not member of any active trunks
  Not member of any configured trunks
  No port name
  Inter-Packet Gap (IPG) is 96 bit times
  300 second input rate: 0 bits/sec, 0 packets/sec, 0.00% utilization
  300 second output rate: 0 bits/sec, 0 packets/sec, 0.00% utilization
  0 packets input, 0 bytes, 0 no buffer
  Received 0 broadcasts, 0 multicasts, 0 unicasts
  0 input errors, 0 CRC, 0 frame, 0 ignored
  0 runts, 0 giants
  5 packets output, 320 bytes, 0 underruns
  Transmitted 0 broadcasts, 5 multicasts, 0 unicasts
  0 output errors, 0 collisions
```

NOTE

The port up/down time is required only for physical ports and not for loopback/ve/ tunnel ports.

- If flow control negotiation is enabled (and a neighbor advertises "Pause-Not Capable"), the display shows:

```
Flow Control is config enabled, oper disabled, negotiation enabled
```

- If flow control negotiation is enabled (and a neighbor advertises "Pause-Capable"), the display shows:

```
Flow Control is config enabled, oper enabled, negotiation enabled
```

- If flow control is enabled, and flow control negotiation is disabled, the display shows:

```
Flow Control is config enabled, oper enabled, negotiation disabled
```

- If flow control is disabled, the display shows:

```
Flow control is config disabled, oper disabled
```

Symmetric flow control

In addition to asymmetric flow control, RUCKUS devices support symmetric flow control, meaning they can both receive and transmit 802.3x PAUSE frames.

Symmetric flow control is best enabled when an application has a requirement for a lossless service class in an Internet Small Computer System Interface (iSCSI) environment. Symmetric flow control is supported on standalone units as well as on all units in a traditional stack. Once this feature is enabled, ingress buffer limits take effect, while egress buffer limits are ignored. The ingress buffer limit, dictates flow control behavior.

About XON and XOFF thresholds

An 802.3x PAUSE frame is generated when the buffer limit at the ingress port reaches or exceeds the port's upper watermark threshold (XOFF limit). The PAUSE frame requests that the sender stop transmitting traffic for a period of time. The time allotted enables the egress and ingress queues to be cleared. When the ingress queue falls below the port's lower watermark threshold (XON limit), an 802.3x PAUSE frame with a quanta of 0 (zero) is generated. The PAUSE frame requests that the sender resume sending traffic normally.

Each 1G, 10G, and 40G port is configured with a default total number of buffers as well as a default XOFF and XON threshold. The defaults are different for 1G ports versus 10G or 40G ports. Also, the default XOFF and XON thresholds are different for jumbo mode versus non-jumbo mode. The defaults are shown in About XON and XOFF thresholds.

TABLE 20 XON and XOFF default thresholds

	Limit when Jumbo disabled / % of buffer limit	Limit when Jumbo enabled / % of buffer limit
1G ports		
Total buffers	272	272
XOFF	240 / 91%	216 / 82%
XON	200 / 75%	184 / 70%
10G ports		
Total buffers	416	416
XOFF	376 / 91%	336 / 82%
XON	312 / 75%	288 / 70%
40G ports		
Total buffers	960	960
XOFF	832 (87%)	832 (87%)
XON	720 (75%)	720 (75%)

If necessary, you can change the total buffer limits and the XON and XOFF default thresholds. Refer to Changing the total buffer limits on page 52 and Changing the XON and XOFF thresholds on page 51, respectively.

Configuration notes and feature limitations for symmetric flow control

Note the following configuration notes and feature limitations before enabling symmetric flow control.

- Symmetric flow control is supported on all 1G,10G, and 40G data ports on ICX devices.
- Symmetric flow control is not supported on stacked ports or across units in a stack. If you are using symmetric flow control on stacked ports or across units in a stack be aware that:
  - It is unrealistic to infer that lossless service exists across stacked units.
  - Symmetric flow control is not priority aware; oversubscription of one priority may cause the dropping of higher priority controls in stacked links. The loss of these priority controls results in a broken stack.
  - The system depends on buffer resources to ensure quality of service. Under symmetric flow control, persistent congestions may leave a buffer resource vulnerable to exhaustion. An example is where bandwidth of ingress ports is greater than egress ports — a packet receives on a 10G port, but then forwards the packet to a 1G port. If the buffers are exhausted, there is no guarantee of quality of service. The end result is an unstable system with flapping protocols.
  - In a stacked environment, pause frames are not propagated from one stack unit to another, as a result they may hold buffers up to a core limit due to multiple port congestions. Under this condition, the stack may break.
  - Not propagating pause frames also prevents head-of-line (HOL) blocking conditions for stacked ports, which are normally used as aggregation links. Stacked ports or trunks are flow control disabled for both transmit and receive, HOL blocking may occur when symmetric flow control is enabled. This means that a peer can stop transmitting traffic streams unrelated to the congestion stream.

- To use this feature, 802.3x flow control must be enabled globally and per interface on ICX devices. By default, 802.3x flow control is enabled, but can be disabled with the **no flow-control** command.
- The following QoS features are not supported together with symmetric flow control:
  - Dynamic buffer allocation—CLI commands (**qd-descriptor** and **qd-buffer**)
  - Buffer profiles—CLI command (**buffer-profile port-region**)
  - DSCP-based QoS—CLI command (**trust dscp**)

  NOTE
  Although the above QoS features are not supported with symmetric flow control, the CLI will still accept these commands. The last command issued will be the one placed into effect on the device. For example, if **trust dscp** is enabled after **symmetric-flow-control** is enabled, symmetric flow control will be disabled and trust dscp will be placed into effect. Make sure you do not enable incompatible QoS features when symmetric flow control is enabled on the device.

Enabling and disabling symmetric flow control

By default, symmetric flow control is disabled and tail drop mode is enabled. However, because flow control is enabled by default on all full-duplex ports, these ports will always honor received 802.3x Pause frames, whether or not symmetric flow control is enabled.

To enable symmetric flow control globally on all full-duplex data ports of a standalone unit, enter the **symmetric-flow-control enable** command.

```
device(config)# symmetric-flow-control enable
```

To enable symmetric flow control globally on all full-duplex data ports of a particular unit in a traditional stack, enter the **symmetric-flow-control enable** command with the appropriate paramters.

```
device(config)# symmetric-flow-control enable unit 4
```

Syntax: [no] symmetric-flow-control enable [**unit** *stack-unit*]

The *stack-unit* parameter specifies one of the units in a stacking system. Master/Standby/Members are examples of a stack-unit

To disable symmetric flow control once it has been enabled, use the **no** form of the command.

Changing the XON and XOFF thresholds

This section describes how to change the XON and XOFF thresholds described in About XON and XOFF thresholds on page 50.

To change the thresholds for all 1G ports, enter a command such as the following.

```
device(config)# symmetric-flow-control set 1 xoff 91 xon 75
```

To change the thresholds for all 10G ports, enter a command such as the following.

```
device(config)# symmetric-flow-control set 2 xoff 91 xon 75
```

In the above configuration examples, when the XOFF limit of 91% is reached or exceeded, the RUCKUS device will send PAUSE frames to the sender telling it to stop transmitting data temporarily. When the XON limit of 75% is reached, the RUCKUS device will send PAUSE frames to the sender telling it to resume sending data.

Syntax: symmetric-flow-control set { **1** | **2** } **xoff** *%* **xon** *%*

symmetric-flow-control set 1 sets the XOFF and XON limits for 1G ports.

symmetric-flow-control set 2 sets the XOFF and XON limits for 10G ports.

For *xoff %* , the % minimum value is 60% and the maximum value is 95%.

For *xon %* , the % minimum value is 50% and the maximum value is 90%.

Use the **show symmetric** command to view the default or configured XON and XOFF thresholds. Refer to Displaying symmetric flow control status on page 52.

Changing the total buffer limits

This section describes how to change the total buffer limits described in About XON and XOFF thresholds on page 50. You can change the limits for all 1G ports and for all 10G ports.

To change the total buffer limit for all 1G ports, enter a command such as the following.

```
device(config)# symmetric-flow-control set 1 buffers 320
Total buffers modified, 1G: 320, 10G: 128
```

To change the total buffer limit for all 10G ports, enter a command such as the following.

```
device(config)# symmetric-flow-control set 2 buffers 128
Total buffers modified, 1G: 320, 10G: 128
```

Syntax: symmetric-flow-control set { **1** | **2** } **buffers** *value*

symmetric-flow-control set 1 buffers value sets the total buffer limits for 1G ports. The default value is 272. You can specify a number from 64 - 320.

symmetric-flow-control set 2 buffers value sets the total buffer limits for 10G ports. The default value is 416. You can specify a number from 64 - 1632.

Use the **show symmetric** command to view the default or configured total buffer limits. Refer to Displaying symmetric flow control status on page 52.

Displaying symmetric flow control status

The **show symmetric-flow-control** command displays the status of symmetric flow control as well as the default or configured total buffer limits and XON and XOFF thresholds.

```
device(config)# show symmetric
Symmetric Flow Control Information:
-----------------------------------
Symmetric Flow Control is enabled on units: 2 3
Buffer parameters:
1G Ports:
        Total Buffers : 272
        XOFF Limit    : 240(91%)
        XON Limit     : 200(75%)
10G Ports:
        Total Buffers : 416
        XOFF Limit    : 376(91%)
        XON Limit     : 312(75%)
```

Syntax: show symmetric-flow-control

Interpacket Gap (IPG) on a switch

IPG is the time delay, in bit time, between frames transmitted by the device. You configure IPG in interface configuration mode. The command you use depends on the interface type on which IPG is being configured.

The default interpacket gap is 96 bits-time, which is 9.6 microseconds for 10 Mbps Ethernet, 960 nanoseconds for 100 Mbps Ethernet, 96 nanoseconds for 1 Gbps Ethernet, and 9.6 nanoseconds for 10 Gbps Ethernet.

The CLI syntax for IPG differs on FastIron standalone devices compared to FastIron stackable devices.

IPG configuration commands are based on "port regions". All ports within the same port region should have the same IPG configuration. If a port region contains two or more ports, changes to the IPG configuration for one port are applied to all ports in the same port region. When you enter a value for IPG, the CLI displays the ports to which the IPG configuration is applied.

When you enter a value for IPG, the device applies the closest valid IPG value for the port mode to the interface. For example, if you specify 120 for a 1 Gbps Ethernet port in 1 Gbps mode, the device assigns 112 as the closest valid IPG value to program into the software.

IPG on a FastIron standalone switch configuration notes

The CLI syntax for IPG differs on standalone devices compared to stackable devices.

Enter the **ipg-gmii** command in interface configuration mode.

```
device(config-if-e1000-7/1)# ipg-gmii 120
IPG 120(112) has been successfully configured for port 7/1
```

- When you enter a value for IPG, the device applies the closest valid IPG value for the port mode to the interface. For example, if you specify 120 for a 1 Gbps Ethernet port in 1 Gbps mode, the device assigns 112 as the closest valid IPG value to program into hardware.

Configuring IPG on a Gbps Ethernet port

On a Gbps Ethernet port, you can configure IPG for 10/100 mode and for Gbps Ethernet mode.

10/100M mode

To configure IPG on a Gbps Ethernet port for 10/100M mode, enter the following command.

```
device(config)# interface ethernet 7/1
device(config-if-e1000-7/1)# ipg-mii 120
IPG 120(120) has been successfully configured for ports 7/1 to 7/12
```

Syntax: [no] ipg-mii *bit-time*

Enter 12-124 for *bit time* . The default is 96 bit time.

1G mode

To configure IPG on a Gbps Ethernet port for 1-Gbps Ethernet mode, enter commands such as the following.

```
device(config)# interface ethernet 7/1
device(config-if-e1000-7/1)# ipg-gmii 120
IPG 120(112) has been successfully configured for ports 0/7/1 to 7/12
```

Syntax: [no] ipg-gmii *bit-time*

Enter 48 - 112 for *bit time* . The default is 96 bit time.

Configuring IPG on a 10 Gbps Ethernet interface

To configure IPG on a 10 Gbps Ethernet interface, enter commands such as the following.

```
device(config)# interface ethernet 9/1
device(config-if-e10000-9/1)# ipg-xgmii 120
IPG 120(128) has been successfully configured for port 9/1
```

Syntax: [no] ipg-xgmii *bit-time*

Enter 96-192 for *bit time* . The default is 96 bit time.

IPG on FastIron Stackable devices

On ICX devices, you can configure an IPG for each port. An IPG is a configurable time delay between successive data packets.

You can configure an IPG with a range from 48-120 bit times in multiples of 8, with a default of 96. The IPG may be set from either the interface configuration level or the multiple interface level.

IPG configuration notes

- When an IPG is applied to a LAG, it applies to all ports in the LAG. When you are creating a new LAG, the IPG setting on the LAG interface is automatically applied to the member ports.
- This feature is supported on 10/100/1000M ports.

Configuring IPG on a 10/100/1000M port

To configure an IPG of 112 on Ethernet interface 0/1/21, for example, enter the following command.

```
device(config)# interface ethernet 0/1/21
device(config-if-e1000-0/1/21)# ipg 112
```

For multiple interface levels, to configure IPG for ports 0/1/11 and 0/1/14 through 0/1/17, enter the following commands.

```
device(config)# interface ethernet 0/1/11 ethernet 0/1/14 to 0/1/17
device(config-mif-0/1/11,0/1/14-0/1/17)# ipg 104
```

Syntax: [no] ipg *value*

For *value* , enter a number in the range from 48-120 bit times in multiples of 8. The default is 96.

As a result of the above configuration, the output from the show interface Ethernet 0/1/21 command is as follows.

```
device# show interfaces ethernet 0/1/21
GigabitEthernet 0/1/21 is up, line protocol is up
Port up for 40 seconds
  Hardware is GigabitEthernet, address is 0000.0004.4014 (bia 0000.0004.4014)
  Configured speed auto, actual 100Mbit, configured duplex fdx, actual fdx
  Configured mdi mode AUTO, actual MDIX
  Member of L2 VLAN ID 1, port is untagged, port state is FORWARDING
  BPDU Guard is disabled, Root Protect is disabled
  STP configured to ON, priority is level0
  Flow Control is config enabled, oper enabled, negotiation disabled
  Mirror disabled, Monitor disabled
  Not member of any active trunks
  Not member of any configured trunks
  No port name
  Inter-Packet Gap (IPG) is 112 bit times
  IP MTU 10222 bytes
  300 second input rate: 0 bits/sec, 0 packets/sec, 0.00% utilization
  300 second output rate: 248 bits/sec, 0 packets/sec, 0.00% utilization
  0 packets input, 0 bytes, 0 no buffer
  Received 0 broadcasts, 0 multicasts, 0 unicasts
  0 input errors, 0 CRC, 0 frame, 0 ignored
  0 runts, 0 giants
  80 packets output, 5120 bytes, 0 underruns
  Transmitted 0 broadcasts, 80 multicasts, 0 unicasts
  0 output errors, 0 collisions
```

Port priority (QoS) modification

You can give preference to the inbound traffic on specific ports by changing the Quality of Service (QoS) level on those ports. For information and procedures, refer to "Quality of Service" chapter in the *RUCKUS FastIron Traffic Management Configuration Guide*.

Dynamic configuration of Voice over IP (VoIP) phones

You can configure a FastIron device to automatically detect and re-configure a VoIP phone when it is physically moved from one port to another within the same device. To do so, you must configure a *voice VLAN ID* on the port to which the VoIP phone is connected. The software stores the voice VLAN ID in the port database for retrieval by the VoIP phone.

The dynamic configuration of a VoIP phone works in conjunction with the VoiP phone discovery process. Upon installation, and sometimes periodically, a VoIP phone will query the RUCKUS device for VoIP information and will advertise information about itself, such as, device ID, port ID, and platform. When the RUCKUS device receives the VoIP phone query, it sends the voice VLAN ID in a reply packet back to the VoIP phone. The VoIP phone then configures itself within the voice VLAN.

As long as the port to which the VoIP phone is connected has a voice VLAN ID, the phone will configure itself into that voice VLAN. If you change the voice VLAN ID, the software will immediately send the new ID to the VoIP phone, and the VoIP phone will re-configure itself with the new voice VLAN.

VoIP configuration notes

- This feature works with any VoIP phone that:
  - Runs CDP
  - Sends a VoIP VLAN query message
  - Can configure its voice VLAN after receiving the VoIP VLAN reply
- Automatic configuration of a VoIP phone will not work if one of the following applies:
  - You do not configure a voice VLAN ID for a port with a VoIP phone
  - You remove the configured voice VLAN ID from a port without configuring a new one
  - You remove the port from the voice VLAN
- Make sure the port is able to intercept CDP packets (**cdp run** command).
- Some VoIP phones may require a reboot after configuring or re-configuring a voice VLAN ID. For example, if your VoIP phone queries for VLAN information only once upon boot up, you must reboot the VoIP phone before it can accept the VLAN configuration. If your phone is powered by a PoE device, you can reboot the phone by disabling then re-enabling the port.

Enabling dynamic configuration of a Voice over IP (VoIP) phone

You can create a voice VLAN ID for a port, or for a group of ports.

To create a voice VLAN ID for a port, enter commands such as the following.

```
device(config)# interface ethernet 1/1/2
device(config-if-e1000-1/1/2)# voice-vlan 1001
```

To create a voice VLAN ID for a group of ports, enter commands such as the following.

```
device(config)# interface ethernet 1/1/1 to 1/1/8
device(config-mif-1/1/1-1/1/8)# voice-vlan 1001
```

To remove a voice VLAN ID, use the **no** form of the command.

Viewing voice VLAN configurations

You can view the configuration of a voice VLAN for a particular port or for all ports.

To view the voice VLAN configuration for a port, specify the port number with the **show voice-vlan** command. The following example shows the command output results.

```
device# show voice-vlan ethernet 1/1/2
Voice vlan ID for port 1/1/2: 1001
```

The following example shows the message that appears when the port does not have a configured voice VLAN.

```
device# show voice-vlan ethernet 1/1/2
Voice vlan is not configured for port 1/1/2.
```

To view the voice VLAN for all ports, use the **show voice-vlan** command. The following example shows the command output results.

```
device# show voice-vlan
Port ID  Voice-vlan
1/1/2    1001
1/1/8    150
1/1/15   200
```

Port flap dampening configuration

Port Flap Dampening increases the resilience and availability of the network by limiting the number of port state transitions on an interface.

If the port link state toggles from up to down for a specified number of times within a specified period, the interface is physically disabled for the specified wait period. Once the wait period expires, the port link state is re-enabled. However, if the wait period is set to zero (0) seconds, the port link state will remain disabled until it is manually re-enabled.

Port flap dampening configuration notes

- When port flap dampening is configured on the LAG interface, all other member ports of that LAG, will inherit the LAG interface configuration, regardless of any previous configuration.
- The RUCKUS device counts the number of times a port link state toggles from "up to down", and not from "down to up".
- The sampling time or window (the time during which the specified toggle threshold can occur before the wait period is activated) is triggered when the first "up to down" transition occurs.
- "Up to down" transitions include UDLD-based toggles, as well as the physical link state.

Configuring port flap dampening on an interface

This feature is configured at the interface level.

```
device(config)# interface ethernet 1/2/1
device(config-if-e10000-1/2/1)# link-error-disable 10 3 10
```

Syntax: [no] link-error-disable *toggle-threshold sampling-time-in-sec wait-time-in-sec*

The *toggle-threshold* is the number of times a port link state goes from up to down and down to up before the wait period is activated. Enter a value from 1 - 50.

The *sampling-time-in-sec* is the amount of time during which the specified toggle threshold can occur before the wait period is activated. The default is 0 seconds. Enter 1 - 65535 seconds.

The *wait-time-in-sec* is the amount of time the port remains disabled (down) before it becomes enabled. Enter a value from 0 - 65535 seconds; 0 indicates that the port will stay down until an administrative override occurs.

Configuring port flap dampening on a trunk

You can configure the port flap dampening feature on the LAG interface of a LAG using the **link-error-disable** command. Once configured on the LAG interface, the feature is enabled on all ports that are members of the LAG. You cannot configure port flap dampening on port members of the LAG.

Enter commands such as the following on the LAG interface.

```
device(config)# interface lag 1
device(config-lag-if-lg1)# link-error-disable 10 3 10
```

Re-enabling a port disabled by port flap dampening

A port disabled by port flap dampening is automatically re-enabled once the wait period expires; however, if the wait period is set to zero (0) seconds, you must re-enable the port by entering the following command on the disabled port.

```
device(config)# interface ethernet 1/2/1
device(config-if-e10000-1/2/1)# no link-error-disable 10 3 10
```

Displaying ports configured with port flap dampening

Ports that have been disabled due to the port flap dampening feature are identified in the output of the **show link-error-disable** command. The following shows an example output.

```
device# show link-error-disable
Port 1/2/1 is forced down by link-error-disable.
```

Use the **show link-error-disable all** command to display the ports with the port flap dampening feature enabled.

For FastIron stackable devices, the output of the command shows the following.

```
device# show link-error-disable all
Port1/8/1 is configured for link-error-disable
            threshold:1, sampling_period:10, waiting_period:0
Port1/8/2 is configured for link-error-disable
            threshold:1, sampling_period:10, waiting_period:0
Port1/8/3 is configured for link-error-disable
            threshold:1, sampling_period:10, waiting_period:0
Port1/8/4 is configured for link-error-disable
            threshold:1, sampling_period:10, waiting_period:0
Port1/8/5 is configured for link-error-disable
            threshold:4, sampling_period:10, waiting_period:2
Port1/8/9 is configured for link-error-disable
             threshold:2, sampling_period:20, waiting_period:0
```

For standalone devices, the output of the command shows the following.

```
device# show link-error-disable all
 Port    -----------------Config---------------    ------Oper----
  #     Threshold  Sampling-Time  Shutoff-Time   State  Counter
-----   ---------  -------------  ------------   -----  -------
1/1/11          3            120           600    Idle      N/A
1/1/12          3            120           500    Down      424
```

In standalone devices, the **show interface** command indicates if the port flap dampening feature is enabled on the port.

```
device# show interface ethernet 1/1/15

GigabitEthernet1/1/15 is up, line protocol is up
Link Error Dampening is Enabled
Port up for 6 seconds
  Hardware is GigabitEthernet, address is 0000.0000.010e (bia 0000.0000.010e)
  Configured speed auto, actual 1Gbit, configured duplex fdx, actual fdx
  Configured mdi mode AUTO, actual MDIX
device# show interface ethernet 1/1/17
```

```
GigabitEthernet1/1/17 is ERR-DISABLED, line protocol is down
  Link Error Dampening is Enabled
Port down for 40 seconds
  Hardware is GigabitEthernet, address is 0000.0000.010e (bia 0000.0000.010e)
  Configured speed auto, actual unknown, configured duplex fdx, actual unknown
```

The line "Link Error Dampening" displays "Enabled" if port flap dampening is enabled on the port or "Disabled" if the feature is disabled on the port. The feature is enabled on the ports in the two examples above. Also, the characters "ERR-DISABLED" is displayed for the "GbpsEthernet" line if the port is disabled because of link errors.

In addition to the show commands above, the output of the **show interface brief** command indicates if a port is down due to link errors.

```
device# show interface brief ethernet 1/1/17
Port    Link     State     Dupl Speed Trunk Tag Priori MAC            Name
1/1/17  ERR-DIS  None      None None  15    Yes level0 0000.0000.010e
```

The ERR-DIS entry under the "Link" column indicates the port is down due to link errors.

NOTE

If a port name is longer than five characters, the port name is truncated in the output of the **show interface brief** command.

Syslog messages for port flap dampening

The following Syslog messages are generated for port flap dampening.

- If the threshold for the number of times that a port link toggles from "up" to "down" then "down" to "up" has been exceeded, the following Syslog message is displayed.

  ```
  0d00h02m10s:I:ERR_DISABLE: Link flaps on port ethernet 1/1/16 exceeded threshold; port in err-
  disable state
  ```

- If the wait time (port is down) expires and the port is brought up the following Syslog message is displayed.

  ```
  0d00h02m41s:I:ERR_DISABLE: Interface ethernet 1/1/16, err-disable recovery timeout
  ```

Configuring link dampening and alarms on ICX 7150 devices

Link dampening can help minimize outages due to microflaps. Microflaps can cause Layer 2 and Layer 3 reconvergence, resulting in outages lasting several minutes. When link dampening is configured, microflaps can be monitored and ignored for a configured period to prevent unnecessary outages. When link dampening and alarms are configured with the **linkdampen** command, you can monitor the link for flaps and determine when to bring the link down.

ICX 7150 devices support the **linkdampen** command, which enables link dampening with configurable sampling periods on a designated port. Microflaps detected on the port and related changes in state are reported through system logs and in **show interfaces ethernet** command output so you can determine when a response is necessary.

NOTE

Link dampening may cause momentary traffic loss, convergence issues, and other side effects and should be used only when required.

Link dampening can be applied to any port, including stacking, SPX, and data ports. When the **linkdampen** command is applied to a port in a LAG interface, the configuration is applied to all ports on the LAG.

To configure link dampening with alarms and the desired sampling period on an ICX 7150 device, perform the following steps.

1. Enter global configuration mode.

```
device# configure terminal
device(config)#
```

2. Enter the **linkdampen** command as shown in the following example. After the keyword **interval**, enter a value from 1 through 4 to indicate the number of 250 millisecond segments to include in the sampling period. Include the port number on which link dampening is to be configured after the keyword **ethernet**.

   The following sampling intervals are available:

   - 1: 250 ms
   - 2: 500 ms
   - 3: 750 ms
   - 4: 1 second

   NOTE
   The recommended sampling period is 1 second (interval value set to 4).

   NOTE
   The **linkdampen** command can coexist on the same interface with the **link-error-disable** command.

```
ICX7150-48PF Router(config)# linkdampen interval 1 ethernet 1/1/1
***CAUTION Link-Dampening may cause momentary traffic loss,
may cause status convergence issues and other side effects.
Use Link-Dampening only when required.
Recommended usage Link-Dampening interval 4 - 1 second.
```

   The example enables link dampening on Ethernet port 1/1/1 and sets the sampling interval to 1 (250 milliseconds).

3. (Optional) To confirm the configuration, enter the **show running-config** command.

```
ICX7150-48PF Router(config)# show running-config
Current configuration:
!
ver 08.0.70cT213
!
stack unit 1
  module 1 icx7150-48pf-poe-port-management-module
  module 2 icx7150-2-copper-port-2g-module
  module 3 icx7150-4-sfp-plus-port-40g-module
  stack-port 1/3/3
!
!
linkdampen interval 1 ethernet 1/1/1     <--- link dampening configuration for Ethernet port 1/1/1
                                                with a sampling interval of 250 milliseconds
logging console
!
!
```

4. To check the link dampening configuration and any related microflaps or state changes that have been recorded, enter the **show interfaces ethernet** command followed by the port number as shown in the following example.

```
ICX7150-48PF Router(config)# show interfaces ethernet 1/1/1
GigabitEthernet1/1/1 is up, line protocol is up
  Port up for 8 minute(s) 40 second(s)
  Hardware is GigabitEthernet, address is 609c.9ffe.03cc (bia 609c.9ffe.03cc)
  Configured speed auto, actual 1Gbit, configured duplex fdx, actual fdx
  Configured mdi mode AUTO, actual MDIX
  Member of L2 VLAN ID 1, port is untagged, port state is FORWARDING
  BPDU guard is Disabled, ROOT protect is Disabled, Designated protect is Disabled
  Link Error Dampening is Disabled
  STP configured to ON, priority is level0, mac-learning is enabled
  Openflow is Disabled, Openflow Hybrid mode is Disabled,  Flow Control is config enabled, oper
enabled, negotiation disabled
  Mirror disabled, Monitor disabled
  Mac-notification is disabled
  Link Micro Flap Dampening is enabled   <--- Link dampening enabled on Ethernet port 1/1/1
  Damping Interval:250 msecs  Total Microflaps:0  <--- No microflaps during sampling period
  !
  !
  !
```

The following example configures link dampening for port 1/1/1. It sets the sampling interval to a value of 1 (which represents one interval of 250 milliseconds). The configuration is confirmed in output for the **show running-config** command and detailed in output for the **show interface ethernet 1/1/1** command.

```
ICX7150-48PF Router# configure terminal
ICX7150-48PF Router(config)# linkdampen interval 1 ethernet 1/1/1
***CAUTION Link-Dampening may cause momentary traffic loss,
may cause status convergence issues and other side effects.
Use Link-Dampening only when required.
Recommended usage Link-Dampening interval 4 - 1 second.
ICX7150-48PF Router(config)# show running-config
Current configuration:
!
ver 08.0.70cT213
!
stack unit 1
  module 1 icx7150-48pf-poe-port-management-module
  module 2 icx7150-2-copper-port-2g-module
  module 3 icx7150-4-sfp-plus-port-40g-module
  stack-port 1/3/3
!
!
linkdampen interval 1 ethernet 1/1/1     <--- link dampening configuration for Ethernet port 1/1/1
                                               with a sampling interval of 250 milliseconds
logging console
!
!

ICX7150-48PF Router(config)# show interfaces ethernet 1/1/1
GigabitEthernet1/1/1 is up, line protocol is up
  Port up for 8 minute(s) 40 second(s)
  Hardware is GigabitEthernet, address is 609c.9ffe.03cc (bia 609c.9ffe.03cc)
  Configured speed auto, actual 1Gbit, configured duplex fdx, actual fdx
  Configured mdi mode AUTO, actual MDIX
  Member of L2 VLAN ID 1, port is untagged, port state is FORWARDING
  BPDU guard is Disabled, ROOT protect is Disabled, Designated protect is Disabled
  Link Error Dampening is Disabled
  STP configured to ON, priority is level0, mac-learning is enabled
  Openflow is Disabled, Openflow Hybrid mode is Disabled,  Flow Control is config enabled, oper enabled,
negotiation disabled
  Mirror disabled, Monitor disabled
  Mac-notification is disabled
  Link Micro Flap Dampening is enabled   <--- Link dampening enabled on Ethernet port 1/1/1
  Damping Interval:250 msecs  Total Microflaps:0  <--- No microflaps during sampling period
  Not member of any active trunks
  Not member of any configured trunks
  No port name
  IPG MII 0 bits-time, IPG GMII 0 bits-time
  MTU 1500 bytes, encapsulation ethernet
  MMU Mode is Store-and-forward
  300 second input rate: 967999344 bits/sec, 202341 packets/sec, 99.85% utilization
  300 second output rate: 967999352 bits/sec, 202341 packets/sec, 99.85% utilization
  105261644 packets input, 62946463112 bytes, 0 no buffer
  Received 105261643 broadcasts, 0 multicasts, 0 unicasts
  0 input errors, 0 CRC, 0 frame, 0 ignored
  0 runts, 0 giants
  105261789 packets output, 62946549822 bytes, 0 underruns
  Transmitted 105261788 broadcasts, 0 multicasts, 0 unicasts
  0 output errors, 0 collisions
  Relay Agent Information option: Disabled
  Protected: No
  MAC Port Security: Disabled

 This port is not being monitored for queue drops
Egress queues:
Queue counters      Queued packets    Dropped Packets
         0           105267070            1168968
         1                   0                  0
         2                   0                  0
         3                   0                  0
```

4	0	0
5	23	0
6	0	0
7	0	0

Port loop detection

This feature allows the RUCKUS device to disable a port that is on the receiving end of a loop by sending test packets. You can configure the time period during which test packets are sent.

Types of loop detection

There are two types of loop detection; Strict Mode and Loose Mode. In Strict Mode, a port is disabled only if a packet is looped back to that same port. Strict Mode overcomes specific hardware issues where packets are echoed back to the input port. In Strict Mode, loop detection must be configured on the physical port.

In Loose Mode, loop detection is configured on the VLAN of the receiving port. Loose Mode disables the receiving port if packets originate from any port or VLAN on the same device. The VLAN of the receiving port must be configured for loop detection in order to disable the port.

Recovering disabled ports

Once a loop is detected on a port, it is placed in Err-Disable state. The port will remain disabled until one of the following occurs:

- You manually disable and enable the port at the Interface Level of the CLI.
- You enter the command **clear loop-detection** . This command clears loop detection statistics and enables all Err-Disabled ports.
- The device automatically re-enables the port. To set your device to automatically re-enable Err-Disabled ports, refer to Configuring the device to automatically re-enable ports on page 63.

Port loopback detection configuration notes

- Loopback detection packets are sent and received on both tagged and untagged ports. Therefore, this feature cannot be used to detect a loop across separate devices.

The following information applies to Loose Mode loop detection:

- With Loose Mode, two ports of a loop are disabled.
- Different VLANs may disable different ports. A disabled port affects every VLAN using it.
- Loose Mode floods test packets to the entire VLAN. This can impact system performance if too many VLANs are configured for Loose Mode loop detection.

  NOTE
  RUCKUS recommends that you limit the use of Loose Mode. If you have a large number of VLANS, configuring loop detection on all of them can significantly affect system performance because of the flooding of test packets to all configured VLANs. An alternative to configuring loop detection in a VLAN-group of many VLANs is to configure a separate VLAN with the same tagged port and configuration, and enable loop detection on this VLAN only.

NOTE

When loop detection is used with Layer 2 loop prevention protocols, such as spanning tree (STP), the Layer 2 protocol takes higher priority. Loop detection cannot send or receive probe packets if ports are blocked by Layer 2 protocols, so it does not detect Layer 2 loops when STP is running because loops within a VLAN have been prevented by STP. Loop detection running in Loose Mode can detect and break Layer 3 loops because STP cannot prevent loops across different VLANs. In these instances, the ports are not blocked and loop detection is able to send out probe packets in one VLAN and receive packets in another VLAN. In this way, loop detection running in Loose Mode disables both ingress and egress ports.

Enabling loop detection

Use the **loop-detection** command to enable loop detection on a physical port (Strict Mode) or a VLAN (Loose Mode). Loop detection is disabled by default. The following example shows a Strict Mode configuration.

```
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# loop-detection
```

The following example shows a Loose Mode configuration.

```
device(config)# vlan20
device(config-vlan-20)# loop-detection
```

By default, the port will send test packets every one second, or the number of seconds specified by the **loop-detection-interval** command. Refer to Configuring a global loop detection interval on page 63.

Syntax: [no] loop-detection

Use the [no] form of the command to disable loop detection.

Configuring a global loop detection interval

The loop detection interval specifies how often a test packet is sent on a port. When loop detection is enabled, the loop detection time unit is 0.1 second, with a default of 10 (one second). The range is from 1 (one tenth of a second) to 100 (10 seconds). You can use the **show loop-detection status** command to view the loop detection interval.

To configure the global loop detection interval, enter a command similar to the following.

```
device(config)# loop-detection-interval 50
```

This command sets the loop-detection interval to 5 seconds (50 x 0.1).

To revert to the default global loop detection interval of 10, enter one of the following.

```
device(config)# loop-detection-interval 10
```

OR

```
device(config)# no loop-detection-interval 50
```

Syntax: [no] loop-detection-interval *number*

where *number* is a value from 1 to 100. The system multiplies your entry by 0.1 to calculate the interval at which test packets will be sent.

Configuring the device to automatically re-enable ports

To configure the RUCKUS device to automatically re-enable ports that were disabled because of a loop detection, enter the **errdisable recovery cause loop-detection** command.

```
device(config)# errdisable recovery cause loop-detection
```

The above command will cause the RUCKUS device to automatically re-enable ports that were disabled because of a loop detection. By default, the device will wait 300 seconds before re-enabling the ports. You can optionally change this interval to a value from 10 to 65535 seconds. Refer to Specifying the recovery time interval on page 64.

Syntax: [no] errdisable recovery cause loop-detection

Use the [no] form of the command to disable this feature.

Specifying the recovery time interval

The recovery time interval specifies the number of seconds the RUCKUS device will wait before automatically re-enabling ports that were disabled because of a loop detection. (Refer to Configuring the device to automatically re-enable ports on page 63.) By default, the device will wait 300 seconds. To change the recovery time interval, enter a command such as the following.

```
device(config)# errdisable recovery interval 120
```

The above command configures the device to wait 120 seconds (2 minutes) before re-enabling the ports.

To revert back to the default recovery time interval of 300 seconds (5 minutes), enter one of the following commands.

```
device(config)# errdisable recovery interval 300
```

OR

```
device(config)# no errdisable recovery interval 120
```

Syntax: [no] errdisable recovery interval *seconds*

where *seconds* is a number from 10 to 65535.

Clearing loop-detection

To clear loop detection statistics and re-enable all ports that are in Err-Disable state because of a loop detection, enter the **clear loop-detection** command.

```
device# clear loop-detection
```

Displaying loop-detection information

Use the **show loop-detection status** command to display loop detection status, as shown.

```
device# show loop-detection status
loop detection packets interval: 10 (unit 0.1 sec)
Number of err-disabled ports: 3
You can re-enable err-disable ports one by one by "disable" then "enable"
under interface config, re-enable all by "clear loop-detect", or
configure "errdisable recovery cause loop-detection" for automatic recovery
index port/vlan  status                        #errdis  sent-pkts recv-pkts
1     1/1/13     untag, LEARNING              0        0         0
2     1/1/15     untag, BLOCKING              0        0         0
3     1/1/17     untag, DISABLED              0        0         0
4     1/1/18     ERR-DISABLE by itself        1        6         1
5     1/1/19     ERR-DISABLE by vlan 12       0        0         0
6     vlan12     2 ERR-DISABLE ports          2        24        2
```

If a port is errdisabled in Strict mode, it shows "ERR-DISABLE by itself". If it is errdisabled due to its associated vlan, it shows "ERR-DISABLE by vlan ?"

The following command displays the current disabled ports, including the cause and the time.

```
device# show loop-detection disable
Number of err-disabled ports: 3
You can re-enable err-disable ports one by one by "disable" then "enable"
under interface config, re-enable all by "clear loop-detect", or
configure "errdisable recovery cause loop-detection" for automatic recovery
index  port         caused-by    disabled-time
1      1/1/18       itself       00:13:30
2      1/1/19       vlan 12      00:13:30
3      1/1/20       vlan 12      00:13:30
```

This example shows the disabled ports, the cause, and the time the port was disabled. If loop-detection is configured on a physical port, the disable cause will show "itself". For VLANs configured for loop-detection, the cause will be a VLAN.

The following command shows the hardware and software resources being used by the loop-detection feature.

```
Vlans configured loop-detection use 1 HW MAC
Vlans not configured but use HW MAC: 1 10
                     alloc in-use  avail get-fail    limit  get-mem  size init
configuration pool      16      6     10        0     3712        6    15   16
linklist pool           16     10      6        0     3712       10    16   16
```

Displaying loop detection resource information

Use the **show loop-detection resource** command to display the hardware and software resource information on loop detection.

```
device# show loop-detection resource
Vlans configured loop-detection use 1 HW MAC
Vlans not configured but use HW MAC: 1 10
                     alloc in-use  avail get-fail    limit  get-mem  size init
configuration pool      16      6     10        0     3712        6    15   16
linklist pool           16     10      6        0     3712       10    16   16
```

Syntax: show loop-detection resource

The following table describes the output fields for this command.

TABLE 21 Field definitions for the **show loop-detection resource** command

Field	Description
alloc	Memory allocated
in-use	Memory in use
avail	Available memory
get-fail	The number of get requests that have failed
limit	The maximum memory allocation
get-mem	The number of get-memory requests
size	The size
init	The number of requests initiated

Displaying loop detection configuration status on an interface

Use the **show interface** command to display the status of loop detection configuration on a particular interface.

```
device# show interface ethernet 1/2/1
10GigabitEthernet1/2/1 is up, line protocol is up
Port up for 1 day 22 hours 43 minutes 5 seconds
Hardware is 10GigabitEthernet, address is 0000.0089.1100 (bia 0000.0089.1118)
Configured speed 10Gbit, actual 10Gbit, configured duplex fdx, actual fdx
Member of 9 L2 VLANs, port is tagged, port state is FORWARDING
BPDU guard is Disabled, ROOT protect is Disabled
```

```
Link Error Dampening is Disabled
STP configured to ON, priority is level0
Loop Detection is ENABLED
Flow Control is enabled
Mirror disabled, Monitor disabled
Member of active trunk ports 1/2/1,1/2/2, lg1, Lag Interface is lg1
Member of configured trunk ports 1/2/1,1/2/2, lg1, Lag Interface is lg1
No port name
IPG XGMII 96 bits-time
MTU 1500 bytes, encapsulation ethernet
ICL port for BH1 in cluster id 1
300 second input rate: 2064 bits/sec, 3 packets/sec, 0.00% utilization
300 second output rate: 768 bits/sec, 1 packets/sec, 0.00% utilization
171319 packets input, 12272674 bytes, 0 no buffer
Received 0 broadcasts, 63650 multicasts, 107669 unicasts
0 input errors, 0 CRC, 0 frame, 0 ignored
0 runts, 0 giants
51094 packets output, 3925313 bytes, 0 underruns
Transmitted 2 broadcasts, 42830 multicasts, 8262 unicasts
0 output errors, 0 collisions
Relay Agent Information option: Disabled
```

Syslog message due to disabled port in loop detection

The following message is logged when a port is disabled due to loop detection. This message also appears on the console.

```
loop-detection: port 1/1/10 vlan 12, detect, putting into err-disable state
```

Shutdown prevention for loop-detection on an interface

The shutdown prevention for loop-detection functionality allows users to disable the shutdown of a port when the loop detection probe packet is received on an interface.

The shutdown prevention provides control over deciding which port is allowed to enter into an error-disabled state and go into a shutdown state when a loop is detected. This function can also be used as a test tool to detect Layer 2 and Layer 3 loops in network current data packet flow.

Shutdown prevention for loop-detection does not allow any corrective action to be taken on the loop. There could be network instability due to the presence of network loops, if adequate corrective measures are not taken by the network administrator.

To enable shutdown prevention for loop detection, follow these steps.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Specify the interface on which you would like to enable the **loop-detection shutdown-disable** command.

   ```
   device(config)# interface ethernet 1/1/7
   ```

3. Enable shutdown prevention for loop detection on Ethernet interface 1/1/7.

   ```
   device(config-if-e1000-1/1/7)# loop-detection shutdown-disable
   ```

Periodic log message generation for shutdown prevention

Generates periodic log messages for shutdown prevention.

You can raise a periodic syslog that provides information about loops in the network. When a loop is detected because of a loop detection protocol data unit (PDU), on a loop detection shutdown-disabled interface, the interface will never be put into an error-disabled state, but it will generate a periodic log message indicating that the interface is in the shutdown-disabled mode. The periodic syslog is by default generated at an interval of five minutes. You can change this interval as required.

You can globally specify the interval at which the loop-detection syslog message is generated if the **loop detection shutdown-disable** command is configured on the port. This configuration applies to all the ports that have shutdown prevention for loop detection configured.

During a log interval duration window, a log message will be displayed for the first loop detection PDU received on the interface. This means that there will be only one log message per port in an interval window.

To configure the periodic log message generation for shutdown prevention, follow these steps.

1. Enter global configuration mode.
2. Enter the **loop-detection syslog-interval** *<num>* command.

   The following command will set the syslog-interval to 1 hr.

```
device(config)# loop-detection-syslog-interval 60
```

Syslog for port shutdown prevention

Describes the syslog for port shutdown prevention.

<14>0d01h38m44s:<product type>: port <port-num> detect loop, ignoring shut down event in shutdown-disable mode.

Replacing a primary IPv4 address automatically

Beginning with FastIron 8.0.50, you no longer need to remove the primary IPv4 address before you configure a new primary address.

Use the **replace** keyword in the **ip address** command to remove a configured IP address.

A secondary address must be removed before the **replace** keyword can be configured. This option is supported on a router image only. Changing the subnet mask is not supported.

ATTENTION
Traffic and protocols on the configured interface are affected during the IP address change.

Prior to FastIron 8.0.50, an IP address configured globally is the IP address of the management port. On a switch, even if the IP address is configured in interface configuration mode, the address is configured globally. Now, whenever the IP address is configured on the management interface (in management interface configuration mode), a message indicates that the global IP address is also being configured accordingly, as in the following example.

```
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ip address 192.168.10.1/24 replace
```

Ethernet loopback

The Ethernet loopback functionality provides a means to gauge the network continuity and performance of an Ethernet port.

The testing of network continuity is achieved by enabling the remote Ethernet device to swap the source MAC address with the destination MAC address and send the incoming frames back to the source. The looping of the incoming traffic back to the source allows to verify the maximum rate of frame transmission without any frame loss.

By enabling Ethernet loopback on multiple remote devices, the network performance of an entire Metro Ethernet Network (MEN) can be analyzed using a single traffic generator device installed at the network core. However, the loopback support is limited to a LAN segment.

Ethernet loopback operational modes

The Ethernet loopback functionality can be enabled on an interface and can be bound either to a specific interface port or to a port and one or more associated VLANs.

Ethernet loopback can be configured in the following modes:

- VLAN-unaware mode
- VLAN-aware mode

In VLAN-unaware mode, the Ethernet loopback configuration is at the interface level and all the frames received on the ports are looped back irrespective of any VLAN. The port does not need to be explicitly assigned as a member of any VLAN. In VLAN-aware mode, the ports must be a part of the associated VLAN and all the frames received on the ports that are associated with a specific VLAN are looped back. The VLANs to which the port is not associated with the loopback function will continue to process traffic normally, allowing non-disruptive loopback testing.

A classification of the traffic flow can also be configured in VLAN-aware and VLAN-unaware modes. The loopback can be configured as flow-aware by specifying the source MAC address and destination MAC address on the interface. In the flow-aware configuration, only the frames received with a specific source MAC address and destination MAC address are looped back. During the loopback, the source MAC address and destination MAC address of the packets are swapped.

Ethernet loopback-enabled ports can send the incoming frames back to the source in the flow-unaware mode also. If the source MAC address and destination MAC address are not specified, all the frames received on the port are looped back and the port does not distinguish between control and data traffic and Ethernet address types (unicast, multicast, or broadcast). This makes the flow-unaware mode disruptive because control traffic is also looped back and affects other services operating on this port. However, this mode is effective when the traffic source device is directly connected to the port .

Ethernet loopback can be configured in the following combinations:

- VLAN-unaware
- VLAN-unaware and flow-aware
- VLAN-aware
- VLAN-aware and flow-aware

NOTE
The flow-unaware configuration is not supported on the ICX 7750, ICX 7450, and ICX 7250.

Ethernet loopback configuration considerations

The configuration considerations for Ethernet loopback are as follows:

- An interface port cannot be configured in both flow-aware and flow-unaware modes simultaneously.
- An interface port cannot be configured in both VLAN-aware and VLAN-unaware modes simultaneously.

- The source MAC address and destination MAC address which define the flow-aware configuration must be unicast MAC addresses.
- The source MAC address configured in the flow-aware configuration must be unique across the network.
- Ports can be added or removed in different Ethernet loopback modes.
- A flow-aware configuration can be added on an in-service Ethernet loopback port.
- A flow-aware configuration on a port cannot be removed from an in-service Ethernet loopback port.
- The Ethernet loopback configuration is persistent across reboots if the configuration is saved. This will help to measure switching time at reload time from a remote device.
- Ethernet loopback cannot be enabled when one or more of the following features are configured:
  - ACL
  - 802.1X port security
  - Traffic shaping
  - Dual mode
  - Rate limiting
- Ethernet loopback depends on ACL entry availability because it uses ACL resources.
- MAC learning is supported for a packet that is looped back in devices.
- Static MAC configuration is not allowed globally when Ethernet loopback is configured in the system.
- When Ethernet loopback is enabled, the packets are looped back at the rate received. However, the packets can be dropped potentially when the device is oversubscribed.
- Ethernet loopback is supported on the physical interface and LAG interface.
- Ethernet loopback can be enabled only on an existing LAG.
- An Ethernet loopback-enabled LAG cannot be undeployed.
- An Ethernet loopback-enabled port cannot be added to an existing LAG.
- VLAN priority remarking is not allowed on an Ethernet loopback-enabled port.
- The state of the port (up or down) does not affect the Ethernet loopback functionality.
- Ethernet loopback configuration is not allowed on mult-range VLAN (MVLAN), VLAN Group, or VLAN Range.
- Ethernet loopback cannot be configured on a set of VLANs that share a Layer 2 topology (Topology Group).
- Ethernet loopback must be configured in a loop-free network for better results.
- Configuring Ethernet loopback on an MCT ICL port is not recommended as it may impact MCT operations.

Configuring Ethernet loopback in VLAN-unaware mode

The following steps configure Ethernet loopback in VLAN-unaware mode.

1. Enter the **configure terminal** command to enter global configuration mode.

```
device# configure terminal
```

2. Enter the **interface ethernet** command to enter interface configuration mode.

```
device(config)# interface ethernet 1/1/1
```

3. (Optional) Enter the **ethernet loopback test-mac** command to configure the port as flow-aware.

   Once configured and when Ethernet loopback is enabled, only the frames received with the specific source MAC address and destination MAC address are looped back. Skip this step to configure flow-unaware mode.

   NOTE
   On ICX 7750, ICX 7450, and ICX 7250 devices, configuring the **ethernet loopback test-mac** command is mandatory because these devices support only flow-aware mode.

```
device(config-if-e1000-1/1/1)# ethernet loopback test-mac 1111.2222.3333 4444.5555.5555
```

4. Enter the **ethernet loopback** command to enable Ethernet loopback.

```
device(config-if-e1000-1/1/1)# ethernet loopback
```

The following example configures Ethernet loopback in VLAN-unaware mode as flow-aware.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ethernet loopback test-mac 1111.2222.3333 4444.5555.5555
device(config-if-e1000-1/1/1)# ethernet loopback
```

The following example configures Ethernet loopback in VLAN-unaware mode as flow-unaware.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ethernet loopback
```

Configuring Ethernet loopback in VLAN-aware mode

The following steps configure Ethernet loopback in VLAN-aware mode.

1. Enter the **configure terminal** command to enter global configuration mode.

```
device# configure terminal
```

2. Enable **acl-per-port-per-vlan** configuration.

```
device(config)# enable acl-per-port-per-vlan
```

   NOTE
   Reboot the device to enable the configuration.

3. (Optional) Enter the **ethernet loopback test-mac** command from interface configuration mode to configure the port as flow-aware and exit interface configuration mode.

   Once configured and when Ethernet loopback is enabled, only the frames received with the specific source MAC address and destination MAC address are looped back. Skip this step to configure flow-unaware mode.

   NOTE
   On ICX 7750, ICX 7450, and ICX 7250 devices, configuring the **ethernet loopback test-mac** command is mandatory because these devices support only flow-aware mode. In other supported platforms, the **ethernet loopback test-mac** command is optional because you can configure flow-aware or flow-unaware mode.

```
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ethernet loopback test-mac 1111.2222.3333 4444.5555.5555
device(config-if-e1000-1/1/1)# exit
```

4. Enter the VLAN configuration mode using the **vlan** command.

```
device(config)# vlan 100
```

5. Enter the **ethernet loopback** command by specifying the Ethernet interface to enable Ethernet loopback on one or a set of ports in a specific VLAN (VLAN-aware mode).

```
device(config-vlan-100)# ethernet loopback ethernet 1/1/1
```

The following example configures Ethernet loopback in VLAN-aware mode as flow-aware.

```
device(config)# enable acl-per-port-per-vlan
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ethernet loopback test-mac 1111.2222.3333 4444.5555.5555
device(config-if-e1000-1/1/1)# exit
device(config)# vlan 100
device(config-vlan-100)# ethernet loopback ethernet 1/1/1
```

The following example configures Ethernet loopback in VLAN-aware mode as flow-unaware.

```
device(config)# vlan 100
device(config-vlan-100)# ethernet loopback ethernet 1/1/1
```

The following example configures Ethernet loopback in VLAN-aware mode as flow-unaware on a set of ports.

```
device(config)# vlan 100
device(config-vlan-100)# ethernet loopback ethernet 1/1/1 to 1/1/10
```

Ethernet loopback syslog messages

The syslog messages in the following table are generated when Ethernet loopback is configured or unconfigured.

TABLE 22 Ethernet loopback syslog messages

Event	Syslog output
Ethernet loopback enabled in the VLAN-aware mode	`<14>0d00h56m26s:RUCKUS-6430 PORT: 1/1/7 VLAN 10 enabled for ethernet loop back`
Ethernet loopback disabled in the VLAN-unaware mode	`<14>0d00h56m26s:RUCKUS-6430 PORT: 1/1/7 VLAN N/A enabled for ethernet loop back`

Disabling the automatic learning of MAC addresses

By default, when a packet with an unknown Source MAC address is received on a port, the RUCKUS device learns this MAC address on the port.

You can prevent a physical port from learning MAC addresses by entering the following command.

```
device(config)#interface ethernet 3/1/1
device(config-if-e1000-3/1/1)#mac-learn-disable
```

Syntax: [no] mac-learn disable

Use the no form of the command to allow a physical port to learn MAC addresses.

MAC address learning configuration notes and feature limitations

- This command is not available on virtual routing interfaces. Also, if this command is configured on the LAG interface, MAC address learning will be disabled on all the ports in the LAG.

- Entering the **mac-learn-disable** command on tagged ports disables MAC learning for that port in all VLANs to which that port is a member. For example, if tagged port 3/1/1 is a member of VLAN 10, 20, and 30 and you issue the **mac-learn-disable** command on port 3/1/1, port 3/1/1 will not learn MAC addresses, even if it is a member of VLAN 10, 20, and 30.

Changing the MAC age time and disabling MAC address learning

To change the MAC address age timer, enter a command such as the following.

```
device(config)# mac-age-time 60
```

- On ICX Series devices, you can configure the MAC address age timer to 0 or a value from 60-86400 (seconds). If you set the MAC age time to 0, aging is disabled.
- If the total MAC addresses in the system is more than 16000, RUCKUS recommends a MAC age timer greater than 60 seconds. If the total MAC addresses in the system is more than 64000, RUCKUS recommends a MAC age timer greater than 120 seconds.

  NOTE
  Usually, the actual MAC age time is from one to two times the configured value. For example, if you set the MAC age timer to 60 seconds, learned MAC entries age out after remaining unused for between 60 - 120 seconds. However, if all of the following conditions are met, then the MAC entries age out after a longer than expected duration:
  - The MAC age timer is greater than 630 seconds.
  - The number of MAC entries is over 6000.
  - All MAC entries are learned from the same packet processor.
  - All MAC entries age out at the same time.

Disabling the automatic learning of MAC addresses

By default, when a packet with an unknown Source MAC address is received on a port, the RUCKUS device learns this MAC address on the port.

You can prevent a physical port from learning MAC addresses by entering the following command.

```
device(config)#interface ethernet 3/1/1
device(config-if-e1000-3/1/1)#mac-learn-disable
```

Syntax: [no] mac-learn disable

Use the no form of the command to allow a physical port to learn MAC addresses.

MAC address learning configuration notes and feature limitations

- This command is not available on virtual routing interfaces. Also, if this command is configured on the LAG interface, MAC address learning will be disabled on all the ports in the LAG.
- Entering the **mac-learn-disable** command on tagged ports disables MAC learning for that port in all VLANs to which that port is a member. For example, if tagged port 3/1/1 is a member of VLAN 10, 20, and 30 and you issue the **mac-learn-disable** command on port 3/1/1, port 3/1/1 will not learn MAC addresses, even if it is a member of VLAN 10, 20, and 30.

Displaying the MAC address table

To display the MAC table, enter the show mac-address command.

```
device#show mac-address
Total active entries from all ports = 3
Total static entries from all ports = 1
  MAC-Address     Port      Type    VLAN
0000.0034.1234     15    Static       1
0000.0038.2f24     14   Dynamic       1
0000.0038.2f00     13   Dynamic       1
0000.0086.b159     10   Dynamic       1
```

In the output of the **show mac-address** command, the *Type* column indicates whether the MAC entry is static or dynamic. A static entry is one you create using the **static-mac-address** command. A dynamic entry is one that is learned by the software from network traffic.

> **NOTE**
> The **show mac-address** command output does not include MAC addresses for management ports, since these ports do not support typical MAC learning and MAC-based forwarding.

Clearing MAC address entries

You can remove learned MAC address entries from the MAC address table. The types of MAC address that can be removed are as follows:

- All MAC address entries
- All MAC address entries for a specified Ethernet port
- All MAC address entries for a specified VLAN
- All specified MAC address entry in all VLANs

For example, to remove entries for the MAC address 0000.0080.00d0 in all VLANs, enter the following command at the Privilege EXEC level of the CLI.

```
device#clear mac-address 0000.0080.00d0
```

Syntax: clear mac-address { *mac-address* | **ethernet** *port-num* | **vlan** *vlan-num* }

If you enter **clear mac-address** without any parameter, the software removes all MAC address entries.

Use the mac-address parameter to remove a specific MAC address from all VLANs. Specify the MAC address in the following format: HHHH.HHHH.HHHH.

Use the **ethernet** port-num parameter to remove all MAC addresses for a specific Ethernet port.

Use the *vlan-num* parameter to remove all MAC addresses for a specific VLAN.

Defining MAC address filters

MAC layer filtering enables you to build access lists based on MAC layer headers in the Ethernet/IEEE 802.3 frame. You can filter on the source and destination MAC addresses. The filters apply to incoming traffic only.

You configure MAC address filters globally, then apply them to individual interfaces. To apply MAC address filters to an interface, you add the filters to that interface MAC address filter group.

The device takes the action associated with the first matching filter. If the packet does not match any of the filters in the access list, the default action is to drop the packet. If you want the system to permit traffic by default, you must specifically indicate this by making the last entry in the access list a permit filter. An example is given below.

Syntax: mac filter *last-index-number* **permit any any**

For devices running Layer 3 code, the MAC address filter is applied to all inbound Ethernet packets, including routed traffic. This includes those port associated with a virtual routing interface. However, the filter is not applied to the virtual routing interface. It is applied to the physical port.

When you create a MAC address filter, it takes effect immediately. You do not need to reset the system. However, you do need to save the configuration to flash memory to retain the filters across system resets.

Monitoring MAC address movement

MAC address movement notification allows you to monitor the movement of MAC addresses that migrate from port to port. It enables you to distinguish between legitimate movement and malicious movement by allowing you to define malicious use as a threshold number of times a MAC address moves within a specific interval.

Malicious use typically involves many MAC address moves, while legitimate use usually involves a single move. Malicious movement is often the result of MAC address spoofing, in which a malicious user masquerades as a legitimate user by changing his own MAC address to that of a legitimate user. As a result, the MAC address moves back and forth between the ports where the legitimate and malicious users are connected. A legitimate use might be to spoof the MAC address of a failed device in order to continue access using a different device.

You can monitor MAC address movements in the following ways:

- Threshold-rate notifications allow you to configure the maximum number of movements over a specified interval for each MAC address before a notification is sent. For example you could define the malicious move rate as three moves every 30 seconds.
- Interval-history notifications are best suited for a statistical analysis of the number of MAC address movements for a configured time interval. For example, you may want to find out how many MAC addresses have moved in the system over a given interval or how many times a specific MAC address has moved during that interval. However, it is not possible to get this information for every MAC address if there are a lot of MAC addresses that moved during the interval. Consequently, the number of MAC addresses that can have a recorded history is limited.

  NOTE
  MAC address move notification does not detect MAC movements across an MCT cluster between MCT peers. It only detects MAC movements locally within a cluster MCT peer.

Configuring the MAC address movement threshold rate

To enable notification of MAC address moves, enter the **mac-movement notification threshold-rate** command at the global configuration level. This command enables a corresponding SNMP trap. Notification is triggered when a threshold number of MAC address moves occurs within a specified period for the same MAC address. This command sets the threshold level and the sampling interval.

Avoid threshold rates and sampling intervals that are too small. If you choose a small threshold and a sampling interval that is also small, an unneccessarily high number of traps could occur.

The following example enables notification of MAC address moves and sends an SNMP trap when any MAC address moves to a different port five times in a 10-second interval.

```
device(config)# mac-movement notification threshold-rate 5 sampling-interval 10
```

To disable notification of MAC address moves and disable the SNMP trap, use the **no** form of the command, as shown in the following example.

```
device(config)# no mac-movement notification threshold-rate 5 sampling-interval 10
```

Syntax: [no] mac-movement notification threshold-rate *move-count* **sampling-interval** *interval*

The *move-count* variable indicates the number of times a MAC address can move within the specified period until an SNMP trap is sent. It has no default value.

The *interval* variable specifies the sampling period in seconds. It has no defaut value.

Viewing the MAC address movement threshold rate configuration

To display the configuration of the MAC address movement threshold rate, enter the **show notification mac-movement threshold-rate** command at the privileged EXEC level. This command also displays ongoing statistics for the current sampling interval.

```
device# show notification mac-movement threshold-rate
Threshold-Rate Mac Movement Notification is ENABLED
Configured Threshold-Rate : 5 moves
Configured Sampling-Interval : 30 seconds
Number of entries in the notification table : 100
MAC-Address       from-Port       to-Port      Last Move-Time      Vlan-id
--------------    ---------       -------      --------------      -------
0000.0000.0022      7/1/1         7/2/2        Apr 29 18:29:35       10
0000.0000.0021      7/1/1         7/2/2        Apr 29 18:29:35       10
0000.0000.0020      7/1/1         7/2/2        Apr 29 18:29:35       10
0000.0000.001f      7/1/1         7/2/2        Apr 29 18:29:35       10
(output truncated)
```

Syntax: show notification mac-movement threshold-rate

The following table defines the fields in the output of the **show notification mac-movement threshold-rate** command.

TABLE 23 Field definitions for the show notification mac-movement threshold-rate command

Field	Description
Threshold-Rate Mac Movement Notification is	Specifies whether the MAC movement notification threshold rate is enabled.
Configured Threshold-Rate	The rate in MAC address moves per sampling interval after which a notification is issued. The range is from 1 through 50000.
Configured Sampling-Interval	The sampling interval in seconds over which the number of MAC address moves is measured. The range is from 1 through 86400, which is the number of seconds in a day.
Number of entries in the notification table	One entry for each time a MAC address notification threshold was reached.
MAC-Address	The MAC address that has moved to a different port.
from-Port	The port from which the MAC address moved.
to-Port	The port to which the MAC address moved.
Last Move-Time	The time of the last move occurred. It uses the system up time If there is no time server configured.
Vlan-id	The VLAN for the port where the MAC address movement was detected.

Configuring an interval for collecting MAC address move notifications

To configure an interval for collecting statistical data about MAC address moves, enter the **mac-movement notification interval-history** command at the privileged EXEC level. This command enables a corresponding SNMP trap. This history includes statistical information such as the number of MAC addresses that move over the specified period, the total number of MAC address moves, which MAC addresses have moved, and how many times a MAC address has moved.

The software places an upper limit on the number of MAC addresses for which MAC address-specific data is reported. This limit is necessary to do this because it is not possible to report on all MAC addresses when many move.

The following example configures a history interval of 10 seconds.

```
device(config)# mac-movement notification interval-history 10
```

To disable the feature and the corresponding SNMP trap, enter the **no** version of the command, as shown in the following example.

```
device(config)# no mac-movement notification interval-history 10
```

Syntax: [no] mac-movement notification interval-history *interval*

The interval variable represents the amount of time in seconds during which the MAC address movement notification data is collected. It has no default value.

Viewing MAC address movement statistics for the interval history

To display the collected history of MAC address movement notifications, enter the **show notification mac-movement interval-history** command at the privileged EXEC level. This command displays how the history interval is configured in addition to the MAC address move data itself.

NOTE

The MAC address movement information is also available in the **supportsave** output. If MAC address movement notification is not enabled, the **show notification mac-movement interval-history** command displays a disabled message.

```
device# show notification mac-movement interval-history
Interval-History Mac Movement Notification is ENABLED
Configured Interval : 30 seconds
Number of macs that moved in the interval : 100
Total number of moves in the interval : 98654
MAC-Address     from-Port   to-Port  Interval Move-Count   Last Move-Time    Vlan-id
--------------  ---------   -------  -------------------   --------------    -------
0000.0000.0052    7/1/1     7/1/2          1000            May 15 01:13:20       10
0000.0000.0051    7/1/1     7/1/2          1002            May 15 01:13:20       10
0000.0000.0050    7/1/1     7/1/2          1012            May 15 01:13:20       10
0000.0000.004f    7/1/1     7/1/2          1018            May 15 01:13:20       10
0000.0000.004e    7/1/1     7/1/2          1012            May 15 01:13:20       10
(output truncated)
```

If MAC address movement notification is not enabled, the **show notification mac-movement interval-history** command displays the following output.

```
device# show notification mac-movement interval-history
Interval-History Mac Movement Notification is DISABLED
```

The following table defines the fields in the output of the **show notification mac-movement interval-history** command.

TABLE 24 Field definitions for the show notification mac-movement interval-history command

Field	Description
Interval-History Mac Movement Notification is	Specifies whether the interval-history data collection is enabled.
Configured Interval	The interval over which the MAC address movement statistics were collected.
Number of macs that moved in the interval	The number of MAC addresses that moved during the configured interval, regardless of how many times each address moved.
Total number of moves in the interval	The total number of MAC address moves over the configured interval.
MAC-Address	The MAC address that has moved to a different port.
from-Port	The port from which the MAC address moved.
to-Port	The port to which the MAC address moved.
Interval Move-Count	The number of times the MAC address has moved within the interval.
Last Move-Time	The time the last MAC move occurred. The system uptime is used if there is no time server configured.

TABLE 24 Field definitions for the show notification mac-movement interval-history command (continued)

Field	Description
Vlan-id	The VLAN ID of the port where the MAC address movement was detected.

Overview of 40 Gbps breakout ports

A 40 Gbps breakout cable can be used on ICX 7750 standalone units to break out certain 40 Gbps ports into four 10 Gbps sub-ports.

The 40 Gbps breakout cable is available for use on ICX 7750-48C, ICX 7750-48F, and ICX 7750-26Q models. Stacking cannot be enabled on ICX 7750 units that have breakout configuration on any 40 Gbps ports and any interface-level configuration must be removed from a 40 Gbps port before it can be broken out into sub-ports.

NOTE
Breakout can be configured only when the device is in store-and-forward mode. Breakout is not supported in cut-through mode.

Ports available for breakout are shown for each model in the following table. Refer to the *Ruckus ICX 7750 Switch Hardware Installation Guide* for information on installing breakout cables.

TABLE 25 ICX 7750 ports available for breakout

	ICX 7750-48C	ICX 7750-48F	ICX 7750-26Q
Module 1	N/A	N/A	1/1/5 through 1/1/16 (12 ports)
Module 2	1/2/1 through 1/2/6 (6 ports)	1/2/1 through 1/2/6 (6 ports)	1/2/1 through 1/2/6 (6 ports)
Module 3	1/3/1 through 1/3/6 (6 ports)	1/3/1 through 1/3/6 (6 ports)	1/3/1 through 1/3/6 (6 ports)

Configuring 40 Gbps breakout ports

Use the **breakout ethernet** command to divide available ICX 7750 40 Gbps ports into four 10 Gbps sub-ports when a breakout cable is attached.

By default, all main 40 Gbps ports are configured to come up in 40 Gbps mode. Once ports are cabled for breakout, configure the ports using the **breakout ethernet** command at the global configuration level.

NOTE
You should remove any interface-level configuration before configuring breakout.

NOTE
If the device is in cut-through mode and you attempt to configure breakout, an error is returned. Cut-through must be disabled to return the unit to store-and-forward mode before breakout is configured.

The **breakout ethernet** command first checks for existing configuration on the port. If existing configuration is detected, an error message similar to the following is displayed to indicate that prior configuration must be removed.

```
Device# configure terminal
Device(config)# breakout ethernet 1/1/11
Error: Port 1/1/11 is tagged
```

Once any previous configuration is removed, the **breakout ethernet** command must be reissued. The resulting configuration must be saved, and the unit must then be reloaded before the four 10 Gbps sub-ports are created and accessible.

For example, to configure ports 1/3/1 through 1/3/6 for breakout, issue the following commands:

```
Device# configure terminal
Device(config)# breakout ethernet 1/3/1 to ethernet 1/3/6
```

The following example configures breakout on port 1/1/5. On the first configuration attempt, an error is returned. The interface-level configuration is removed. Then the **write-memory** command is issued, followed by the **reload** command, to successfully configure the port for breakout.

```
Device# configure terminal
Device(config)# breakout ethernet 1/1/5
Error: Port 1/1/5 has sflow forwarding
Device(config)# interface ethernet 1/1/5
Device(config-if-e40000-1/1/5)# no sflow forwarding
Device(config-if-e40000-1/1/5)# end
Device# write memory
Write startup-config done.
Device# configure terminal
Device(config)# breakout ethernet 1/1/5
Reload required.  Please write memory and then reload or power cycle.
Device(config)# write memory
Write startup-config done.
Device(config)# Flash Memory Write (8192 bytes per dot) .
Copy Done.
Device(config)# end
Device# reload
```

Configuring sub-ports

After 40 Gbps ports are successfully configured and activated for breakout, the sub-ports are available for configuration.

NOTE
Sub-port configuration persists only as long as the original 40 Gbps port is configured for breakout. Once breakout is removed and the device is reloaded, the sub-ports and their configuration are also removed.

NOTE
When a breakout cable is removed, the breakout configuration still exists. The user should manually issue the **no breakout** command to change a breakout port to a regular port.

Once a 40 Gbps port is broken out, the configuration is saved (with the **write memory** command), and the unit is reloaded with the updated configuration, four sub-ports are available for detailed configuration.

The sub-ports are configured like any other port; however, special four-tuple notation is required to reference them. Regular ports are identified by three-tuple notation; that is, by three numbers separated by a forward slash to indicate unit, slot, and port. For example 1/2/3 designates unit 1/ slot 2/port 3. To designate sub-ports, you must add a fourth identification number, for example, 1/2/3:4. The four 10 Gbps sub-ports for port 1/2/3 can be represented as 1/2/3:1, 1/2/3:2, 1/2/3:3, and 1/2/3:4.

The following example shows no breakout on port 1/2/4, a 40 Gbps port that is up.

```
device# show interface brief

Port    Link    State   Dupl Speed Trunk Tag Pvid Pri MAC               Name
1/1/1   Down    None    None None  None  No  1    0   cc4e.2439.3700
1/1/2   Down    None    None None  None  No  1    0   cc4e.2439.3701
1/1/3   Down    None    None None  None  No  1    0   cc4e.2439.3702
1/1/4   Down    None    None None  None  No  1    0   cc4e.2439.3703
1/1/5   Down    None    None None  None  No  1    0   cc4e.2439.3704
1/1/6   Down    None    None None  None  No  1    0   cc4e.2439.3708
1/1/7   Down    None    None None  None  No  1    0   cc4e.2439.370c
1/1/8   Down    None    None None  None  No  1    0   cc4e.2439.3710
1/1/9   Down    None    None None  None  No  1    0   cc4e.2439.3714
1/1/10  Down    None    None None  None  No  1    0   cc4e.2439.3718
1/1/11  Down    None    None None  None  No  1    0   cc4e.2439.371c
1/1/12  Down    None    None None  None  No  1    0   cc4e.2439.3720
```

```
1/1/13  Down    None    None None  None  No  1    0   cc4e.2439.3724
1/1/14  Down    None    None None  None  No  1    0   cc4e.2439.3728
1/1/15  Down    None    None None  None  No  1    0   cc4e.2439.372c
1/1/16  Down    None    None None  None  No  1    0   cc4e.2439.3730
1/1/17  Down    None    None None  None  No  1    0   cc4e.2439.3734
1/1/18  Down    None    None None  None  No  1    0   cc4e.2439.3735
1/1/19  Down    None    None None  None  No  1    0   cc4e.2439.3736
1/1/20  Down    None    None None  None  No  1    0   cc4e.2439.3737
1/2/1   Down    None    None None  None  No  1    0   cc4e.2439.3715
1/2/2   Down    None    None None  None  No  1    0   cc4e.2439.3719
1/2/3   Down    None    None None  None  No  1    0   cc4e.2439.371d
1/2/4   Up      Forward Full 40G   None  No  1    0   cc4e.2439.3721
1/2/5   Down    None    None None  None  No  1    0   cc4e.2439.3725
1/2/6   Down    None    None None  None  No  1    0   cc4e.2439.3729
mgmt1   Up      None    Full 1G    None  No  None 0   cc4e.2439.3700
```

The following example breaks out port 1/2/4.

```
device(config)# breakout ethernet 1/2/4
Reload required.  Please write memory and then reload or power cycle.
device(config)# end
device# write memory
Write startup-config done.

device# Flash Memory Write (8192 bytes per dot) .
Copy Done.
device# reload
```

The following example shows that port 1/2/4 has been configured for breakout into four 10 Gbps sub-ports.

```
device# show interface brief

Port    Link    State   Dupl Speed Trunk Tag Pvid Pri MAC             Name
1/1/1   Down    None    None None  None  No  1    0   cc4e.2439.3700
1/1/2   Down    None    None None  None  No  1    0   cc4e.2439.3701
1/1/3   Down    None    None None  None  No  1    0   cc4e.2439.3702
1/1/4   Down    None    None None  None  No  1    0   cc4e.2439.3703
1/1/5   Down    None    None None  None  No  1    0   cc4e.2439.3704
1/1/6   Down    None    None None  None  No  1    0   cc4e.2439.3708
1/1/7   Down    None    None None  None  No  1    0   cc4e.2439.370c
1/1/8   Down    None    None None  None  No  1    0   cc4e.2439.3710
1/1/9   Down    None    None None  None  No  1    0   cc4e.2439.3714
1/1/10  Down    None    None None  None  No  1    0   cc4e.2439.3718
1/1/11  Down    None    None None  None  No  1    0   cc4e.2439.371c
1/1/12  Down    None    None None  None  No  1    0   cc4e.2439.3720
1/1/13  Down    None    None None  None  No  1    0   cc4e.2439.3724
1/1/14  Down    None    None None  None  No  1    0   cc4e.2439.3728
1/1/15  Down    None    None None  None  No  1    0   cc4e.2439.372c
1/1/16  Down    None    None None  None  No  1    0   cc4e.2439.3730
1/1/17  Down    None    None None  None  No  1    0   cc4e.2439.3734
1/1/18  Down    None    None None  None  No  1    0   cc4e.2439.3735
1/1/19  Down    None    None None  None  No  1    0   cc4e.2439.3736
1/1/20  Down    None    None None  None  No  1    0   cc4e.2439.3737
1/2/1   Down    None    None None  None  No  1    0   cc4e.2439.3715
1/2/2   Down    None    None None  None  No  1    0   cc4e.2439.3719
1/2/3   Down    None    None None  None  No  1    0   cc4e.2439.371d
1/2/4:1 Up      Forward Full 10G   None  No  1    0   cc4e.2439.3721
1/2/4:2 Up      Forward Full 10G   None  No  1    0   cc4e.2439.3722
1/2/4:3 Up      Forward Full 10G   None  No  1    0   cc4e.2439.3723
1/2/4:4 Up      Forward Full 10G   None  No  1    0   cc4e.2439.3724
1/2/5   Down    None    None None  None  No  1    0   cc4e.2439.3725
1/2/6   Down    None    None None  None  No  1    0   cc4e.2439.3729
mgmt1   Up      None    Full 1G    None  No  None 0   cc4e.2439.3700
```

The following example configures names for port 1/2/4 sub-ports.

```
device# configure terminal
device(config)# interface ethernet 1/2/4:1
device(config-if-e10000-1/2/2:1)# port-name subport1
device(config-if-e10000-1/2/2:1)# interface ethernet 1/2/4:2
device(config-if-e10000-1/2/2:2)# port-name subport2
```

```
device(config-if-e10000-1/2/2:2)# interface ethernet 1/2/4:3
device(config-if-e10000-1/2/2:3)# port-name subport3
device(config-if-e10000-1/2/2:3)# interface ethernet 1/2/4:4
device(config-if-e10000-1/2/2:4)# port-name subport4
device(config-if-e10000-1/2/2:4)# end
device(config)# end
device# end
```

Displaying information for breakout ports

Use the **show breakout** command to display breakout port status.

The **show breakout** command indicates which ports are configured for breakout and which breakout ports are in operation. The command also displays ports that have been configured for breakout but that are not yet broken out into sub-ports, pending reload.

The following example displays breakout port information for an ICX 7750-48F. Port 1/2/1 is the only port with active sub-ports; however, ports 1/2/2 and 1/2/4 are configured for breakout, pending reload.

```
Device# show breakout
Unit-Id: 1
Port         Module Exist  Module Conf    Breakout-config   Breakout-oper
1/2/1        yes           no             yes               yes
1/2/2        yes           no             yes               no
1/2/3        yes           no             no                no
1/2/4        yes           no             yes               no
1/2/5        yes           no             no                no
1/2/6        yes           no             no                no
1/3/1        yes           no             no                no
1/3/2        yes           no             no                no
1/3/3        yes           no             no                no
1/3/4        yes           no             no                no
1/3/5        yes           no             no                no
1/3/6        yes           no             no                no
```

Removing breakout configuration

Use the **no breakout** command as described to remove 40 Gbps breakout configuration.

Removing 4X10 Gbps sub-ports and restoring the original 40 Gbps port requires the same steps as configuring breakout.

Enter the **no breakout** command for an individual port or port range as shown in the following examples. However, for the restored 40 Gbps port configuration to take effect, you must also execute the **write memory** command and then use the **reload** command to update the unit's configuration.

The following example checks for ports with active breakout configuration and then removes breakout from ports 1/3/1 through 1/3/6.

```
Device# show breakout

Unit-Id: 1

Port       Module Exist    Module Conf     breakout_conf   breakout_oper
1/1/5      Yes             No              Yes             Yes
1/1/6      Yes             No              Yes             Yes
1/1/7      Yes             No              Yes             Yes
1/1/8      Yes             No              Yes             Yes
1/1/9      Yes             No              Yes             Yes
1/1/10     Yes             No              Yes             Yes
1/1/11     Yes             No              Yes             Yes
1/1/12     Yes             No              Yes             Yes
1/1/13     Yes             No              Yes             Yes
1/1/14     Yes             No              Yes             Yes
1/1/15     Yes             No              Yes             Yes
1/1/16     Yes             No              Yes             Yes
1/2/1      Yes             No              Yes             Yes
1/2/2      Yes             No              Yes             Yes
1/2/3      Yes             No              Yes             Yes
1/2/4      Yes             No              Yes             Yes
1/2/5      Yes             No              Yes             Yes
1/2/6      Yes             No              Yes             Yes
1/3/1      Yes             No              Yes             Yes
1/3/2      Yes             No              Yes             Yes
1/3/3      Yes             No              Yes             Yes
1/3/4      Yes             No              Yes             Yes
1/3/5      Yes             No              Yes             Yes
1/3/6      Yes             No              Yes             Yes


Device# configure terminal
Device(config)# no breakout ethernet 1/3/1 to 1/3/6
Reload required.  Please write memory and then reload or power cycle.
Device(config)# write memory
Write startup-config done.

Device(config)# Flash Memory Write (8192 bytes per dot) .
Copy Done.
Device(config)# end
Device# reload
```

NOTE

If there had been any configuration on any sub-ports (1/3/1:1 to 1/3/6:4), the **no breakout** command would have returned an error. The configuration would then have to be removed from the sub-ports before breakout configuration could be removed.

The following example shows a failed attempt to remove breakout from port 1/1/5 as indicated by the error message. Configuration is then removed from sub-port 1/1/5:1 before the breakout configuration is successfully removed.

Once the updated configuration is loaded, the ports are restored as full 40 Gbps ports. The former sub-port configuration is not retained in memory.

```
device(config)# no breakout ethernet 1/1/5
Error: Port 1/1/5:1 is tagged

device(config)# vlan 200
device(config-vlan-200)# no tagged ethernet 1/1/5:1
Deleted tagged port(s) to port-vlan 200.
device(config)# end
device# configure terminal
device(config)# no breakout ethernet 1/1/5
Reload required.  Please write memory and then reload or power cycle.
device(config)# end
device# write memory
Write startup-config done.

device# Flash Memory Write (8192 bytes per dot) .
Copy Done.
```

CLI banner configuration

RUCKUS devices can be configured to display a greeting message on users' terminals when they enter the Privileged EXEC CLI level or access the device through Telnet.

In addition, a RUCKUS device can display a message on the Console when an incoming Telnet CLI session is detected.

Setting a message of the day banner

You can configure the RUCKUS device to display a message on a user terminal when a Telnet CLI session is established.

For example, to display the message "Welcome to ICX!" when a Telnet CLI session is established.

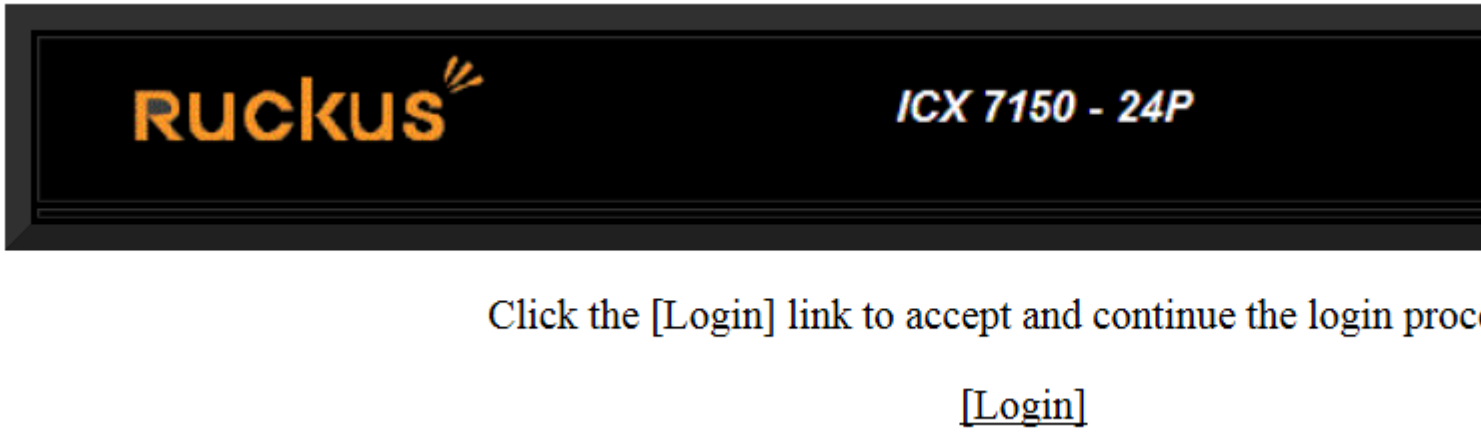
```
device(config)# banner motd $ (Press Return)
Enter TEXT message, End with the character '$'.
Welcome to ICX! $
```

A delimiting character is established on the first line of the banner motd command. You begin and end the message with this delimiting character. The delimiting character can be any character except " (double-quotation mark) and cannot appear in the banner text. In this example, the delimiting character is $ (dollar sign). The text in between the dollar signs is the contents of the banner. The banner text can be up to 4000 characters long, which can consist of multiple lines.

To remove the banner, enter the **no banner motd** command.

NOTE
The **banner** *delimiting-character* command is equivalent to the **banner motd** *delimiting-character* command.

When you access the Web Management Interface, the banner is displayed.



NOTE
If you are using a Web client to view the message of the day, and your banners are very wide, with large borders, you may need to set your PC display resolution to a number greater than the width of your banner. For example, if your banner is 100 characters wide and the display is set to 80 characters, the banner may distort, or wrap, and be difficult to read. If you set your display resolution to 120 characters, the banner will display correctly.

Requiring users to press the Enter key after the message of the day banner

In earlier IronWare software releases, users were required to press the Enter key after the Message of the Day (MOTD) was displayed, prior to logging in to the RUCKUS device on a console or from a Telnet session.

Now, this requirement is disabled by default. Unless configured, users do not have to press Enter after the MOTD banner is displayed.

For example, if the MOTD "Authorized Access Only" is configured, by default, the following messages are displayed when a user tries to access the RUCKUS device from a Telnet session.

```
Authorized Access Only ...
Username:
```

The user can then login to the device.

However, if the requirement to press the **Enter key** is enabled, the following messages are displayed when accessing the switch from Telnet.

```
Authorized Access Only ...
Press <Enter> to accept and continue the login process....
```

The user must press the **Enter key** before the login prompt is displayed.

Also, on the console, the following messages are displayed if the requirement to press the **Enter key** is disabled.

```
Press Enter key to login
Authorized Access Only ...
User Access Verification
Please Enter Login Name:
```

However, if the requirement to press the **Enter key** after a MOTD is enabled, the following messages are displayed when accessing the switch on the console.

```
Press Enter key to login
Authorized Access Only ...
Press <Enter> to accept and continue the login process....
```

The user must press the **Enter key** to continue to the login prompt.

To enable the requirement to press the **Enter key** after the MOTD is displayed, enter a command such as the following.

```
device(config)# banner motd require-enter-key
```

Syntax: **[no] banner motd require-enter-key**

Use the **no** form of the command to disable the requirement.

Setting a privileged EXEC CLI level banner

You can configure the RUCKUS device to display a message when a user enters the Privileged EXEC CLI level.

Example

```
You can configure the Ruckus device to display a message when a user enters the Privileged EXEC CLI level.
```

As with the **banner motd** command, you begin and end the message with a delimiting character; in this example, the delimiting character is #(pound sign). The delimiting character can be any character except " (double-quotation mark) and cannot appear in the banner text. The text in between the pound signs is the contents of the banner. Banner text can be up to 4000 characters, which can consist of multiple lines.

Syntax: **[no] banner exec_mode** *delimiting-character*

To remove the banner, enter the **no banner exec_mode** command.

Automatic execution of commands in batches

The batch and execute functionality provides two separate but mutually inclusive features that help to automate execution of a group of CLI commands in batches at a scheduled time, count, and interval.

The batch process allows you to create and save a group of CLI commands per batch ID using the **batch buffer** command from global configuration mode. The commands added in the batch are saved in the running configuration. The commands that are present at the user EXEC mode, privileged EXEC mode, global configuration mode, and sub-level commands can be added to a batch.

The commands that are saved in the batch buffer are applied on the device only if the **execute batch** command is issued from the privileged EXEC mode. If any of the commands in a batch is invalid or fails, an error is displayed and the other commands in the batch continue to run as per the schedule. The automatic execution of commands in batches helps to collect logs for a defined period.

The execution of command batches can be scheduled in the following ways:

- Now: Runs the commands in a batch immediately. You can also specify the count, interval, or a date and time until which the commands must run. If the interval is not set, the commands will run at the default interval of 30 minutes.
- After: Schedules to run the commands in a batch after a specific duration.
- At: Schedules to run the commands in a batch at a specific time.
- Begin: Schedules to run the commands in a batch starting from the specified start-date. If the count, interval, and end-date are not specified, the commands will run infinitely at the default interval of 30 minutes. You can also specify the count, interval, or a date and time until which the commands must run.

Configuration considerations for creating and running commands in batches

- You can create only up to 4 batches of commands and each batch can have a maximum of 10 commands.
- The following list of commands cannot be issued using the batch process at the privileged EXEC mode:
  - **exit**
  - **ping**
  - **reload**
  - **telnet**
  - **quit**
  - **traceroute**
  - **ssh**
- The following list of commands cannot be issued using the batch process at the global configuration mode:
  - **quit**
  - **relative-utilization**
  - **batch**
- The maximum duration limit that can be configured to start batch buffer execution is 49 days from the current system clock time.
- If multiple commands that perform flash access are added in a batch, it is likely to give an error because the flash operation of the first command will hinder the subsequent command to access flash resulting in the failure of command execution.
- Batches scheduled for execution can be edited. That is, you can add, replace, or remove the commands in the batch buffer. The latest changes will be carried out at the time of batch execution.
- A change in the system date and time does not bear any impact on a batch buffer that is already scheduled for execution.
- The **show running-config** command, if added recursively in the same or multiple batches, will impact optimal utilization of system resources.
- Any command that requires user intervention (for example, providing user credentials) will fail during batch execution.

- At a particular instance, a batch can be scheduled only once.
- A batch buffer cannot be scheduled when the batch execution process for that batch is in progress.
- When a telnet or SSH session executing a batch command is closed, the corresponding batch execution will be cancelled.

Configuring automatic execution of commands in batches

The following steps configure a batch buffer for a set of commands and automatically run the commands saved in the batch buffer at scheduled time.

1. Enter the **configure terminal** command to enter global configuration mode.

```
device# configure terminal
```

2. Enter the **batch buffer** command to create and save a group of CLI commands per batch ID and exit global configuration mode.

```
device(config)# batch buffer 1 &
configure terminal
hostname ruckus &
device(config)# exit
```

   The delimiting character (&) enables an onboard editor on which the list of CLI commands is added. The second occurrence of the delimiting character closes the onboard editor. The commands that are saved in the batch buffer are applied on the device only if the **execute batch** command is issued.

3. (Optional) Enter the **write memory** and **show configuration** command to verify whether the commands added in the batch buffer are saved in the running configuration.

```
device# show configuration
!
!
batch buffer 1 ^C
configure terminal^C
hostname ruckus^C
```

4. (Optional) Enter the **show clock** command to display the system clock. The system date and time must be considered while scheduling the batch execution.

```
device# show clock
03:15:04.599 GMT+00 Tue Dec 22 2015
```

5. Enter the **execute batch** command to issue the commands that are saved in the batch immediately or at a scheduled time, count, and interval.

```
device# execute batch 1 begin 12-22-15 03:20:00 end 12-31-2015 interval days 4
```

6. (Optional) Enter the **show batch schedule** command to view the schedule of the batches and status of execution.

```
device# show batch schedule
Printing the details of Timer
Batch buffer 1 timer is off
Batch buffer 2 timer is off
Batch buffer 3 timer is off
Batch buffer 4 timer is off
Printing Details of Start Timer
Batch buffer 1  start timer will be executed 0 days 0 hours 4 minutes 20 seconds from now
Batch buffer 2 start timer is off
Batch buffer 3 start timer is off
Batch buffer 4 start timer is off
Printing Details of Stop Timer
Batch buffer 1 stop timer will be executed 9 days 20 hours 44 minutes 19 seconds from now
Batch buffer 2 stop timer is off
Batch buffer 3 stop timer is off
Batch buffer 4 stop timer is off
```

CLI command history

CLI commands executed on the device from any console, Telnet, or SSH sessions are stored in the warm memory.

By default, the history list of commands that are executed without any parse errors is persistent and is available after a user-executed reload or unexpected reload. Apart from the user-executed commands, data such as the username, session details, IP address, and time at which the command is executed are also saved in the memory. A maximum of 1024 commands are stored, beyond which the latest commands overwrite the oldest commands. The command log history can be viewed using the **show cli-command-history** command. You can clear the allocated logging memory and remove the command history using the **clear cli-command-history** command.

CLI command history persistence is also supported in a stacking environment. In a stack, only the commands that are executed from an active device are stored in the log and the same commands are sent to the stand-by device. The commands executed by other members of a stack and stand-by devices are not stored.

NOTE
CLI command history persistence is always enabled and cannot be disabled.

NOTE
CLI command history persistence is not related to Syslog.

CLI command history persistence limitations

The following limitations apply to CLI command history persistence:

- The command history data is not retained after a power cycle; but is retained after a soft reboot or unexpected reload.
- The following commands are not stored in the command history:
  - The commands to change the modes such as **enable**, **exit**, and **configure terminal**.
  - Help commands such as "?" and "tab"
  - **username** *name* **password** *password-string*
  - **enable super-user-password**
  - **enable telnet password**
  - **clear cli-command-history**

Displaying and clearing command log history

By default, the CLI commands executed on the device are stored in the memory. The command history persistence is always enabled and cannot be disabled. The following steps allows you to view the command log history and clear the allocated logging memory to remove the command history.

1. Enter the **show cli-command-history** command to display the history list of CLI commands executed on the device.

```
device# show cli-command-history

Slno Session  User-name            Ip-address    Executed-time   Command
   1 console  Un-authenticated user              Jun  2 10:15:54 no crypto-ssl certificate zero*
   2 console  Un-authenticated user              Jun  2 10:15:42 show files
   3 console  Un-authenticated user              Jun  2 10:15:39 show web
   4 console  Un-authenticated user              Jun  2 10:15:36 no web-management http
   5 console  Un-authenticated user              Jun  2 10:15:20 show web
   6 console  Un-authenticated user              Jun  2 10:14:53 write memory
  36 telnet_5 Ruckus              10.70.43.98 Jun  2 09:46:06 show ip
```

2. Enter the **clear cli-command-history** command to clear the allocated logging memory and remove the command log history.

```
device(config)# clear cli-command-history
```

Displaying a console message when an incoming Telnet session is detected

You can configure the RUCKUS device to display a message on the Console when a user establishes a Telnet session.

This message indicates where the user is connecting from and displays a configurable text message.

```
device(config)# banner incoming $ (Press Return)
Enter TEXT message, End with the character '$'.
Incoming Telnet Session!! $
```

When a user connects to the CLI using Telnet, the following message appears on the Console.

```
Telnet from 209.157.22.63
Incoming Telnet Session!!
```

As with the **banner motd** command, you begin and end the message with a delimiting character; in this example, the delimiting character is $(dollar sign). The delimiting character can be any character except " (double-quotation mark) and cannot appear in the banner text. The text in between the dollar signs is the contents of the banner. Banner text can be up to 4000 characters, which can consist of multiple lines.

Syntax: **[no] banner incoming** *delimiting-character*

To remove the banner, enter the **no banner incoming** command.

Cut-through switching

RUCKUS devices operate in cut-through switching mode, meaning it starts forwarding a frame even before the whole frame has been received. The amount of time the device takes to start forwarding the packet (referred to as the switch's latency) is on the order of a few microseconds only, regardless of the packet size. The Table provides the latency details.

TABLE 26 Cut-through latency

Packet size in bytes	10G latency in microseconds (10G to 10G)	40G latency in microseconds(40G to 40G)
64	1.41	1.26

TABLE 26 Cut-through latency (continued)

Packet size in bytes	10G latency in microseconds (10G to 10G)	40G latency in microseconds(40G to 40G)
128	1.47	1.27
256	1.55	1.31
512	1.75	1.36
1024	1.73	1.46
1516	1.73	1.55
5000	1.73	1.66
9212	1.73	1.66

- If there is any over-subscription on the egress port, either due to speed mismatch or network topology, the device will buffer the packets and the forwarding behavior will be similar to store-and-forward mode.
- If an FCS error is determined when the packet is processed by the ingress pipe, it is dropped at the end of the ingress pipe. When an FCS error is determined after the packet transmission to the egress port has begun, it is transmitted with a faulty CRC. When an FCS error is determined during a packet transmission the packet truncated.
- Forwarding from fast speed ports to slower ports is equivalent to store-and-forward (has to be stored first). Forwarding from slower speed ports to faster ports is also equivalent to store-and-forward (to avoid underrun).
- Cut-through switching is not enabled on 1G ports.
- Cut-through minimum packet size is 128 bytes.
- Features that are based on the packet length are not supported since the packet is transmitted before being fully received.

The switching method for packet forwarding can be changed from the default cut-through mode to the store-and-forward mode using the **store-and-forward** command. In the store-and-forward mode, the data packets are not forwarded until the device receives the whole frame and checked its integrity. However, there are many factors to consider when selecting which switching method is best for your environment and in some cases it is desirable to change from the default method and configure a device to store-and-forward.

NOTE
You must save the configuration and reload for the change to take effect.

The **no** form of **store-and-forward** command restores the default packet-forwarding method to cut-through.

The following table describes some of the differences in how packets are handled depending on the switching method.

Feature	Cut-through	Store-and-forward
Forwarding	Data forwarding starts before an entire packet is received	Device waits for entire packet received before processing.
Latency	Low latency, less than 1 micro second.	Higher latency; latency depends on frame size.
FCS Errors	FCS errors may be propagated from one device to another.	FCS errors are checked and error packets are discarded in the MAC receive.
MTU size	MTU size is validated by MAC receive. Oversize packets are marked as error packets but not dropped in the MAC receive.	MTU size is validated by MAC receive. Oversize packets are dropped at the MAC layer.

Jumbo frame support

Ethernet traffic moves in units called frames. The maximum size of frames is called the Maximum Transmission Unit (MTU). When a network device receives a frame larger than its MTU, the data is either fragmented or dropped. Historically, Ethernet has a maximum frame size of 1500 bytes, so most devices use 1500 as their default MTU.

Jumbo frames are Ethernet frames with more than 1,500 bytes MTU. Conventionally, jumbo frames can carry up to 10200 bytes MTU. FastIron devices support Layer 2 jumbo frames on 10/100, 100/100/1000, and 10GbE ports.

ICX 7xxx series devices support Layer 2 jumbo frames on 10/100, 100/100/1000, 40GbE and 10GbE ports. Conventionally, jumbo frames can carry up to 9,000 bytes MTU. In cut-through mode, in jumbo mode, the MTU is 10200 which uses 20 buffers. In non-jumbo mode MTU is 1522 which uses 3 buffers. Support for jumbo frames can be enabled using the **jumbo** command.

Wake-on-LAN support across VLANs

Wake-on-LAN (WOL) is an industry standard technology that allows you to turn on dormant PCs (WOL client) remotely.

The WoL technology makes use of specially formatted network packets (often referred to as a "magic" packet generated through a software utility) that contains the target PC's MAC address to wake up the remote clients. The magic packet is mostly based on UDP and is sent to clients that are enabled to respond to these packets. The WOL technology allows administrators to remotely power on the PC and perform scheduled maintenance tasks even if the user has powered the system down. By remotely triggering the computer to wake up, the administrator does not have to be physically present to perform maintenance tasks on each computer on the network.

The WOL technology works based on the principle that when the PC shuts down, the NIC continues to receive power, and keeps listening on the network for the magic packet to arrive. The magic packet is mostly based on UDP. For example, the utility application software sends a UDP packet on port (7) echo to trigger the wake-up of the remote machine. The client PCs on different subnets/VLANs can be turned on remotely by a WOL server.

ICX devices natively support or switch the magic packets. However, by default, ICX devices do not forward requests for UDP applications to different subnets or VLANs. So, the ICX device must be configured to forward the directed broadcasts for the magic packet to be sent over the sleepy ports using the **ip forward-protocol udp** command.

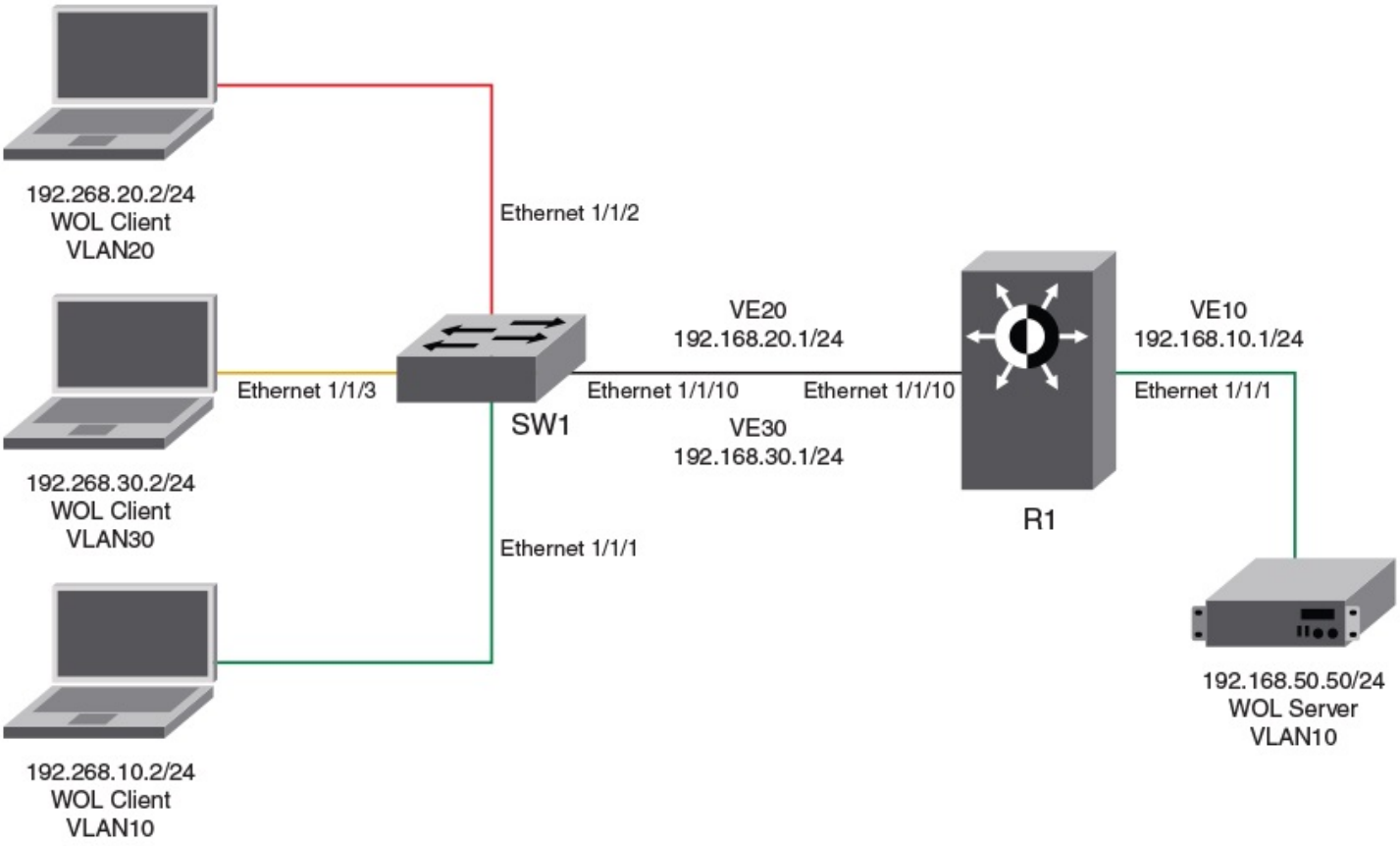
You must also configure a helper address on the VLAN of the WOL server to join the subnet of the desired clients using the **ip helper-address** command. You must specify the broadcast address of each client network as this is the only way to send a packet to a PC that is shut down. Because the PC is asleep, the PC will not respond to ARP requests as it does not own its IP when the PC is down.

Prerequisites

The following checks must be done before deploying WOL across several subnets to wake up the target client PC:

- Check the BIOS settings and ensure that Wake-On-LAN is enabled.
- Check the NIC Advanced Settings and ensure that Magic & Directed Packets are accepted.
- Connect the WOL server and the desktop or laptop client to the same VLAN.
- Invoke Wake Up PC from Software utility

FIGURE 1 Wake-on_LAN Network Diagram



Following is a sample configuration for Wake-On-LAN (WOL) support across different VLANs:

Router (inter-VLAN) configuration:

```
device(config)# vlan 10 name server_vlan  by port
device(config-vlan-10)# tagged ethernet 1/1/10
device(config-vlan-10)# untagged ethernet 1/1/1
device(config-vlan-10)# router-interface ve 10
device(config-vlan-10)# exit
device(config)# vlan 20 name user_vlan  by port
device(config-vlan-20)# tagged ethernet 1/1/10
device(config-vlan-20)# router-interface ve 20
device(config-vlan-20)# exit
device(config)# vlan 30 name user_vlan  by port
device(config-vlan-30)# tagged ethernet 1/1/10
device(config-vlan-30)# router-interface ve 30
device(config-vlan-30)# exit
device(config)# ip forward-protocol udp echo
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ip address 192.168.10.1 255.255.255.0
device(config-if-e1000-1/1/1)# ip helper-address 1 192.168.20.255
device(config-if-e1000-1/1/1)# ip helper-address 2 192.168.30.255
device(config-if-e1000-1/1/1)# interface ve 20
device(config-vif-20)# ip address 192.168.20.1 255.255.255.0
device(config-vif-20)# interface ve 30
device(config-vif-30)# ip address 192.168.30.1 255.255.255.0
```

Switch configuration:

```
device(config)# vlan 10 name server_vlan  by port
device(config-vlan-10)# tagged ethernet 1/1/10
device(config-vlan-10)# untagged ethernet 1/1/1
device(config-vlan-10)#  exit
device(config)# vlan 20 name user_vlan20 by port
device(config-vlan-20)# tagged ethe 1/1/10
device(config-vlan-20)# untagged ethe 1/1/2
device(config-vlan-20)# exit
device(config)# vlan 30 name user_vlan30 by port
device(config-vlan-30)# tagged ethernet 1/1/10
device(config-vlan-30)# untagged ethernet 1/1/3
```

Terminal logging

Many customers do not have a console port connected to the units and therefore cannot monitor any debug or error messages that are shown on the console. For example, in a stacking environment where the console and management port is connected only to an active unit, the user cannot access or monitor any debug or error messages generated on the system from the member units, standby units, or PE units.

Terminal logging, which is enabled by default, captures all the console messages generated on the system to a RAMFS file, and copies the RAMFS file to the flash memory upon certain triggers. Logs from Telnet and SSH sessions are also logged to the file. Each unit in the stack (active, standby, or member unit) has corresponding log files created if terminal logging is enabled. Apart from the console prints which are stored in the ss_console.txt file, terminal logging also logs dmesg output (Linux kernel log) in the kmsg.txt file and copies it to flash memory. The logging files are stored in the /fast_iron/logs folder. The log files copied to the flash memory can be retrieved later using supportsave for offline debugging and analysis.

The following triggers copy both the FastIron terminal logging files and Linux dmesg to the flash memory.

- Booting the system from the primary partition.
- Booting the system from the secondary partition.
- Issuing a reload of the entire stack.
- Issuing a reload of a particular unit (standby, member, or PE).
- FastIron crash
- Watchdog timeout

Terminal logging limitations

The following limitations apply to terminal logging:

- The file size is limited to 10 MB after which the prints wrap over.
- Uboot logs are not logged.
- SIL logs are not logged.
- SIM logs are not logged.
- If the user switches to the OS prompt, then OS logs are not logged.

Enabling terminal logging

Terminal logging is enabled by default. Terminal logging can be disabled or re-enabled manually.

To disable terminal logging, enter the following commands.

```
device# configure terminal
device(config)# no terminal logging
Terminal Logging Feature is now disabled
```

To re-enable terminal logging, enter the following commands.

```
device# configure terminal
device(config)# terminal logging
Terminal Logging Feature is now enabled
```

Network Time Protocol Version 4 (NTPv4)

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Network Time Protocol Version 4 Overview

The NTPv4 feature synchronizes the local system clock in the device with the Coordinated Universal Time (UTC). The synchronization is achieved by maintaining a loop-free timing topology computed as a shortest-path spanning tree rooted on the primary server. NTP does not know about local time zones or daylight-saving time. A time server located anywhere in the world can provide synchronization to a client located anywhere else in the world. It allows clients to use different time zone and daylight-saving properties. Primary servers are synchronized by wire or radio to national standards such as GPS. Timing information is conveyed from primary servers to secondary servers and clients in the network. NTP runs on UDP, which in turn runs on IP.

NTP has a hierarchical structure. NTP uses the concept of a stratum to describe how many NTP hops away a machine is from an authoritative time source. A stratum 1 time server typically has an authoritative time source such as a radio or atomic clock, or a Global Positioning System (GPS) time source directly attached. A stratum 2 time server receives its time through NTP from a stratum 1 time server and so on. As the network introduces timing discrepancies, lower stratum devices are a factor less accurate. A hierarchical structure allows the overhead of providing time to many clients to be shared among many time servers. Not all clients need to obtain time directly from a stratum 1 reference, but can use stratum 2 or 3 references.

NTP operates on a client-server basis. The current implementation runs NTP as a secondary server and/or a NTP Client. As a secondary server, the device operates with one or more upstream servers and one or more downstream servers or clients. A client device synchronizes to one or more upstream servers, but does not provide synchronization to dependant clients. Secondary servers at each lower level are assigned stratum numbers one greater than the preceding level. As stratum number increases, the accuracy decreases. Stratum one is assigned to Primary servers.

NTP uses the concept of associations to describe communication between two machines running NTP. NTP associations are statistically configured. On startup or on the arrival of NTP packets, associations are created. Multiple associations are created by the protocol to communicate with multiple servers. NTP maintains a set of statistics for each of the server or the client it is associated with. The statistics represent measurements of the system clock relative to each server clock separately. NTP then determines the most accurate and reliable candidates to synchronize the system clock. The final clock offset applied for clock adjustment is a statistical average derived from the set of accurate sources.

When multiple sources of time (hardware clock, manual configuration) are available, NTP is always considered to be more authoritative. NTP time overrides the time that is set by any other method.

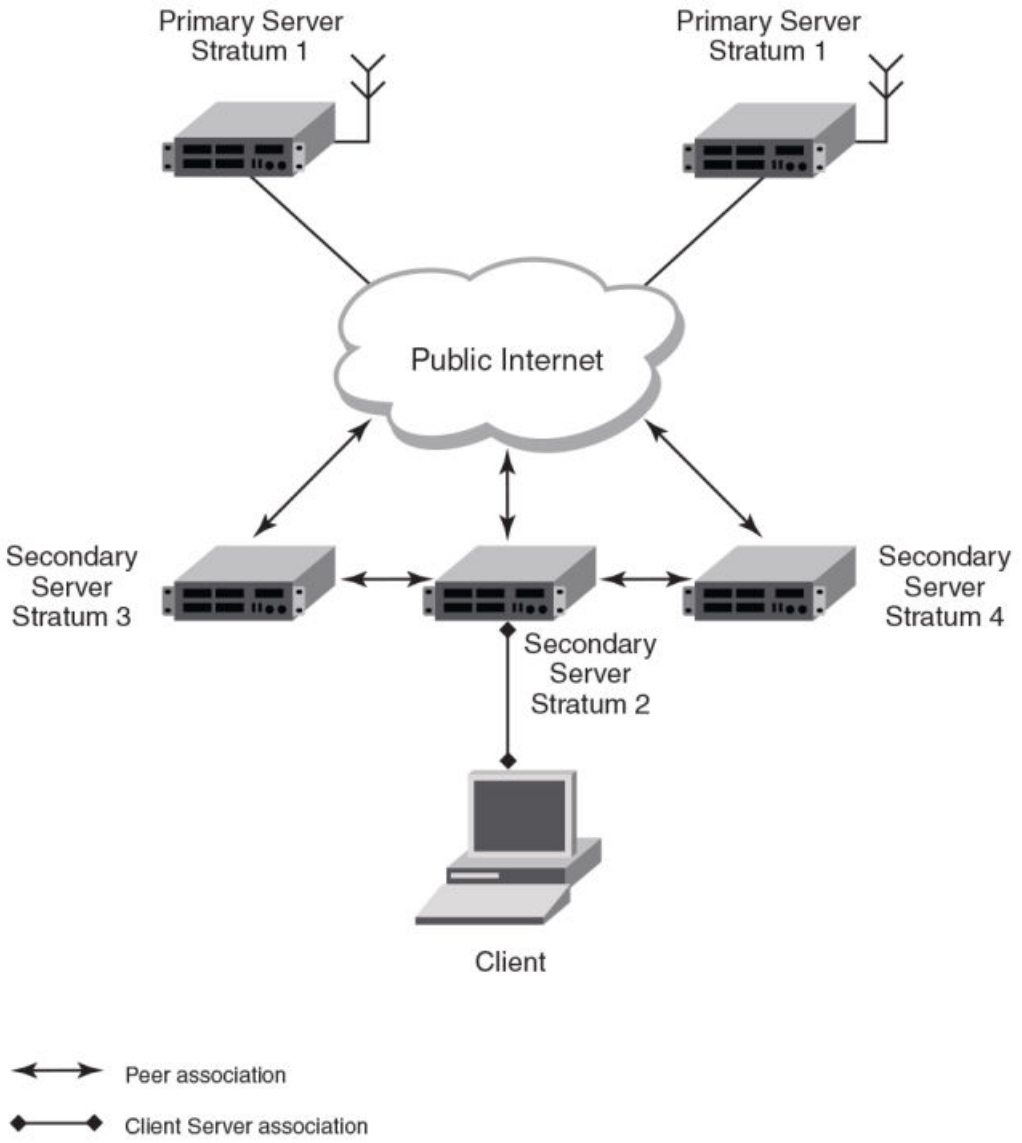
NTPv4 obsoletes NTPv3 (RFC1305) and SNTP (RFC4330). SNTP is a subset of NTPv4. RFC 5905 describes NTPv4.

To keep the time in your network current, it is recommended that each device have its time synchronized with at least four external NTP servers. External NTP servers should be synchronized among themselves to maintain time synchronization.

NOTE

Network Time Protocol (NTP) commands must be configured on each individual device.

FIGURE 2 NTP Hierarchy



- NTP implementation conforms to RFC 5905.
- NTP can be enabled in server and client mode simultaneously.
- The NTP uses UDP port 123 for communicating with NTP servers/peers.
- NTP server and client can communicate using IPv4 or IPv6 address
- NTP implementation supports below association modes.
  - Client
  - Server
  - Symmetric active/passive
  - Broadcast server
  - Broadcast client
- NTP supports maximum of 8 servers and 8 peers. The 8 peers includes statically configured and dynamically learned.

- NTP can operate in authenticate or non-authenticate mode. Only symmetric key authentication is supported.
- By default, NTP operates in default VLAN and it can be changed.

Limitations

- FastIron devices cannot operate as primary time server (or stratum 1). It only serves as secondary time server (stratum 2 to 15).
- NTP server and client cannot communicate using hostnames.
- NTP is not supported on VRF enabled interface.
- Autokey public key authentication is not supported.
- The NTP version 4 Extension fields are not supported. The packets containing the extension fields are discarded.
- The NTP packets having control (6) or private (7) packet mode is not supported. NTP packets with control and private modes will be discarded.
- On reboot or switchover, all the NTP state information will be lost and time synchronization will start fresh.
- NTP multicast server/client and manycast functionalities are not supported.
- NTP versions 1 and 2 are not supported.
- NTP MIB is not supported.

Network Time Protocol leap second

A leap second is a second added to Coordinated Universal Time (UTC) in order to keep it synchronized with astronomical time (UT1).

There are two main reasons that cause leap seconds to occur. The first is that the atomic second defined by comparing cesium clocks to the Ephemeris Time (ET) scale was incorrect, as the duration of the ephemeris second was slightly shorter than the mean solar second and this characteristic was passed along to the atomic second. The second reason for leap seconds is that the speed of the Earth's rotation is not constant. It sometimes speeds up, and sometimes slows down, but when averaged over long intervals the trend indicates that it is gradually slowing. This gradual decrease in the rotational rate is causing the duration of the mean solar second to gradually increase with respect to the atomic second.

Leap seconds are added in order to keep the difference between UTC and astronomical time (UT1) to less than 0.9 seconds. The International Earth Rotation and Reference Systems Service (IERS), measures Earth's rotation and publishes the difference between UT1 and UTC. Usually leap seconds are added when UTC is ahead of UT1 by 0.4 seconds or more.

How RUCKUS supports leap second handling for NTP

The obvious question raised is what happens during the NTP leap second itself.

Specifically, a positive leap second is inserted between second 23:59:59 of a chosen UTC calendar date (the last day of a month, usually June 30 or December 31) and second 00:00:00 of the following date. This extra second is displayed on UTC clocks as 23:59:60. On clocks that display local time tied to UTC, the leap second may be inserted at the end of some other hour (or half-hour or quarter-hour), depending on the local time zone. When ever there is a leap second the NTP server notifies by setting the NTP leap second bits.

On RUCKUS devices when ever there is a negative leap second, the clock is set once second backward of the following date as described here. On positive leap second the clock suppress second 23:59:59 of the last day of a chosen month, so that second 23:59:58 of that date would be followed immediately by second 00:00:00 of the following date.

NTP server

An NTP server provides the correct network time on your device using the Network time protocol (NTP). Network Time Protocol can be used to synchronize the time on devices across a network. An NTP time server is used to obtain the correct time from a time source and adjust the local time in each connecting device.

The NTP server functionality is enabled when you use the **ntp** command.

When the NTP server is enabled, it starts listening on the NTP port for client requests and responds with the reference time. Its Stratum number will be the upstream time server's Stratum + 1. The Stratum 1 NTP server is the time server that is directly attached to the authoritative time source.

The device cannot be configured as primary time server with Stratum 1. It can be configured as secondary time server with Stratum 2 to 15 to serve the time using the local clock.

The NTP server is stateless and does not maintain any NTP client information.

System as an Authoritative NTP Server

The NTP server can operate in master mode to serve time using the local clock, when it has lost synchronization. Serving local clock can be enabled using the master command. In this mode, the NTP server stratum number is set to the configured stratum number. When the master command is configured and the device was never synchronized with an upstream time server and the clock setting is invalid, the server will respond to client's request with the stratum number set to 16. While the device is operating in the master mode and serving the local clock as the reference time, if synchronization with the upstream server takes place it will calibrate the local clock using the NTP time. The stratum number will switch to that of the synchronized source +1. And when synchronization is lost, the device switches back to local clock time with stratum number as specified manually (or the default).

NOTE
Local time and time zone has to be configured before configuring the master command.

- The following scenarios are observed when the master command is not configured and the NTP upstream servers are configured:
- If the synchronization with the NTP server/peer is active, the system clock is synchronized and the reference time is the NTP time.
- If the NTP server/peer is configured but not reachable and if the local clock is valid, the server will respond to client's request with the stratum number set to 16.
- If there is no NTP server/peer configured and if the local clock is valid, the server will respond to client's request with the stratum number set to 16.
- If there is no NTP server/peer configured and if the local clock is invalid, the system clock is not synchronized.

The following scenarios are observed when the master command is configured and the NTP upstream servers are also configured:

- If the synchronization with the time server/peer is active, system clock is synchronized and the reference time is the NTP time.If the NTP server/peer is configured but not reachable, the system clock is synchronized. If the local time is valid then the reference time is the local clock time.
- If the NTP server/peer is not configured, the system clock is synchronized. If the local clock is valid, then the reference time is the local clock time.
- If the NTP server/peer is not configured and the local clock is invalid, system clock is not synchronized.

NOTE
Use the master command with caution. It is very easy to override valid time sources using this command, especially if a low stratum number is configured. Configuring multiple machines in the same network with the master command can cause instability in timekeeping if the machines do not agree on the time.

NTP Client

An NTP client gets time responses from an NTP server or servers, and uses the information to calibrate its clock. This consists of the client determining how far its clock is off and adjusting its time to match that of the server. The maximum error is determined based on the round-trip time for the packet to be received.

The NTP client can be enabled when we enter the **ntp** command and configure one or more NTP servers/peers.

The NTP client maintains the server and peer state information as association. The server and peer association is mobilized at the startup or whenever user configures. The statically configured server/peer associations are not demobilized unless user removes the configuration. The symmetric passive association is mobilized upon arrival of NTP packet from peer which is not statically configured. The associations will be demobilized on error or time-out.

NTP peer

NTP peer mode is intended for configurations where a group of devices operate as mutual backups for each other. If one of the devices loses a reference source, the time values can flow from the surviving peers to all the others. Each device operates with one or more primary reference sources, such as a radio clock, or a subset of reliable NTP secondary servers. When one of the devices lose all reference sources or simply cease operation, the other peers automatically reconfigures so that time values can flow from the surviving peers to others.

When the NTP server or peer is configured with burst mode, client will send burst of up to 8 NTP packets in each polling interval. The burst number of packets in each interval increases as the polling interval increases from minimum polling interval towards maximum interval.

The NTP peer can operate in:

- Symmetric Active-When the peer is configured using the peer command.
- Symmetric Passive-Dynamically learned upon arrival of a NTP packet from the peer which is not configured. The symmetric passive association is removed on timeout or error.

The following scenarios are observed when the upstream server is not reachable after retries:

- If the NTP server/peer is configured and the master command is not configured, then the system clock is synchronized. When the system clock is synchronized, the server will respond to client's request with the stratum number set to +1. And when the system clock is unsynchronized, the server will respond to client's request with the stratum number set to 16.
- If the NTP server/peer is configured and the master command is configured, then the system clock is synchronized. When the system clock is synchronized, the reference time is the local clock time. If the local clock is valid then the server will respond to client's request with the specified stratum number if it is configured otherwise with the default stratum number.

The following scenarios are observed when you remove the last NTP server/peer under the conditions - the NTP server/peer is configured, master command is not configured, system clock is synchronized and the reference time is the NTP time:

- If the local clock is not valid, the system clock is not synchronized.
- If the local clock is valid, the system clock is synchronized and the reference time is the local clock. The server will respond to the client's request with the specified stratum number if it is configured otherwise with the default stratum number.

  NOTE
  To create a symmetric active association when a passive association is already formed, disable NTP, configure peer association and then enable NTP again.

NTP broadcast server

An NTP server can also operate in a broadcast mode. Broadcast servers send periodic time updates to a broadcast address, while multicast servers send periodic updates to a multicast address. Using broadcast packets can greatly reduce the NTP traffic on a network, especially for a network with many NTP clients.

The interfaces should be enabled with NTP broadcasting. The NTP broadcast server broadcasts the

NTP packets periodically (every 64 sec) to subnet broadcast IP address of the configured interface.

- NTP broadcast packets are sent to the configured subnet when the NTP broadcast server is configured on the interface which is up and the IP address is configured for the broadcast subnet under the following conditions:
  - The local clock is valid and the system clock is synchronized
  - The local clock is valid and the system clock is not synchronized
  - Authentication key is configured, the system clock is synchronized and the local clock is valid
- NTP broadcast packets are not sent in the following cases:
  - NTP broadcast server is configured on the interface which is down even if the system clock is synchronized and the local clock is valid.
  - NTP broadcast server is configured on the interface which is up and no IP address is configured for the broadcast subnet even if the system clock is synchronized and the local clock is valid.
  - NTP broadcast server is configured on the interface which is not present and no IP address is configured for the broadcast subnet even if the system clock is synchronized and the local clock is valid.
  - NTP broadcast server without authentication key is configured on the interface which is up and the IP address is configured for the broadcast subnet even when NTP authentication is enforced and the system clock is synchronized and the local clock is valid.

NTP broadcast client

An NTP broadcast client listens for NTP packets on a broadcast address. When the first packet is received, the client attempts to quantify the delay to the server, to better quantify the correct time from later broadcasts. This is accomplished by a series of brief interchanges where the client and server act as a regular (non-broadcast) NTP client and server. Once interchanges occur, the client has an idea of the network delay and thereafter can estimate the time based only on broadcast packets.

NTP associations

Networking devices running NTP can be configured to operate in variety of association modes when synchronizing time with reference time sources. A networking device can obtain time information on a network in two ways-by polling host servers and by listening to NTP broadcasts. That is, there are two types of associations-poll-based and broadcast-based.

NTP poll-based associations

The following modes are the NTP polling based associations:

1. Server mode
2. Client mode

3. Symmetric Active/Passive

   The server mode requires no prior client configuration. The server responds to client mode NTP packets. Use the master command to set the device to operate in server mode when it has lost the synchronization.

   When the system is operating in the client mode, it polls all configured NTP servers and peers. The device selects a host from all the polled NTP servers to synchronize with. Because the relationship that is established in this case is a client-host relationship, the host will not capture or use any time information sent by the local client device. This mode is most suited for file-server and workstation clients that are not required to provide any form of time synchronization to other local clients. Use the server and peer to individually specify the time server that you want the networking device to consider synchronizing with and to set your networking device to operate in the client mode.

   Symmetric active/passive mode is intended for configurations where group devices operate as mutual backups for each other. Each device operates with one or more primary reference sources, such as a radio clock, or a subset of reliable NTP secondary servers. If one of the devices lose all reference sources or simply cease operation, the other peers automatically reconfigures. This helps the flow of time value from the surviving peers to all the others.

   When a networking device is operating in the symmetric active mode, it polls its assigned time-serving hosts for the current time and it responds to polls by its hosts. Because symmetric active mode is a peer-to-peer relationship, the host will also retain time-related information of the local networking device that it is communicating with. When many mutually redundant servers are interconnected via diverse network paths, the symmetric active mode should be used. Most stratum 1 and stratum 2 servers on the Internet adopt the symmetric active form of network setup. The FastIron device operates in symmetric active mode, when the peer information is configured using the peer command and specifying the address of the peer. The peer is also configured in symmetric active mode in this way by specifying the FastIron device information. If the peer is not specifically configured, a symmetric passive association is activated upon arrival of a symmetric active message.

   The specific mode that you should set for each of your networking devices depends primarily on the role that you want them to assume as a timekeeping device (server or client) and the device's proximity to a stratum 1 timekeeping server. A networking device engages in polling when it is operating as a client or a host in the client mode or when it is acting as a peer in the symmetric active mode. An exceedingly large number of ongoing and simultaneous polls on a system can seriously impact the performance of a system or slow the performance of a given network. To avoid having an excessive number of ongoing polls on a network, you should limit the number of direct, peer-to-peer or client-to-server associations. Instead, you should consider using NTP broadcasts to propagate time information within a localized network.

NTP broadcast-based associations

The broadcast-based NTP associations should be used in configurations involving potentially large client population. Broadcast-based NTP associations are also recommended for use on networks that have limited bandwidth, system memory, or CPU resources.

The devices operating in the broadcast server mode broadcasts the NTP packets periodically which can be picked up by the devices operating in broadcast client mode. The broadcast server is configured using the **broadcast** command.

A networking device operating in the broadcast client mode does not engage in any polling. Instead, the device receives the NTP broadcast server packets from the NTP broadcast servers in the same subnet. The NTP broadcast client forms a temporary client association with the NTP broadcast server. A broadcast client is configured using the **broadcast client** command. For broadcast client mode to work, the broadcast server and the clients must be located on the same subnet.

Synchronizing time

After the system peer is chosen, the system time is synchronized based on the time difference with system peer:

- If the time difference with the system peer is 128 msec and < 1000 sec, the system clock is stepped to the system peer reference time and the NTP state information is cleared.

Authentication

The time kept on a machine is a critical resource, so it is highly recommended to use the encrypted authentication mechanism.

The NTP can be configured to provide cryptographic authentication of messages with the clients/peers, and with its upstream time server. Symmetric key scheme is supported for authentication. The scheme uses MD5 keyed hash algorithm.

The authentication can be enabled using the **authenticate** command. The set of symmetric key and key string is specified using the **authentication-key** command.

If authentication is enabled, NTP packets not having a valid MAC address are dropped.

If the NTP server/peer is configured without authentication keys, the NTP request is not sent to the configured server/peer.

NOTE
The same set or subset of key id and key string should be installed on all NTP devices.

VLAN and NTP

When VLAN is configured,

- NTP time servers should be reachable through the interfaces which belong to the configured VLAN. Otherwise, NTP packets are not transmitted. This is applicable to both the unicast and the broadcast server/client.
- NTP broadcast packets are sent only on the interface which belongs to the configured VLAN.
- The received unicast or broadcast NTP packet are dropped if the interface on which packet has been received does not belong to the configured VLAN

Configuring NTP

NTP services are disabled on all interfaces by default.

Before you begin to configure NTP, you must use the clock set command to set the time on your device to within 1000 seconds of the coordinated Universal Time (UTC).

Enabling NTP

To enable NTP, use the **ntp** command in configuration mode. This command enables the NTP client and server mode.

```
device(config)# ntp
device(config-ntp)#
```

Use the **no** form of the command to disable NTP and remove the NTP configuration.

NOTE
The **no ntp** command removes all the configuration configured statistically as well as learned associations from NTP neighbors.

Disabling NTP

To disable the NTP server and client mode, use the **disable** command in NTP configuration mode. Disabling the NTP server or client mode does not remove the configuration.

```
device# configure terminal
device(config)# ntp
device(config-ntp)# disable
```

To enable the client mode, use the **no disable** command. To enable the client and server mode, use the **no disable serve** command.

The keyword **serve** disables NTP server mode. If the keyword **serve** is specified, NTP does not serve the time to downstream devices. In contrast, if the keyword **serve** is not specified, both NTP client and NTP server mode are disabled.

> **NOTE**
> The **no disable** command enables both client and server if the client was already enabled and the server was already disabled at that time the **no disable server** command was entered.

Enabling NTP authentication

To enable Network Time Protocol (NTP) strict authentication, use the **authenticate** command. To disable the function, use the **no** form of this command.

By default, authentication is disabled.

```
device(config-ntp)# [no] authenticate
```

Syntax: [no] authenticate

Defining an authentication key

To define an authentication key for Network Time Protocol (NTP), use the **authentication-key** command. To remove the authentication key for NTP, use the **no** form of this command.

By default, authentication keys are not configured.

```
device(config-ntp)# authentication-key key-id 1 md5 moof
```

Syntax: [no] authentication-key *key-id* [**md5** | **sha1**] *key-string*

The valid key-id parameter is 1 to 65535.

MD5 is the message authentication support that is provided using the Message Digest 5 Algorithm.

The **sha1** keyword specifies that the SHA1 keyed hash algorithm is used for NTP authentication.

> **NOTE**
> If JITC is enabled, only the **sha1** option is available.

The key-string option is the value of the MD5 or SHA1 key. The maximum length of the key string may be defined up to 16 characters. Up to 32 keys may be defined.

Specifying a source interface

When the system sends an NTP packet, the source IP address is normally set to the address of the interface through which the NTP packet is sent. Use the **source-interface** command to configure a specific interface from which the IP source address will be taken. To remove the specified source address, use the no form of this command.

This interface will be used for the source address for all packets sent to all destinations. If a source address is to be used for a specific association, use the source keyword in the peer or server command.

NOTE
If the source-interface is not configured, then the lowest IP address in the outgoing interface will be used in the NTP packets. Source IP address of a tunnel interface is not supported.

```
device(config-ntp)# source-interface ethernet 1/3/1
```

Syntax: [no] source-interface ethernet { *port* | **loopback** *num* | **ve** *num* }

Specify the *port* parameter in the format stack-unit/slotnum/portnum.

The *loopback num* parameter specifies the loopback interface number.

The *ve* num parameter specifies the virtual port number.

Enable or disable the VLAN containment for NTP

To enable or disable the VLAN containment for NTP, use the **access-control vlan** command. To remove the specified NTP VLAN configuration, use the no form of this command.

NOTE
The management interface is not part of any VLAN. When configuring the VLAN containment for NTP, it will not use the management interface to send or receive the NTP packets.

```
device(config-ntp)# access-control vlan 100
```

Syntax: [no] access-control vlan *vlan-id*

The *vlan-id* parameter specifies the VLAN ID number.

Configuring the NTP client

To configure the device in client mode and specify the NTP servers to synchronize the system clock, use the server command. A maximum 8 NTP servers can be configured. To remove the NTP server configuration, use the **no** form of this command.

By default, no servers are configured.

```
device(config-ntp)#server 1.2.3.4 key 1234
```

Syntax: [no] server { *ipv4-address* | *ipv6-address* } [**version** *num*] [**key** *key-id*] [**minpoll** *interval*] [**maxpoll** *interval*] [**burst**]

The *ipv4-address or ipv6-address* parameter is the IP address of the server providing the clock synchronization.

The *version num* option defines the Network Time Protocol (NTP) version number. Valid values are 3 or 4. If the **num** option is not specified, the default is 4.

The *key key-id* option defines the authentication key. By default, no authentication key is configured.

The *minpoll interval* option is the shortest polling interval. The range is from 4 through 17. Default is 6. The interval argument is power of 2 (4=16s, 5=32s, 6=64s, 7=128s, 8=256s, 9=512s, and so on).

The *maxpoll interval* option is the longest polling interval. The range is 4 through 17. Default is 10. The interval argument is calculated by the power of 2 (4=16s, 5=32s, 6=64s, 7=128s, 8=256s, 9=512s, and so on).

The *burst* option sends a burst of packets to the server at each polling interval.

Configuring the master

To configure the FastIron device as a Network Time Protocol (NTP) master clock to which peers synchronize themselves when an external NTP source is not available, use the **master** command. The master clock is disabled by default. To disable the master clock function, use the no form of this command.

NOTE
This command is not effective, if the NTP is enabled in client-only mode.

```
device(config-ntp)# master stratum 5
```

Syntax: [no] master [**stratum** *number*]

The number variable is a number from 2 to 15. It indicates the NTP stratum number that the system will claim.

Configuring the NTP peer

To configure the software clock to synchronize a peer or to be synchronized by a peer, use the peer command. A maximum of 8 NTP peers can be configured. To disable this capability, use the **no** form of this command.

This **peer** command is not effective if the NTP is enabled in client-only mode.

NOTE
If the peer is a member of symmetric passive association, then configuring the **peer** command will fail.

```
device(config-ntp)# peer 1.2.3.4 key 1234
```

Syntax: [no] peer { *ipv4-address* | *ipv6-address* } [**version** *num* [**key** *key-id*] [**minpoll** *interval*] [**maxpoll** *interval*] [**burst**]

The *ipv4-address or ipv6-address* parameter is the IP address of the peer providing the clock synchronization.

The *version num* option defines the Network Time Protocol (NTP) version number. Valid values are 3 and 4. If this option is not specified, then the default is 4.

The *key key-id* option defines the authentication key. By default, no authentication key is configured.

The *minpoll interval* option is the shortest polling interval. The range is from 4 through 17. Default is 6. The interval argument is power of 2 (4=16s, 5=32s, 6=64s, 7=128s, 8=256s, 9=512s, and so on).

The *maxpoll interval* option is the longest polling interval. The range is 4 through 17. Default is 10. The interval argument is calculated by the power of 2 (4=16s, 5=32s, 6=64s, 7=128s, 8=256s, 9=512s, and so on).

The *burst* option sends a burst of packets to the peer at each polling interval.

NOTE
When the NTP server/peer is configured, the **master** command is not configured; on configuring the **clock set** command the system clock is not synchronized. When the **master** command is configured, on configuring the **clock set** command the system clock is synchronized and the reference time will be the local clock.

To have active peers at both the ends, you need to disable NTP, configure the peers and enable the NTP using the **no disable** command.

Configuring NTP on an interface

To configure the NTP interface context, use the **ntp-interface** command. The broadcast server or client is configured on selected interfaces. To remove the NTP broadcast configurations on the specified interface, use the no form of this command.

NOTE

The **ntp-interface** command is a mode change command, and will not be included in to the show run output unless there is configuration below that interface.

```
device(config-ntp)# ntp-interface ethernet 1/2/13
device(config-ntp-if-e1000-1/2/13)# exit
device(config-ntp)# ntp-interface management 1
device(config-ntp-mgmt-1)# exit
device(config-ntp)# ntp-interface ve 100
device(config-ntp-ve-100)#
```

Syntax: [no] ntp-interface { **management 1** | **ethernet** *port* | **ve** *id* }

The *management 1* parameter is the management port 1.

The *ethernet port* parameter specifies the ethernet port number. Specify the port parameter in the format stack-unit/slotnum/portnum.

The *ve id* parameter specifies the virtual port number.

Configuring the broadcast client

To configure a device to receive Network Time Protocol (NTP) broadcast messages on a specified interface, use the broadcast client command. NTP broadcast client can be enabled on maximum of 16 ethernet interfaces. If the interface is operationally down or NTP is disabled, then the NTP broadcast server packets are not received. To disable this capability, use the **no** form of this command.

```
device(config-ntp mgmt-1)# broadcast client
```

Syntax: [no] broadcast client

Configuring the broadcast destination

To configure the options for broadcasting Network Time Protocol (NTP) traffic, use the **ntp broadcast destination** command. The NTP broadcast server can be enabled on maximum 16 ethernet interfaces and four subnet addresses per interface. If the interface is operationally down or there is no ip address configured for the subnet address, then the NTP broadcast server packets are not sent. To disable this capability, use the no form of this command.

By default, the broadcast mode is not enabled.

NOTE

This command is not effective, if the NTP server is disabled.

```
device(config)#int m1
device(config-if-mgmt-1)#ip address 10.20.99.173/24
device(config-if-mgmt-1)#ntp
device(config-ntp)#ntp-interface m1
device(config-ntp -mgmt-1)# broadcast destination 10.20.99.0 key 2
```

Syntax: [no] broadcast destination *ip-address* [**key** *key-id*] [**version** *num*]

The *ip-address* parameter is the IPv4 subnet address of the device to send NTP broadcast messages to.

The *key key-id* option defines the authentication key. By default, no authentication key is configured.

The *version num* option defines the Network Time Protocol (NTP) version number. If this option is not specified, then the default value is 4.

Displaying NTP status

Use the **show ntp status** command to display the NTP status.

```
device#show ntp status
Clock is synchronized, stratum 4, reference clock is 10.20.99.174
precision is 2**-16
reference time is D281713A.80000000 (03:21:29.3653007907 GMT+00 Thu Dec 01 2011)
clock offset is -2.3307 msec, root delay is 24.6646 msec
root dispersion is 130.3376 msec, peer dispersion is 84.3335 msec
system poll interval is 64, last clock update was 26 sec ago
NTP server mode is enabled, NTP client mode is enabled
NTP master mode is disabled, NTP master stratum is 8
NTP is not in panic mode
```

The following table provides descriptions of the **show ntp status** command output.

TABLE 27 NTP status command output descriptions

Field	Description
synchronized	Indicates the system clock is synchronized to NTP server or peer.
stratum	Indicates the stratum number that this system is operating. Range 2..15.
reference	IPv4 address or first 32 bits of the MD5 hash of the IPv6 address of the peer to which clock is synchronized.
precision	Precision of the clock of this system in Hz.
reference time	Reference time stamp.
clock offset	Offset of clock (in milliseconds) to synchronized peer.
root delay	Total delay (in milliseconds) along path to root clock.
root dispersion	Dispersion of root path.
peer dispersion	Dispersion of root path.
system poll interval	Poll interval of the local system.
last update	Time the router last updated its NTP information.
server mode	Status of the NTP server mode for this device.
client mode	Status of the NTP client mode for this device.
master	Status of the master mode.
master stratum	Stratum number that will be used by this device when master is enabled and no upstream time servers are accessible.
panic mode	Status of the panic mode.

Displaying NTP associations

Use the **show ntp associations** command to display detailed association information of the NTP server or peers.

```
device# show ntp associations
address ref clock st when poll reach delay offset disp
*~172.19.69.1 172.24.114.33 3 25 64 3 2.89 0.234 39377
~2001:235::234
INIT 16 - 64 0 0.00 0.000 15937
* synced, # selected, + candidate, - outlayer, x falseticker, ~ configured
```

The following table provides descriptions of the **show ntp associations** command output.

TABLE 28 NTP associations command output descriptions

Field	Description
*	The peer has been declared the system peer and lends its variables to the system variables.
#	This peer is a survivor in the selection algorithm.
+	This peer is a candidate in the combine algorithm.
-	This peer is discarded as outlier in the clustering algorithm.
x	This peer is discarded as 'falseticker' in the selection algorithm.
~	The server or peer is statically configured.
address	IPv4 or IPv6 address of the peer.
ref clock	IPv4 address or first 32 bits of the MD5 hash of the IPv6 address of the peer to which clock is synchronized.
St	Stratum setting for the peer.
when	Time, in seconds, since last NTP packet was received from peer.
poll	Polling interval (seconds).
reach	Peer reachability (bit string, in octal).
delay	Round-trip delay to peer, in milliseconds.
offset	Relative time difference between a peer clock and a local clock, in milliseconds.
disp	Dispersion.

Displaying NTP associations details

Use the **show ntp associations detail** command to display all the NTP servers and peers association information.

```
device# show ntp association detail
2001:1:99:30::1 configured server, sys peer, stratum 3
ref ID 204.235.61.9, time d288dc3b.f2a17891 (10:23:55.4070668433 Pacific Tue Dec 06 2011)
our mode client, peer mode server, our poll intvl 10, peer poll intvl 10,
root delay 0.08551025 msec, root disp 0.09309387, reach 17, root dist 0.17668502
delay 0.69961487 msec, offset -13.49459670 msec, dispersion 17.31550718,
precision 2**-16, version 4
org time d288df70.a91de561 (10:37:36.2837308769 Pacific Tue Dec 06 2011)
rcv time d288df70.a0c8d19e (10:37:36.2697515422 Pacific Tue Dec 06 2011)
xmt time d288df70.a086e4de (10:37:36.2693194974 Pacific Tue Dec 06 2011)
filter delay 1.7736 0.9933 0.8873 0.6699 0.7709 0.7712 0.7734 6.7741
filter offset -17.9936 33.0014 -13.6604 -13.4494 -14.4481 -16.4453 -18.4423 -22.0025
filter disp 15.6660 0.0030 17.7730 17.7700 17.6670 17.6640 17.6610 16.6635
filter epoch 55824 56866 55686 55688 55690 55692 55694 55759
```

Use the **show ntp associations detail** command with the appropriate parameters to display the NTP servers and peers association information for a specific IP address.

```
device# show ntp association detail 1.99.40.1
1.99.40.1 configured server, candidate, stratum 3
ref ID 216.45.57.38, time d288de7d.690ca5c7 (10:33:33.1762436551 Pacific Tue Dec 06 2011)
our mode client, peer mode server, our poll intvl 10, peer poll intvl 10,
root delay 0.02618408 msec, root disp 0.10108947, reach 3, root dist 0.23610585
delay 0.92163588 msec, offset 60.77749188 msec, dispersion 70.33842156,
precision 2**-16, version 4
org time d288defa.b260a71f (10:35:38.2992678687 Pacific Tue Dec 06 2011)
rcv time d288defa.a2efbd41 (10:35:38.2733620545 Pacific Tue Dec 06 2011)
xmt time d288defa.a2ae54f8 (10:35:38.2729334008 Pacific Tue Dec 06 2011)
filter delay 0.000 6.7770 6.7773 6.7711 6.7720 6.7736 6.7700 0.9921
filter offset 0.000 19.0047 19.1145 19.2245 19.3313 17.4410 15.4463 60.7777
filter disp 16000.000 16.0005 15.9975 15.9945 15.9915 15.8885 15.8855 0.0030
filter epoch 55683 55683 55685 55687 55689 55691 55693 56748
```

Syntax: show ntp association detail { *ipv4-address* | *ipv6-address* }

The following table provides descriptions of the **show ntp associations detail** command output.

TABLE 29 NTP associations detail command output descriptions

Field	Description
server	Indicates server is statically configured.
symmetric active peer	Indicates peer is statically configured.
symmetric passive peer	Indicates peer is dynamically configured.
sys_peer	This peer is the system peer
candidate	This peer is chosen as candidate in the combine algorithm.
reject	This peer is rejected by the selection algorithm
falsetick	This peer is dropped as falseticker by the selection algorithm
outlyer	This peer is dropped as outlyer by the clustering algorithm
Stratum	Stratum number
ref ID	IPv4 address or hash of IPv6 address of the upstream time server to which the peer is synchronized.
Time	Last time stamp that the peer received from its master.
our mode	This system's mode relative to peer (active/passive/client/server/bdcast/bdcast client).
peer mode	Mode of peer relative to this system.
our poll intvl	This system's poll interval to this peer.
peer poll intvl	Poll interval of peer to this system
root delay	The delay along path to root (the final stratum 1 time source).
root disp	Dispersion of path to root.
reach peer	The peer reachability (bit string in octal).
Delay	Round-trip delay to peer.
offset	Offset of a peer clock relative to this clock.
Dispersion	Dispersion of a peer clock.
precision	Precision of a peer clock.
version	Peer NTP version number.
org time	Originate time stamp of the last packet.
rcv time	Receive time stamp of the last packet.
xmt time	Transmit time stamp of the last packet.
filter delay	Round-trip delay in milliseconds of last 8 samples.
filter offset	Clock offset in milliseconds of last 8 samples.
filter error	Approximate error of last 8 samples.

Configuration Examples

The following sections list configuration examples to configure the RUCKUS device.

NTP server and client mode configuration

Sample CLI commands to configure the RUCKUS device in NTP server and client modes.

```
device(config-ntp)# server 10.1.2.3 minpoll 5 maxpoll 10
device(config-ntp)# server 11::1/64
device(config-ntp)# peer 10.100.12.18
device(config-ntp)# peer 10.100.12.20
device(config-ntp)# peer 10.100.12.67
device(config-ntp)# peer 10.100.12.83
```

NTP client mode configuration

Sample CLI commands to configure the RUCKUS device in NTP client mode.

```
device(config-ntp)# server 10.1.2.3 minpoll 5 maxpoll 10
device(config-ntp)# server 11::1/24
device(config-ntp)# peer 10.100.12.83
device(config-ntp)# disable serve
```

NTP strict authentication configuration

Sample CLI commands to configure the RUCKUS device in strict authentication mode.

```
device(config-ntp)# authenticate
device(config-ntp)# authentication-key key-id 1 md5 key123
device(config-ntp)# server 10.1.2.4 key 1
```

NTP loose authentication configuration

Sample CLI commands to configure the RUCKUS device in loose authentication mode. This allows some of the servers or clients to use the authentication keys.

```
device(config-ntp)# authentication-key key-id 1 md5 key123
device(config-ntp)# server 10.1.2.4 key 1
device(config-ntp)# server 10.1.2.7
```

NTP interface context for the broadcast server or client mode

Sample CLI commands to enter the NTP interface context.

```
device(config)#int management 1
device(config-if-mgmt-1)#ip address 10.20.99.173/24
device(config-if-mgmt-1)#ntp
device(config-ntp)# ntp-interface management 1
device(config-ntp-mgmt-1)# broadcast destination 10.23.45.128
device(config-ntp)# ntp-interface ethernet 1/1/3
device(config-ntp-if-e1000-1/1/3)# broadcast destination 10.1.1.0 key 1
device(config-ntp)# ntp-interface ve 100
device(config-ntp-ve-100)# broadcast destination 10.2.2.0 key 23
```

NTP broadcast client configuration

Sample CLI commands to configure the NTP broadcast client.

```
device(config-ntp)# ntp-interface management 1
device(config-ntp-mgmt-1)# broadcast client
device(config-ntp)# ntp-interface ethernet 1/1/5
device(config-ntp-if-e1000-1/1/5)# broadcast client
```

```
device(config-ntp)# ntp-interface ve 100
device(config-ntp-ve-100)# broadcast client
```

NTP over management VRF

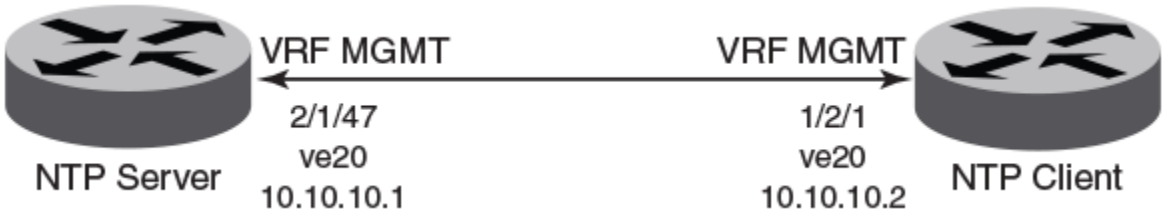
Network Time Protocol (NTP) traffic can be segregated from network traffic using the management VRF.

VRF (Virtual Routing and Forwarding) is a technology that divides network traffic into different logical VRF domains. Using VRF, multiple routing tables and Forwarding Tables (FTs) can exist in one routing device with one routing table for each VRF instance. A VRF-capable router can function as a group of multiple virtual routers on the same physical router. VRF, in conjunction with virtual private network (VPN) solutions, guarantees privacy of information and isolation of traffic within a logical VRF domain.

When NTP is configured over Management VRF, the NTP traffic is routed through Management VRF. NTP over Management VRF is used to provide secure management access to the device by sending outbound NTP traffic through the VRF specified as a global management VRF and this isolates NTP traffic from the network data traffic.

The following diagrams illustrate some potential use case scenarios for NTP over Management VRF:

FIGURE 3 Use case 1: Management VRF forwarding with one client and one server on ve



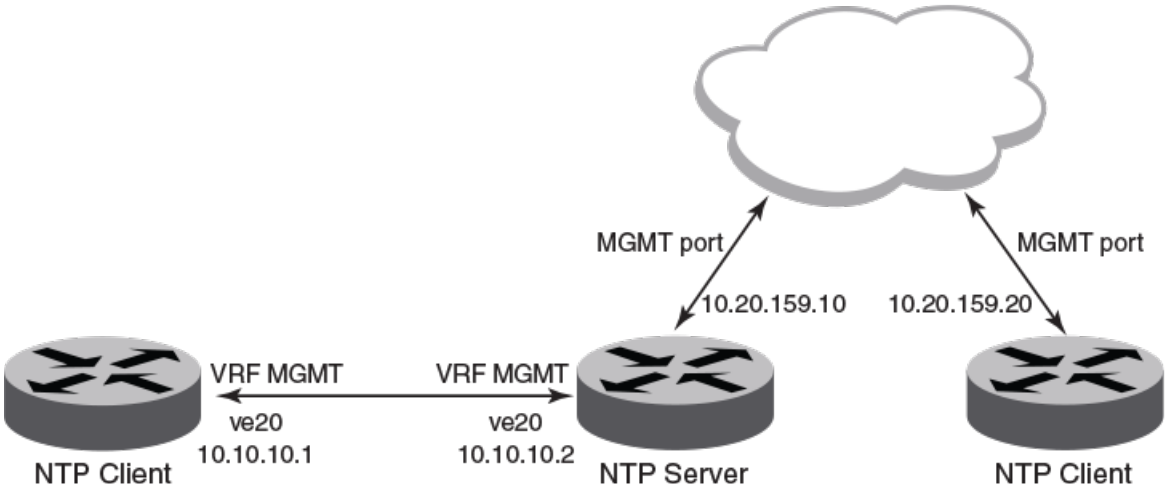
In this scenario, NTP over Management VRF is implemented on both an NTP server and an NTP client device using virtual Ethernet (VE) interfaces.

FIGURE 4 Use case 2: NTP server over Management VRF with one client using Management VRF and another client using Ethernet



In this scenario, the NTP server has one client using Management VRF and one client using an Ethernet port.

FIGURE 5 Use case 3: NTP server over Management VRF with one client on Management VRF and one client on Management port



In this scenario, the NTP server has one client using Management VRF and one client on a management port.

NTP over Management VRF limitations

Some limitations exist when running Network Time Protocol (NTP) over a management VRF.

Be aware of the following limitations before implementing NTP over a management VRF.

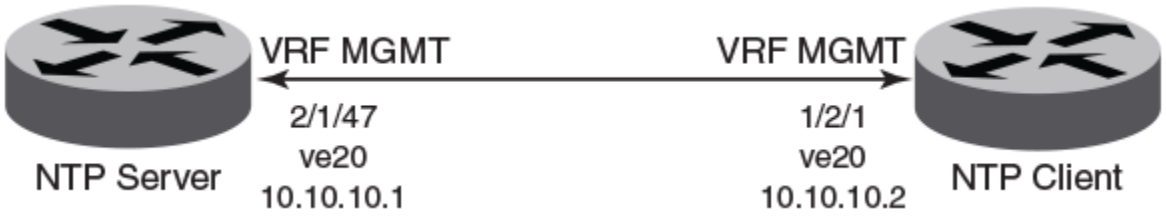
- The communication channel between the NTP client and server is through the InBand data port only. An Out-Of-Band (OOB) management port is not supported.
- One external NTP server must exist to synchronize an NTP client with an NTP server.
- If you configure NTP in a VRF, ensure that the NTP server and clients can reach each other through the configured VRFs.
- A source interface must be configured to support the management VRF.
- Management VRF for NTP broadcast clients are supported only on one interface, using the **source-interface** command, because the outgoing port is determined by the routing table.
- Management VRF for peers is supported only on “symmetric active” not on "symmetric passive" NTP association modes because the Management VRF is related to the NTP **source-interface** command.

Configuring NTP over management VRF on an NTP server

To implement NTP over Management VRF, a Network Time Protocol (NTP) server device must be configured to communicate with NTP client devices.

A Virtual Routing and Forwarding (VRF) instance named MGMT must be configured. The example after the task steps displays this configuration.

NTP over management VRF allows NTP traffic to be isolated from network traffic. In this task, the following diagram represents the use case. An NTP server is configured to run NTP over Management VRF with just one client and running over Virtual Ethernet (VE) interfaces.



1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure a port-based VLAN and enter VLAN configuration mode.

```
device(config)# vlan 10 by port
```

3. Add an untagged port to the VLAN.

```
device(config-vlan-10)# untagged ethernet 2/1/47
```

4. Attach a router interface to VE interface 20.

```
device(config-vlan-10)# router-interface ve 20
```

5. Exit to global configuration mode.

```
device(config-vlan-10)# exit
```

6. Configures the VRF named mgmt as a global management VRF.

```
device(config)# management-vrf MGMT
```

7. Enters virtual interface mode for interface ve 20.

```
device(config)# interface ve 20
```

8. Configure the VRF named mgmt as a forwarding VRF.

```
device(config-if-ve-20)# vrf forwarding MGMT
```

9. Configure an IP address on the interface.

```
device(config-if-ve-20)# ip address 10.10.10.1 255.255.255.0
```

10. Exit to global configuration mode.

```
device(config-if-ve-20)# exit
```

11. Enables the Network Time Protocol (NTP) client and server mode.

```
device(config)# ntp
```

12. Configures the device as an NTP master clock to which peers synchronize themselves when an external NTP source is not available.

```
device(config-ntp)# master
```

The following example configures NTP over management VRF on an NTP server including the initial VRF configuration.

```
configure terminal
 vrf MGMT
  rd 3:3
  address-family ipv4
   ip route 0.0.0.0/0 10.10.10.1
   exit-address-family
  exit-vrf
 vlan 10 by port
  untagged ethernet 2/1/47
  router-interface ve 20
  exit
 management-vrf MGMT
 interface ve 20
  vrf forwarding MGMT
  ip address 10.10.10.1 255.255.255.0
  exit
 ntp
  master
```

After configuring the NTP server, configure the NTP client devices.

Configuring NTP over management VRF on an NTP client

To implement NTP over Management VRF, an Network Time Protocol (NTP) client device must be configured to communicate with an NTP server device.

A Virtual Routing and Forwarding (VRF) instance named mgmt must be configured. The example after the task steps displays this configuration.

NTP over management VRF allows NTP traffic to be isolated from network traffic. In this task, the following diagram represents the use case. An NTP client is configured to run NTP over Management VRF and communicate with an NTP server device. Configure this task with appropriate interface modifications on all other NTP clients that are to communicate with the NTP server.



1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure a port-based VLAN and enter VLAN configuration mode.

```
device(config)# vlan 10 by port
```

3. Add an untagged port to the VLAN.

```
device(config-vlan-10)# untagged ethernet 1/2/1
```

4. Attach a router interface to virtual ethernet (ve) interface 20.

```
device(config-vlan-10)# router-interface ve 20
```

5. Exit to global configuration mode.

```
device(config-vlan-10)# exit
```

6. Configures the VRF named mgm as a global management VRF.

```
device(config)# management-vrf mgmt
```

7. Enters virtual interface mode for interface ve 20.

```
device(config)# interface ve 20
```

8. Configure the VRF named mgmt as a forwarding VRF.

```
device(config-if-ve-20)# vrf forwarding mgmt
```

9. Configure an IP address on the interface.

```
device(config-if-ve-20)# ip address 10.10.10.2 255.255.255.0
```

10. Exit to global configuration mode.

```
device(config-if-ve-20)# exit
```

11. Enables the Network Time Protocol (NTP) client and server mode.

```
device(config)# ntp
```

12. Identifies the source interface for the NTP server.

```
device(config-ntp)# source-interface ve 20
```

13. Identifies the IP address of the VE interface through which the management VRF is running.

```
device(config-ntp)# server 10.10.10.1
```

The following example configures NTP over management VRF on an NTP client including the initial VRF configuration.

```
configure terminal
 vrf mgmt
  rd 3:3
  address-family ipv4
   ip route 0.0.0.0/0 10.10.10.2
   exit-address-family
  exit-vrf
 vlan 10 by port
  untagged ethernet 1/2/1
  router-interface ve 20
  exit
 management-vrf mgmt
 interface ve 20
  vrf forwarding mgmt
  ip address 10.10.10.2 255.255.255.0
  exit
 ntp
  source-interface ve 20
  server 10.10.10.1
```

Configuration example for NTP over management VRF using IPv6

NTP over management VRF configuration supports IPv6 addresses.

NTP over management VRF allows NTP traffic to be isolated from network traffic. Configuration must be performed on one NTP server device and one or more NTP client devices.

NTP Server

The following example configures NTP over management VRF on an NTP server. This configuration uses IPv6 addressing.

```
vrf mgmt_ipv6
 rd 3:3
 address-family ipv6
 ip route 0:0::0:0/0 10:10:10:1
 exit-address-family
exit-vrf
interface ethernet 1/2/1
 vrf forwarding mgmt_ipv6
 ipv6 address 10:10::10:2/64
 exit
management-vrf mgmt_ipv6
ntp
 master
```

NTP Client

The following example configures NTP over management VRF on an NTP client. This configuration uses IPv6 addressing.

```
vrf mgmt_ipv6
 rd 3:3
 address-family ipv6
 ip route 0:0::0:0/0 10:10:10:2
 exit-address-family
exit-vrf
interface ethernet 2/1/47
 vrf forwarding mgmt_ipv6
 ipv6 address 10:10::10:1/64
 exit
management-vrf mgmt_ipv6
ntp
 source-interface ethernet 2/1/47
 server 10:10::10:2
```

Cisco Discovery Protocol

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Cisco Discovery Protocol overview

Using multicast announcements to share information about Cisco devices, Cisco Discovery Protocol (CDP) is a proprietary Layer 2 protocol that is equivalent to the RUCKUS protocol Foundry Discovery Protocol (FDP).

Cisco Discovery Protocol (CDP) packets are used by Cisco devices to advertise themselves to other Cisco devices. By default, RUCKUS devices forward these packets without examining their contents. You can configure a RUCKUS device to intercept and display the contents of CDP packets. This feature is useful for learning device and interface information for Cisco devices in the network.

RUCKUS devices support intercepting and interpreting CDP version 1 and CDP version 2 packets.

NOTE
The RUCKUS device can interpret only the information fields that are common to both CDP version 1 and CDP version 2.

NOTE
When you enable interception of CDP packets, the RUCKUS device drops the packets. As a result, Cisco devices will no longer receive the packets.

CDP support was replaced with the IEEE 802.1AB standard Link Layer Discovery Protocol (LLDP) that is implemented by multiple vendors and is functionally similar to CDP. It is used to share information about other directly connected Cisco equipment, such as the operating system version and IP address. CDP can also be used for On-Demand Routing, which is a method of including routing information in CDP announcements so that dynamic routing protocols do not need to be used in simple networks.

Enabling CDP packet interception

A RUCKUS device can be enabled to intercept and display Cisco Discovery Protocol (CDP) packets.

CDP packet interception is disabled by default on all interfaces. CDP packet interception can be enabled globally to apply to all interfaces. If CDP packet interception is to be disabled for an individual interface, the configuration is applied in interface configuration mode. This task shows how to enable CDP globally, disable CDP on one interface and reenable CDP on the interface.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Globally enable CDP packet interception.

```
device(config)# cdp run
```

3. Enter interface configuration mode.

```
device(config)# interface ethernet 1/1/2
```

4. Disable CDP packet interception on Ethernet interface 1/1/2.

```
device(config-if-e1000-1/1/2)# no cdp enable
```

5. Reenable CDP packet interception on Ethernet interface 1/1/2.

```
device(config-if-e1000-1/1/2)# cdp enable
```

The following example enables CDP packet interception globally and disables CDP packet interception on Ethernet interface 1/1/2.

```
device# configure terminal
device(config)# cdp run
device(config)# interface ethernet 1/1/2
device(config-if-e1000-1/1/2)# no cdp enable
```

Displaying CDP packet information

After enabling CDP packet interception, you can view CDP packet information.

Ensure that CDP has been enabled.

You can display the following CDP information:

- Cisco neighbors
- CDP entries for all Cisco neighbors or a specific neighbor
- CDP packet statistics

NOTE
The commands used to display CDP information are the same as those used to display FDP information. In the following steps we are only displaying CDP information that a RUCKUS device has intercepted. You will normally see Foundry Discovery Protocol (FDP) information in addition to CDP information.

1. To display CDP entries for all neighbors, enter the following command:

```
device# show fdp entry *

Device ID: Router
Entry address(es):
  IP address: 10.95.6.143
Platform: cisco RSP4,  Capabilities: Router
Interface: Eth 1/1/2,  Port ID (outgoing port): FastEthernet5/0/0
Holdtime : 124 seconds
Version :
Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-JSV-M), Version 12.0(5)T1,  RELEASE SOFTWARE
(fc1)
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 19-Aug-99 04:12 by cmong
```

2. To display CDP entries for a specific device, specify the device ID.

```
device# show fdp entry Router1

Device ID: Router1
Entry address(es):
  IP address: 10.95.6.143
Platform: cisco RSP4,  Capabilities: Router
Interface: Eth 1/1/2,  Port ID (outgoing port): FastEthernet5/0/0
Holdtime : 156 seconds
Version :
Cisco Internetwork Operating System Software
IOS (tm) RSP Software (RSP-JSV-M), Version 12.0(5)T1,  RELEASE SOFTWARE
(fc1)
Copyright (c) 1986-1999 by cisco Systems, Inc.
Compiled Thu 19-Aug-99 04:12 by cmong
```

3. To display CDP packet statistics, enter the following command:

```
device# show fdp traffic

CDP counters:
  Total packets output: 0, Input: 3
  Hdr syntax: 0, Chksum error: 0, Encaps failed: 0
  No memory: 0, Invalid packet: 0, Fragmented: 0
```

Clearing CDP statistics and neighbor information

Cisco Discovery Protocol (CDP) update information and statistics can be cleared.

Before clearing CDP information ensure that CDP is enabled.

You can clear the following CDP information:

- Information received in CDP updates
- CDP statistics

NOTE
The same commands clear information for both FDP and CDP.

1. To clear the information received in CDP updates from neighboring devices, enter the following command:

```
device# clear fdp table
```

2. To clear CDP statistics, enter the following command:

```
device# clear fdp counters
```

Foundry Discovery Protocol

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Foundry Discovery Protocol overview

The Foundry Discovery Protocol (FDP) enables RUCKUS devices to advertise themselves to other RUCKUS devices on the network. When you enable FDP on a RUCKUS device, the device periodically advertises information including the following:

- Hostname (device ID)
- Product platform and capability
- Software version
- VLAN and Layer 3 protocol address information for the port sending the update. IP information is supported.

NOTE
FDP is not supported on port extender (PE) ports.

A RUCKUS device running FDP sends FDP updates on Layer 2 to MAC address 00-00-00-CC-CC-CC. Other RUCKUS devices listening on that address receive the updates and can display the information in the updates. RUCKUS devices can send and receive FDP updates on ethernet interfaces.

FDP is disabled by default.

NOTE
If FDP is not enabled on a RUCKUS device that receives an FDP update or the device is running a software release that does not support FDP, the update passes through the device at Layer 2.

Enabling FDP

A RUCKUS device can be enabled to send FDP packets.

FDP is disabled by default on all interfaces. FDP can be enabled globally to apply to all interfaces. If FDP is to be disabled for an individual interface, the configuration is applied in interface configuration mode. This task shows how to enable FDP globally, set some optional FDP parameters, disable FDP on one interface and reenable FDP on the interface.

NOTE
FDP is not supported on port extender (PE) ports.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Globally enable FDP.

```
device(config)# fdp run
```

3. Change the FDP update timer to send an FDP update every 120 seconds.

```
device(config)# fdp timer 120
```

   By default, FDP sends an update every 60 seconds.

4. Change the FDP hold time to 360 seconds.

```
device(config)# fdp holdtime 360
```

   By default, the FDP hold time is 180 seconds.

5. Enter interface configuration mode.

```
device(config)# interface ethernet 1/1/4
```

6. Disable FDP on Ethernet interface 1/1/4.

```
device(config-if-e1000-1/1/4)# no fdp enable
```

7. Reenable FDP on Ethernet interface 1/1/4.

```
device(config-if-e1000-1/1/4)# fdp enable
```

The following example enables FDP globally and sets the FDP timer and hold time. FDP is disabled on Ethernet interface 1/1/4.

```
device# configure terminal
device(config)# fdp run
device(config)# fdp timer 120
device(config)# fdp holdtime 360
device(config)# interface ethernet 1/1/4
device(config-if-e1000-1/1/4)# no fdp enable
```

The following example enables FDP globally and sets the FDP timer and hold time. FDP is disabled on Ethernet interface 1/4.

```
device# configure terminal
device(config)# fdp run
device(config)# fdp timer 120
device(config)# fdp holdtime 360
device(config)# interface ethernet 1/4
device(config-if-e1000-1/4)# no fdp enable
```

Verifying FDP

After enabling FDP you can verify the configuration and view FDP information.

Ensure that FDP has been enabled.

You can display the following Foundry Discovery Protocol (FDP) information:

- FDP entries for RUCKUS neighbors
- Individual FDP entries
- FDP information for an interface on the device you are managing
- FDP packet statistics

NOTE

Foundry Discovery Protocol (FDP) packets are blocked at PE interfaces, even when FDP pass-through is configured. However, the packets are still forwarded upstream for processing in the CB. Although FDP neighbors can be displayed within the Campus Fabric domain, for example, with the **show fdp neighbor** command, no FDP packets are forwarded to non-SPX devices (that is, to devices that are connected to PEs but that are not part of the Campus Fabric domain).

NOTE

If the RUCKUS device has intercepted CDP updates, then the CDP information is also displayed.

1. To display a summary list of all the RUCKUS neighbors that have sent FDP updates to this RUCKUS device enter the following command:

```
device# show fdp neighbors

Capability Codes: R - Router, T - Trans Bridge, B - Source Route Bridge
                  S - Switch, H - Host, I - IGMP, r - Repeater
(*) indicates a CDP device
   Device ID      Local Int    Holdtm Capability Platform     Port ID
   -------------- ------------ ------ ---------- ------------ ----------
   deviceB        Eth 1/2/9    178    Router     FastIron Rou Eth 1/2/9
```

2. To display detailed information about all the RUCKUS neighbors that have sent FDP updates to this RUCKUS device enter the following command:

```
device# show fdp neighbors detail

Device ID: FastIronB configured as default VLAN1, tag-type8100
Entry address(es):
  IP address: 192.168.0.13
  IPv6 address (Global): c:a:f:e:c:a:f:e
Platform: FastIron Router,  Capabilities: Router
Interface: Eth 1/2/9
Port ID (outgoing port): Eth 1/2/9 is TAGGED in following VLAN(s):
 9 10 11
Holdtime : 176 seconds
Version :
Foundry, Inc. Router, IronWare Version 07.6.01b1T53 Compiled on Aug 29
2002 at 10:35:21 labeled as B2R07601b1
```

3. To display detailed FDP entry information for a specific RUCKUS neighbor device, enter the following command:

```
device# show fdp entry FastIronB

Device ID: FastIronB configured as default VLAN1, tag-type8100
Entry address(es):
Platform: FastIron Router,  Capabilities: Router
Interface: Eth 1/2/9
Port ID (outgoing port): Eth 1/2/9 is TAGGED in following VLAN(s):
 9 10 11
Holdtime : 176 seconds
Version :
Foundry, Inc. Router, IronWare Version 07.6.01b1T53 Compiled on Aug 29
2002 at 10:35:21 labeled as B2R07601b1
```

4. To display FDP information for a specific Ethernet interface, enter the following:

```
device# show fdp interface ethernet 1/2/3

FastEthernet1/2/3 is up, line protocol is up
  Encapsulation ethernet
  Sending FDP packets every 5 seconds
  Holdtime is 180 seconds
```

This example shows information for a specific Ethernet interface indicating how often the port sends FDP updates and how long neighbors that receive the updates, can hold them before discarding them.

5. To display FDP and CDP packet statistics, enter the following command:

```
device# show fdp traffic

CDP/FDP counters:
  Total packets output: 6, Input: 5
  Hdr syntax: 0, Chksum error: 0, Encaps failed: 0
  No memory: 0, Invalid packet: 0, Fragmented: 0
  Internal errors: 0
```

Clearing FDP statistics and neighbor information

FDP update information and statistics can be cleared.

Before clearing FDP information ensure that FDP is enabled.

You can clear the following FDP and CDP information:

- Information received in FDP and CDP updates
- FDP and CDP statistics

NOTE
The same commands clear information for both FDP and CDP.

1. To clear the information received in FDP updates from neighboring devices, enter the following command:

```
device# clear fdp table
```

2. To clear FDP and CDP statistics, enter the following command:

```
device# clear fdp counters
```

LLDP and LLDP-MED

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LLDP terms used in this chapter

Endpoint device - An LLDP-MED device located at the network edge, that provides some aspect of IP communications service based on IEEE 802 LAN technology. An Endpoint device is classified in one of three class types (I, II, or III) and can be an IP telephone, softphone, VoIP gateway, or conference bridge, among others.

Link Layer discovery protocol (LLDP) - The Layer 2 network discovery protocol described in the IEEE 802.1AB standard, *Station and Media Access Control Connectivity Discovery*. This protocol enables a station to advertise its capabilities to, and to discover, other LLDP-enabled stations in the same 802 LAN segments.

LLDP agent - The protocol entity that implements LLDP for a particular IEEE 802 device. Depending on the configured LLDP operating mode, an LLDP agent can send and receive LLDP advertisements (frames), or send LLDP advertisements only, or receive LLDP advertisements only.

LLDP media endpoint devices (LLDP-MED) - The Layer 2 network discovery protocol extension described in the ANSI/TIA-1057 standard, *LLDP for Media Endpoint Devices*. This protocol enables a switch to configure and manage connected Media Endpoint devices that need to send media streams across the network (for example, IP telephones and security cameras).

LLDPDU (LLDP Data Unit) - A unit of information in an LLDP packet that consists of a sequence of short variable length information elements, known as **TLVs**. LLDP pass-through is not supported in conformance to IEEE standard.

MIB (Management Information Base) - A virtual database that identifies each manageable object by its name, syntax, accessibility, and status, along with a text description and unique object identifier (OID). The database is accessible by a Network Management Station (NMS) using a management protocol such as the Simple Network Management Protocol (SNMP).

Network connectivity device - A forwarding 802 LAN device, such as a router, switch, or wireless access point.

Station - A node in a network.

TLV (Type-Length-Value) - An information element in an LLDPDU that describes the type of information being sent, the length of the information string, and the value (actual information) that will be transmitted.

TTL (Time-to-Live) - Specifies the length of time that the receiving device should maintain the information acquired through LLDP in its MIB.

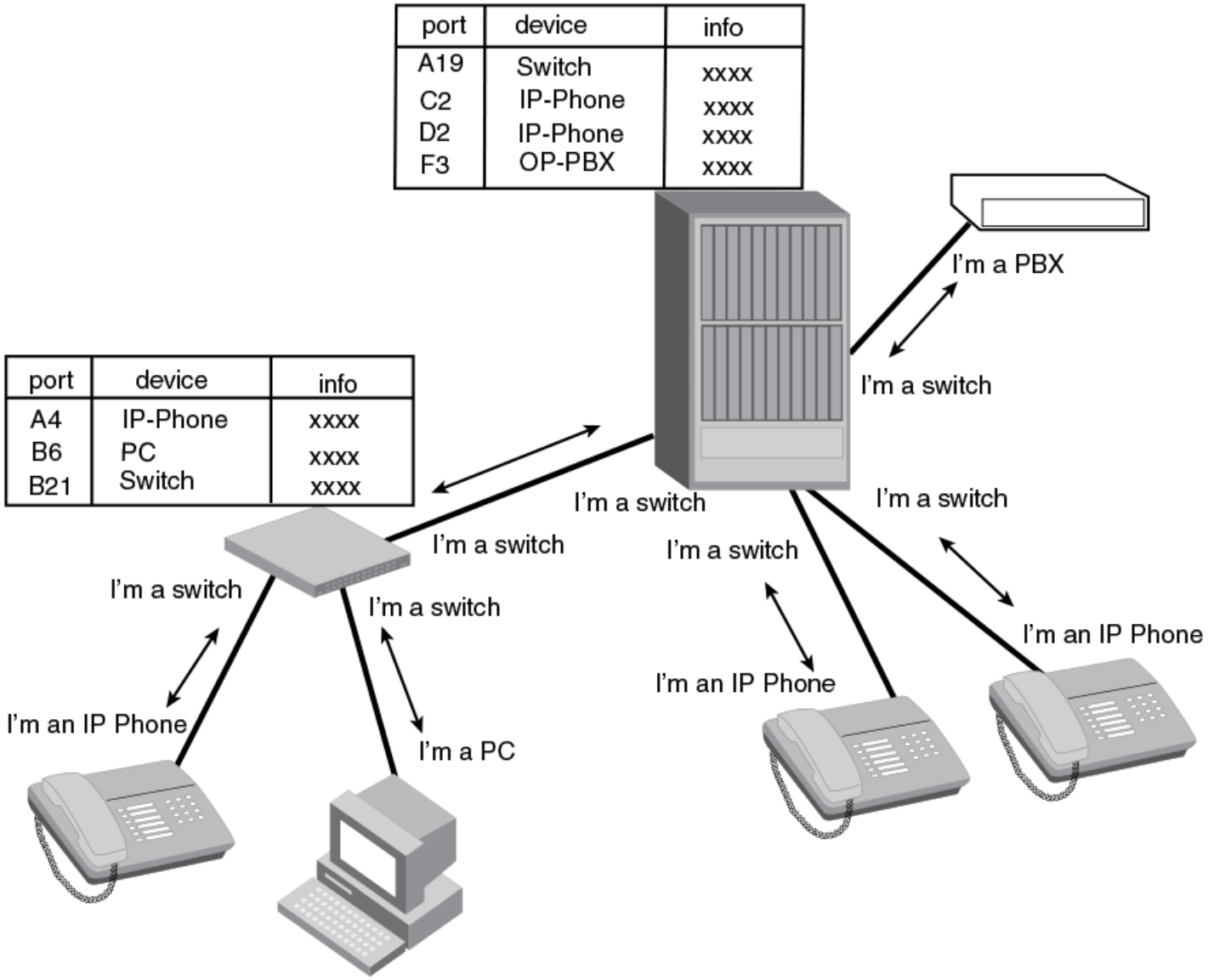
LLDP overview

LLDP enables a station attached to an IEEE 802 LAN/MAN to advertise its capabilities to, and to discover, other stations in the same 802 LAN segments.

The information distributed by LLDP (the advertisement) is stored by the receiving device in a standard Management Information Base (MIB), accessible by a Network Management System (NMS) using a management protocol such as the Simple Network Management Protocol (SNMP). The information also can be viewed from the CLI, using **show LLDP** commands.

The following diagram illustrates LLDP connectivity

FIGURE 6 LLDP connectivity



Benefits of LLDP

LLDP provides the following benefits:

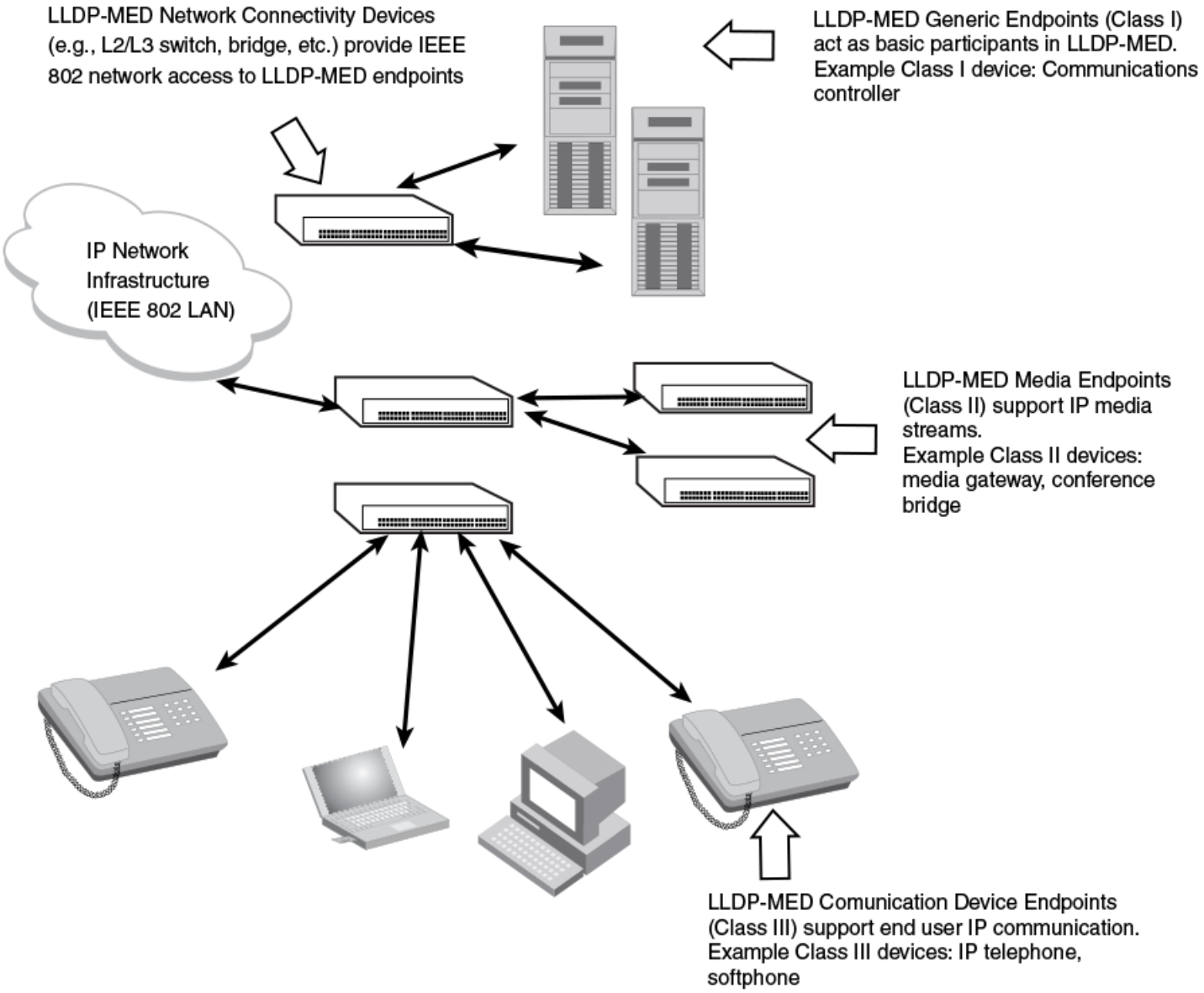
- Network Management:
  - Simplifies the use of and enhances the ability of network management tools in multi-vendor environments
  - Enables discovery of accurate physical network topologies such as which devices are neighbors and through which ports they connect
  - Enables discovery of stations in multi-vendor environments
- Network Inventory Data:
  - Supports optional system name, system description, system capabilities and management address
  - System description can contain the device product name or model number, version of hardware type, and operating system
  - Provides device capability, such as switch, router, or WLAN access point
- Network troubleshooting:
  - Information generated by LLDP can be used to detect speed and duplex mismatches
  - Accurate topologies simplify troubleshooting within enterprise networks
  - Can discover devices with misconfigured or unreachable IP addresses

LLDP-MED overview

LLDP-MED is an extension to LLDP. This protocol enables advanced LLDP features in a Voice over IP (VoIP) network. Whereas LLDP enables network discovery between Network Connectivity devices, LLDP-MED enables network discovery between Network Connectivity devices and media Endpoints such as, IP telephones, softphones, VoIP gateways and conference bridges.

The following diagram illustrates LLDP-MED connectivity.

FIGURE 7 LLDP-MED connectivity



Benefits of LLDP-MED

LLDP-MED provides the following benefits:

- Vendor-independent management capabilities, enabling different IP telephony systems to interoperate in one network.
- Automatically deploys network policies, such as Layer 2 and Layer 3 QoS policies and Voice VLANs.
- Supports E-911 Emergency Call Services (ECS) for IP telephony
- Collects Endpoint inventory information
- Network troubleshooting
  - Helps to detect improper network policy configuration

LLDP-MED class

An LLDP-MED class specifies an Endpoint type and its capabilities. An Endpoint can belong to one of three LLDP-MED class types:

- **Class 1 (Generic endpoint)** - A Class 1 Endpoint requires basic LLDP discovery services, but does not support IP media nor does it act as an end-user communication appliance. A Class 1 Endpoint can be an IP communications controller, other communication-related server, or other device requiring basic LLDP discovery services.
- **Class 2 (Media endpoint)** - A Class 2 Endpoint supports media streams and may or may not be associated with a particular end user. Device capabilities include media streaming, as well as all of the capabilities defined for Class 1 Endpoints. A Class 2 Endpoint can be a voice/media gateway, conference, bridge, media server, etc.
- **Class 3 (Communication endpoint)** - A Class 3 Endpoint supports end user IP communication. Capabilities include aspects related to end user devices, as well as all of the capabilities defined for Class 1 and Class 2 Endpoints. A Class 3 Endpoint can be an IP telephone, softphone (PC-based phone), or other communication device that directly supports the end user.

Discovery services defined in Class 3 include location identifier (ECS/E911) information and inventory management.

The LLDP-MED device class is advertised when LLDP-MED is enabled on a port.

General LLDP operating principles

LLDP and LLDP-MED use the services of the Data Link sublayers, Logical Link Control and Media Access Control, to transmit and receive information to and from other LLDP Agents (protocol entities that implement LLDP).

LLDP is a one-way protocol. An LLDP agent can transmit and receive information to and from another LLDP agent located on an adjacent device, but it cannot solicit information from another LLDP agent, nor can it acknowledge information received from another LLDP agent.

LLDP operating modes

When LLDP is enabled on a global basis, by default, each port on the RUCKUS device will be capable of transmitting and receiving LLDP packets. You can disable a port's ability to transmit and receive LLDP packets, or change the operating mode to one of the following:

- Transmit LLDP information only
- Receive LLDP information only

LLDP transmit mode

An LLDP agent sends LLDP packets to adjacent LLDP-enabled devices. The LLDP packets contain information about the transmitting device and port.

An LLDP agent initiates the transmission of LLDP packets whenever the transmit countdown timing counter expires, or whenever LLDP information has changed. When a transmit cycle is initiated, the LLDP manager extracts the MIB objects and formats this information into TLVs. The TLVs are inserted into an LLDPDU, addressing parameters are prepended to the LLDPDU, and the information is sent out LLDP-enabled ports to adjacent LLDP-enabled devices.

LLDP receive mode

An LLDP agent receives LLDP packets from adjacent LLDP-enabled devices. The LLDP packets contain information about the transmitting device and port.

When an LLDP agent receives LLDP packets, it checks to ensure that the LLDPDUs contain the correct sequence of mandatory TLVs, then validates optional TLVs. If the LLDP agent detects any errors in the LLDPDUs and TLVs, it drops them in software. TLVs that are not recognized but do not

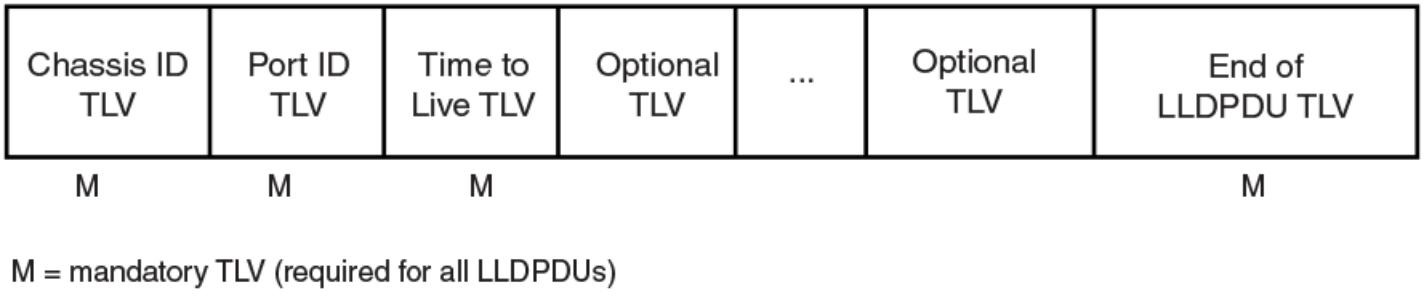
contain basic formatting errors, are assumed to be valid and are assigned a temporary identification index and stored for future possible alter retrieval by network management. All validated TLVs are stored in the neighbor database.

LLDP packets

LLDP agents transmit information about a sending device/port in packets called LLDP Data Units (LLDPDUs). All the LLDP information to be communicated by a device is contained within a single 1500 byte packet. A device receiving LLDP packets is not permitted to combine information from multiple packets.

As shown in the following figure, each LLDPDU has three mandatory TLVs, an End of LLDPDU TLV, plus optional TLVs as selected by network management.

FIGURE 8 LLDPDU packet format



Each LLDPDU consists of an untagged Ethernet header and a sequence of short, variable length information elements known as type, length, value (TLV).

TLVs have Type, Length, and Value fields, where:

- **Type** identifies the kind of information being sent
- **Length** indicates the length (in octets) of the information string
- **Value** is the actual information being sent (for example, a binary bit map or an alpha-numeric string containing one or more fields).

TLV support

This section lists the LLDP and LLDP-MED TLV support.

LLDP TLVs

There are two types of LLDP TLVs, as specified in the IEEE 802.3AB standard.

Basic management TLVs consist of both optional general system information TLVs as well as mandatory TLVs.

Mandatory TLVs cannot be manually configured. They are always the first three TLVs in the LLDPDU, and are part of the packet header.

General system information TLVs are optional in LLDP implementations and are defined by the Network Administrator.

RUCKUS devices support the following Basic Management TLVs:

- Chassis ID (mandatory)
- Port ID (mandatory)
- Time to Live (mandatory)

- Port description
- System name
- System description
- System capabilities
- Management address
- End of LLDPDU

Organizationally-specific TLVs are optional in LLDP implementations and are defined and encoded by individual organizations or vendors. These TLVs include support for, but are not limited to, the IEEE 802.1 and 802.3 standards and the TIA-1057 standard.

RUCKUS devices support the following Organizationally-specific TLVs:

- **802.1 organizationally-specific TLVs**
  - Port VLAN ID
  - VLAN name TLV
- **802.3 organizationally-specific TLVs**
  - MAC/PHY configuration/status
  - Power through MDI
  - Link aggregation
  - Maximum frame size

LLDP-MED TLVs

RUCKUS devices honor and send the following LLDP-MED TLVs, as defined in the TIA-1057 standard:

- LLDP-MED capabilities
- Network policy
- Location identification
- Extended power-via-MDI

Mandatory TLVs

When an LLDP agent transmits LLDP packets to other agents in the same 802 LAN segments, the following mandatory TLVs are always included:

- Chassis ID
- Port ID
- Time to Live (TTL)

This section describes the above TLVs in detail.

Chassis ID

The Chassis ID identifies the device that sent the LLDP packets.

There are several ways in which a device may be identified. A chassis ID subtype, included in the TLV and shown in the following table, indicates how the device is being referenced in the Chassis ID field.

TABLE 30 Chassis ID subtypes

ID subtype	Description
0	Reserved

TABLE 30 Chassis ID subtypes (continued)

ID subtype	Description
1	Chassis component
2	Interface alias
3	Port component
4	MAC address
5	Network address
6	Interface name
7	Locally assigned
8 - 255	Reserved

RUCKUS devices use chassis ID subtype 4, the base MAC address of the device. Other third party devices may use a chassis ID subtype other than 4. The chassis ID will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
Chassis ID (MAC address):  0000.0033.e2c0
```

The chassis ID TLV is always the first TLV in the LLDPDU.

Port ID

The Port ID identifies the port from which LLDP packets were sent.

There are several ways in which a port may be identified, as shown in the following table. A port ID subtype, included in the TLV, indicates how the port is being referenced in the Port ID field.

TABLE 31 Port ID subtypes

ID subtype	Description
0	Reserved
1	Interface alias
2	Port component
3	MAC address
4	Network address
5	Interface name
6	Agent circuit ID
7	Locally assigned
8 - 255	Reserved

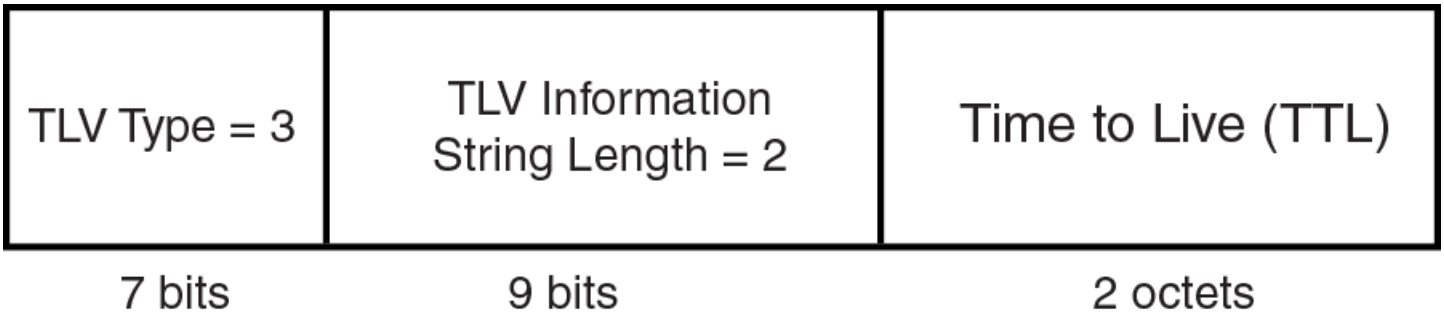
RUCKUS devices use port ID subtype 3, the permanent MAC address associated with the port. Other third party devices may use a port ID subtype other than 3. The port ID appears similar to the following on the remote device, and in the CLI display output on the RUCKUS device (show lldp local-info).

```
Port ID (MAC address):  0000.0033.e2d3
```

The LLDPDU format is shown in LLDP packets on page 128.

The Port ID TLV format is shown below.

FIGURE 9 Port ID TLV packet format



TTL value

The Time to Live (TTL) Value is the length of time the receiving device should maintain the information acquired by LLDP in its MIB.

The TTL value is automatically computed based on the LLDP configuration settings. The TTL value will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (show lldp local-info).

```
Time to live: 40 seconds
```

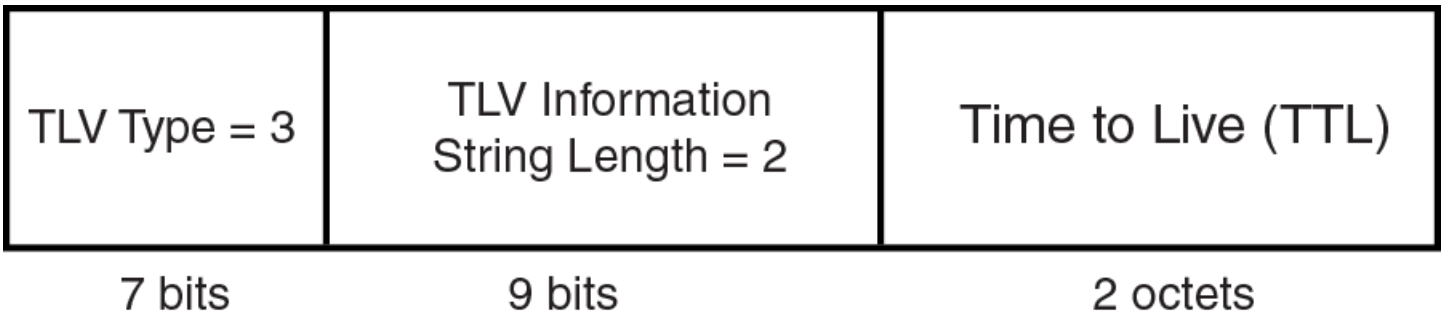
If the TTL field has a value other than zero, the receiving LLDP agent is notified to completely replace all information associated with the LLDP agent/port with the information in the received LLDPDU.

If the TTL field value is zero, the receiving LLDP agent is notified that all system information associated with the LLDP agent/port is to be deleted. This TLV may be used, for example, to signal that the sending port has initiated a port shutdown procedure.

The LLDPDU format is shown in LLDP packets on page 128.

The TTL TLV format is shown below.

FIGURE 10 TTL TLV packet format



MIB support

RUCKUS devices support the following standard management information base (MIB) modules:

- LLDP-MIB
- LLDP-EXT-DOT1-MIB
- LLDP-EXT-DOT3-MIB
- LLDP-EXT-MED-MIB

Syslog messages

Syslog messages for LLDP provide management applications with information related to MIB data consistency and general status. These Syslog messages correspond to the lldpRemTablesChange SNMP notifications. Refer to Enabling LLDP SNMP notifications and Syslog messages on page 136.

Syslog messages for LLDP-MED provide management applications with information related to topology changes. These Syslog messages correspond to the lldpXMedTopologyChangeDetected SNMP notifications. Refer to Enabling SNMP notifications and Syslog messages for LLDP-MED topology changes on page 145.

LLDP configuration

This section describes how to enable and configure LLDP.

The following table lists the LLDP global-level tasks and the default behavior/value for each task.

TABLE 32 LLDP global configuration tasks and default behavior /value

Global task	Default behavior / value when LLDP is enabled
Enabling LLDP on a global basis	Disabled
Specifying the maximum number of LLDP neighbors per device	Automatically set to 392 neighbors per device
Specifying the maximum number of LLDP neighbors per port	Automatically set to 4 neighbors per port
Enabling SNMP notifications and Syslog messages	Disabled
Changing the minimum time between SNMP traps and Syslog messages	Automatically set to 2 seconds when SNMP notifications and Syslog messages for LLDP are enabled
Enabling and disabling TLV advertisements	When LLDP transmit is enabled, by default, the RUCKUS device will automatically advertise LLDP capabilities, except for the system description, VLAN name, and power-via-MDI information, which may be configured by the system administrator. Also, if desired, you can disable the advertisement of individual TLVs.
Changing the minimum time between LLDP transmissions	Automatically set to 2 seconds
Changing the interval between regular LLDP transmissions	Automatically set to 30 seconds
Changing the holdtime multiplier for transmit TTL	Automatically set to 4
Changing the minimum time between port reinitializations	Automatically set to 2 seconds

LLDP configuration notes and considerations

- LLDP is supported on Ethernet interfaces only.
- By default, if a port is 802.1X-enabled, the transmission and reception of LLDP packets will only take place while the port is authorized. The **lldp-pass-through** command overrides this behavior.
- Cisco Discovery Protocol (CDP) and RUCKUS Discovery Protocol (FDP) run independently of LLDP. Therefore, these discovery protocols can run simultaneously on the same device.
- By default, the RUCKUS device limits the number of neighbors per port to four, and staggers the transmission of LLDP packets on different ports, in order to minimize any high-usage spikes to the CPU.
- Ports that are in blocking mode (spanning tree) can still receive LLDP packets from a forwarding port.
- Auto-negotiation status indicates what is being advertised by the port for 802.3 auto-negotiation.

Enabling and disabling LLDP

LLDP is enabled by default on individual ports. However, to run LLDP, you must first enable it on a global basis (on the entire device).

To enable LLDP globally, enter the following command at the global CONFIG level of the CLI.

```
device(config)#lldp run
```

Syntax:[no] lldp run

Enabling support for tagged LLDP packets

By default, RUCKUS devices do not accept tagged LLDP packets from other vendors' devices. To enable support, apply the command **lldp tagged-packets process** at the Global CONFIG level of the CLI. When enabled, the device will accept incoming LLDP tagged packets if the VLAN tag matches any of the following:

- a configured VLAN on the port
- the default VLAN for a tagged port
- the configured untagged VLAN for a dual-mode port

To enable support for tagged LLDP packets, enter the following command.

```
device(config)#lldp tagged-packets process
```

Syntax: [no] lldptagged-packets process

Changing a port LLDP operating mode

When LLDP is enabled on a global basis, by default, each port on the RUCKUS device will be capable of transmitting and receiving LLDP packets. You can disable a port's ability to transmit and receive LLDP packets, or change the operating mode to one of the following:

- Transmit LLDP information only
- Receive LLDP information only

You can configure a different operating mode for each port on the RUCKUS device. For example, you could disable the receipt and transmission of LLDP packets on port e 1/2/1, configure port e 1/2/3 to only receive LLDP packets, and configure port e 1/2/5 to only transmit LLDP packets.

The following sections show how to change the operating mode.

Enabling and disabling receive and transmit mode

To disable the receipt and transmission of LLDP packets on individual ports, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#no lldp enable ports e 1/2/4 e 1/2/5
```

The above command disables LLDP on ports 1/2/4 and 1/2/5. These ports will not transmit nor receive LLDP packets.

To enable LLDP on a port after it has been disabled, enter the following command.

```
device(config)#lldp enable ports e 1/2/4
```

Syntax: [no] lldp enable ports ethernet *port-list* | **all**

Use the [no] form of the command to disable the receipt and transmission of LLDP packets on a port.

NOTE
When a port is configured to both receive and transmit LLDP packets and the MED capabilities TLV is enabled, LLDP-MED is enabled as well. LLDP-MED is not enabled if the operating mode is set to receive only or transmit only.

Enabling and disabling receive only mode

When LLDP is enabled on a global basis, by default, each port on the RUCKUS device will be capable of transmitting and receiving LLDP packets. To change the LLDP operating mode from receive and transmit mode to receive only mode, simply disable the transmit mode. Enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#no lldp enable transmit ports e 1/2/4 e 1/2/5 e 1/2/6
```

The above command changes the LLDP operating mode on ports 1/2/4, 1/2/5, and 1/2/6 from transmit and receive mode to receive only mode.

To change a port LLDP operating mode from transmit only to receive only, first disable the transmit only mode, then enable the receive only mode. Enter commands such as the following.

```
device(config)#no lldp enable transmit ports e 1/2/7 e 1/2/8 e 1/2/9
device(config)#lldp enable receive ports e 1/2/7 e 1/2/8 e 1/2/9
```

The above commands change the LLDP operating mode on ports 1/2/7, 1/2/8, and 1/2/9, from transmit only to receive only. Note that if you do not disable the transmit only mode, you will configure the port to both transmit and receive LLDP packets.

NOTE
LLDP-MED is not enabled when you enable the receive only operating mode. To enable LLDP-MED, you must configure the port to both receive and transmit LLDP packets. Refer to Changing a port LLDP operating mode.

Syntax:[no] lldp enable receive ports ethernet *port-list* | **all**

Use the [no] form of the command to disable the receive only mode.

Enabling and disabling transmit only mode

When LLDP is enabled on a global basis, by default, each port on the RUCKUS device will be capable of transmitting and receiving LLDP packets. To change the LLDP operating mode to transmit only mode, simply disable the receive mode. Enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#no lldp enable receive ports e 1/2/4 e 1/2/5 e 1/2/6
```

The above command changes the LLDP operating mode on ports 1/2/4, 1/2/5, and 1/2/6 from transmit and receive mode to transmit only mode. Any incoming LLDP packets will be dropped in software.

To change a port LLDP operating mode from receive only to transmit only, first disable the receive only mode, then enable the transmit only mode. For example, enter commands such as the following at the Global CONFIG level of the CLI.

```
device(config)#no lldp enable receive ports e 1/2/7 e 1/2/8
device(config)#lldp enable transmit ports e 1/2/7 e 1/2/8
```

The above commands change the LLDP operating mode on ports 1/2/7 and 1/2/8 from receive only mode to transmit only mode. Any incoming LLDP packets will be dropped in software. Note that if you do not disable receive only mode, you will configure the port to both receive and transmit LLDP packets.

NOTE
LLDP-MED is not enabled when you enable the transmit only operating mode. To enable LLDP-MED, you must configure the port to both receive and transmit LLDP packets. Refer to Changing a port LLDP operating mode.

Syntax: [no] lldp enabletransmit ports ethernet *port-list* | **all**

Use the [no] form of the command to disable the *transmit only* mode.

Configuring LLDP processing on 802.1x blocked port

This feature adds support for reception and transmission of Link Layer Discovery Protocol (LLDP) packets over an 802.1x blocked port. The default behavior is to drop received LLDP packets and not to transmit LLDP packets over an 802.1x disabled port. To receive or transmit LLDP packets over 802.1x blocked port or in other words to enable the LLDP processing on 802.1x blocked ports, use the **lldp-pass-through** configuration command.

To enable the LLDP processing on all 802.1x blocked ports, enter the following command at the 802.1X configuration mode:

```
device(config-dot1x)# lldp-pass-through all
```

Syntax: [no] lldp-pass-through all

To enable LLDP processing on a specific 802.1x blocked port, enter the following command at the 802.1X configuration mode:

```
device(config-dot1x)# lldp-pass-through ethernet 1/1/1
```

Syntax: [no] lldp-pass-through ethernet *port*

Specify the *port* variable in the format *unit/slot/port*.

The **no** form of these commands disables LLDP processing on 802.1x blocked ports.

For more information on LLDP and 801.1x, refer IEEE 802.1AB and IEEE 802.1x.

NOTE
If **lldp-pass-through** is disabled, the neighboring information is lost only after LLDP timeout period (default is 120).

Maximum number of LLDP neighbors

You can change the limit of the number of LLDP neighbors for which LLDP data will be retained, per device as well as per port.

Specifying the maximum number of LLDP neighbors per device

You can change the maximum number of neighbors for which LLDP data will be retained for the entire system.

For example, to change the maximum number of LLDP neighbors for the entire device to 26, enter the following command.

```
device(config)#lldp max-total-neighbors 26
```

Syntax: [no] lldp max-total-neighbors *value*

Use the [no] form of the command to remove the static configuration and revert to the default value of 392.

where *value* is a number between 16 and 8192. The default number of LLDP neighbors per device is 392.

Use the **show lldp** command to view the configuration.

Specifying the maximum number of LLDP neighbors per port

You can change the maximum number of LLDP neighbors for which LLDP data will be retained for each port. By default, the maximum number is four and you can change this to a value between one and 64.

For example, to change the maximum number of LLDP neighbors to six, enter the following command.

```
device(config)#lldp max-neighbors-per-port 6
```

Syntax: [no] lldp max-neighbors-per-port *value*

Use the [no] form of the command to remove the static configuration and revert to the default value of four.

where *value* is a number from 1 to 64. The default is number of LLDP neighbors per port is four.

Use the **show lldp** command to view the configuration.

Enabling LLDP SNMP notifications and Syslog messages

SNMP notifications and Syslog messages for LLDP provide management applications with information related to MIB data updates and general status.

When you enable LLDP SNMP notifications, corresponding Syslog messages are enabled as well. When you enable LLDP SNMP notifications, the device will send traps and corresponding Syslog messages whenever there are changes to the LLDP data received from neighboring devices.

LLDP SNMP notifications and corresponding Syslog messages are disabled by default. To enable them, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp enable snmp notifications ports e 1/4/2 to 1/4/6
```

The above command enables SNMP notifications and corresponding Syslog messages on ports 1/4/2 through 1/4/6. By default, the device will send no more than one SNMP notification and Syslog message within a five second period. If desired, you can change this interval. Refer to Specifying the minimum time between SNMP traps and Syslog messages on page 136.

Syntax: [no] lldp enablesnmp notifications ports ethernet *port-list* | **all**

Specifying the minimum time between SNMP traps and Syslog messages

When SNMP notifications and Syslog messages for LLDP are enabled, the device will send no more than one SNMP notification and corresponding Syslog message within a five second period. If desired, you can throttle the amount of time between transmission of SNMP traps (lldpRemTablesChange) and Syslog messages from five seconds up to a value equal to one hour (3600 seconds).

> **NOTE**
> Because LLDP Syslog messages are rate limited, some LLDP information given by the system will not match the current LLDP statistics (as shown in the **show lldp statistics** command output).

To change the minimum time interval between traps and Syslog messages, enter a command such as the following.

```
device(config)#lldp snmp-notification-interval 60
```

When the above command is applied, the LLDP agent will send no more than one SNMP notification and Syslog message every 60 seconds.

Syntax: [no] lldp snmp-notification-interval *seconds*

where *seconds* is a value between 5 and 3600. The default is 5 seconds.

Changing the minimum time between LLDP transmissions

The LLDP transmit delay timer limits the number of LLDP frames an LLDP agent can send within a specified time frame. When you enable LLDP, the system automatically sets the LLDP transmit delay timer to two seconds. If desired, you can change the default behavior from two seconds to a value between 1 and 8192 seconds.

> **NOTE**
> The LLDP transmit delay timer must not be greater than one quarter of the LLDP transmission interval (CLI command **lldp transmit-interval**).

The LLDP transmit delay timer prevents an LLDP agent from transmitting a series of successive LLDP frames during a short time period, when rapid changes occur in LLDP. It also increases the probability that multiple changes, rather than single changes, will be reported in each LLDP frame.

To change the LLDP transmit delay timer, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp transmit-delay 7
```

The above command causes the LLDP agent to wait a minimum of seven seconds after transmitting an LLDP frame and before sending another LLDP frame.

Syntax: [no] lldp transmit-delay *seconds*

where *seconds* is a value between 1 and 8192. The default is two seconds. Note that this value must not be greater than one quarter of the LLDP transmission interval (CLI command **lldp transmit-interval**).

Changing the interval between regular LLDP transmissions

The LLDP transmit interval specifies the number of seconds between regular LLDP packet transmissions. When you enable LLDP, by default, the device will wait 30 seconds between regular LLDP packet transmissions. If desired, you can change the default behavior from 30 seconds to a value between 5 and 32768 seconds.

To change the LLDP transmission interval, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp transmit-interval 40
```

The above command causes the LLDP agent to transmit LLDP frames every 40 seconds.

Syntax:[no] lldp transmit-interval *seconds*

where *seconds* is a value from 5 to 32768. The default is 30 seconds.

> **NOTE**
> Setting the transmit interval or transmit holdtime multiplier, or both, to inappropriate values can cause the LLDP agent to transmit LLDPDUs with TTL values that are excessively high. This in turn can affect how long a receiving device will retain the information if it is not refreshed.

Changing the holdtime multiplier for transmit TTL

The holdtime multiplier for transmit TTL is used to compute the actual time-to-live (TTL) value used in an LLDP frame. The TTL value is the length of time the receiving device should maintain the information in its MIB. When you enable LLDP, the device automatically sets the holdtime multiplier for TTL to four. If desired, you can change the default behavior from four to a value between two and ten.

To compute the TTL value, the system multiplies the LLDP transmit interval by the holdtime multiplier. For example, if the LLDP transmit interval is 30 and the holdtime multiplier for TTL is 4, then the value 120 is encoded in the TTL field in the LLDP header.

To change the holdtime multiplier, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp transmit-hold 6
```

Syntax:[no] lldp transmit-hold *value*

where *value* is a number from 2 to 10. The default value is 4.

> **NOTE**
> Setting the transmit interval or transmit holdtime multiplier, or both, to inappropriate values can cause the LLDP agent to transmit LLDPDUs with TTL values that are excessively high. This in turn can affect how long a receiving device will retain the information if it is not refreshed.

Changing the minimum time between port reinitializations

The LLDP re-initialization delay timer specifies the minimum number of seconds the device will wait from when LLDP is disabled on a port, until it will honor a request to re-enable LLDP on that port. When you enable LLDP, the system sets the re-initialization delay timer to two seconds. If desired, you can change the default behavior from two seconds to a value between one and ten seconds.

To set the re-initialization delay timer, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp reinit-delay 5
```

The above command causes the device to wait five seconds after LLDP is disabled, before attempting to honor a request to re-enable it.

Syntax: [no] lldp reinit-delay *seconds*

where *seconds* is a value from 1 - 10. The default is two seconds.

LLDP TLVs advertised by the RUCKUS device

When LLDP is enabled on a global basis, the RUCKUS device will automatically advertise the following information, except for the features noted:

General system information:

- Management address
- Port description
- System capabilities
- System description (not automatically advertised)
- System name

802.1 capabilities:

- VLAN name (not automatically advertised)
- Untagged VLAN ID

802.3 capabilities:

- Link aggregation information
- MAC/PHY configuration and status
- Maximum frame size
- Power-via-MDI information (not automatically advertised)

The above TLVs are described in detail in the following sections.

NOTE
The system description, VLAN name, and power-via-MDI information TLVs are not automatically enabled. The following sections show how to enable these advertisements.

General system information for LLDP

Except for the system description, the RUCKUS device will advertise the following system information when LLDP is enabled on a global basis:

- Management address
- Port description
- System capabilities
- System description (not automatically advertised)

- System name

Management address

A management address is normally an IPv4 or IPv6 address that can be used to manage the device. Management address advertising has two modes: default, or explicitly configured. The default mode is used when no addresses are configured to be advertised for a given port. If any addresses are configured to be advertised for a given port, then only those addresses are advertised. This applies across address types, so for example, if just one IPv4 address is explicitly configured to be advertised for a port, then no IPv6 addresses will be advertised for that port (since none were configured to be advertised), even if IPv6 addresses are configured within the system.

If no management address is explicitly configured to be advertised, the RUCKUS device will use the first available IPv4 address and the first available IPv6 address (so it may advertise IPv4, IPv6 or both). A Layer 3 switch will select the first available address of each type from those configured on the following types of interfaces, in the following order of preference:

- Physical port on which LLDP will be transmitting the packet
- Virtual router interface (VE) on a VLAN that the port is a member of
- Dedicated management port
- Loop back interface
- Virtual router interface (VE) on any other VLAN
- Other physical port
- Other interface

For IPv6 addresses, link-local and anycast addresses will be excluded from these searches.

If no IP address is configured on any of the above, the port's current MAC address will be advertised.

To advertise a IPv4 management address, enter a command such as the following:

```
device(config)# lldp advertise management-address ipv4 10.157.2.1 ports e 1/1/4
```

The management address will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**):

```
Management address (IPv4): 10.157.2.1
```

Syntax:[no] lldp advertise management-address ipv4 *ipv4 address* **ports ethernet** *port list* | **all**

To support an IPv6 management address, there is a similar command that has equivalent behavior as the IPv4 command.

To advertise an IPv6 management address, enter a command such as the following:

```
device(config)#lldp advertise management-address ipv6 2001:DB8::90 ports e 1/2/7
```

Syntax:[no] lldp advertise management-address ipv6 *ipv6 address* **ports ethernet** *port list* | **all**

ipv4 address or *ipv6 address* or both are the addresses that may be used to reach higher layer entities to assist discovery by network management. In addition to management addresses, the advertisement will include the system interface number associated with the management address.

For *port list* , specify the ports in the format *unit/slot/port*. You can list all of the ports individually; use the keyword **to** specify a range of ports, or a combination of both. To apply the configuration to all ports on the device, use the keyword **all** instead of listing the ports individually.

Port description

The port description TLV identifies the port from which the LLDP agent transmitted the advertisement. The port description is taken from the ifDescr MIB object from MIB-II.

By default, the port description is automatically advertised when LLDP is enabled on a global basis. To disable advertisement of the port description, enter a command such as the following.

```
device(config)#no lldp advertise port-description ports e 1/2/4 to 1/2/12
```

The port description will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
Port description: "GigabitEthernet20"
```

Syntax:[no] lldp advertise port-description ports ethernet *port-list* | **all**

System capabilities

The system capabilities TLV identifies the primary functions of the device and indicates whether these primary functions are enabled. The primary functions can be one or more of the following (more than one for example, if the device is both a bridge and a router):

- Repeater
- Bridge
- WLAN access point
- Router
- Telephone
- DOCSIS cable device
- Station only (devices that implement end station capability)
- Other

System capabilities for RUCKUS devices are based on the type of software image in use (for example, Layer 2 switch or Layer 3 router). The enabled capabilities will be the same as the available capabilities, except that when using a router image (base or full Layer 3), if the global route-only feature is turned on, the bridge capability will not be included, since no bridging takes place.

By default, the system capabilities are automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise system-capabilities ports e 1/2/4 to 1/2/12
```

The system capabilities will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
System capabilities :   bridge
Enabled capabilities:   bridge
```

Syntax: [no] lldp advertise system-capabilities ports ethernet *port-list* | **all**

System description

The system description is the network entity, which can include information such as the product name or model number, the version of the system hardware type, the software operating system level, and the networking software version. The information corresponds to the sysDescr MIB object in MIB-II.

To advertise the system description, enter a command such as the following.

```
device(config)# lldp advertise system-description ports e 1/2/4 to 1/2/12
```

The system description will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ System description  : "Ruckus Wireless, Inc.,ICX7450_L3_SOFT_PACKAGE,
SW: Version 08.0.40q030T213 Compiled on Thu Jul 16 06:27:06 2015 labeled as ICXR08040
```

NOTE
The contents of the show command output will vary depending on which TLVs are configured to be advertised.

Syntax:[no] lldp advertise system-description ports ethernet *port-list* | **all**

System name

The system name is the system administratively assigned name, taken from the sysName MIB object in MIB-II. The sysName MIB object corresponds to the name defined with the CLI command **hostname**.

By default, the system name is automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)# no lldp advertise system-name ports e 1/2/4 to 1/2/12
```

The system name will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
System name:  "ICX7450SP-ADV Router"
```

Syntax:[no] lldp advertise system-name ports ethernet *port-list* | **all**

802.1 capabilities

Except for the VLAN name, the RUCKUS device will advertise the following 802.1 attributes when LLDP is enabled on a global basis:

- VLAN name (not automatically advertised)
- Untagged VLAN ID

VLAN name

The VLAN name TLV contains the name and VLAN ID of a VLAN configured on a port. An LLDPDU may include multiple instances of this TLV, each for a different VLAN.

To advertise the VLAN name, enter a command such as the following.

```
device(config)#lldp advertise vlan-name vlan 99 ports e 1/2/4 to 1/2/12
```

The VLAN name will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
VLAN name (VLAN 99): "Voice-VLAN-99"
```

Syntax:[no] lldp advertise vlan-name vlan *vlan ID* **ports ethernet** *port-list* | **all**

For*vlan ID* , enter the VLAN ID to advertise.

Untagged VLAN ID

The port VLAN ID TLV advertises the Port VLAN Identifier (PVID) that will be associated with untagged or priority-tagged frames. If the port is not an untagged member of any VLAN (i.e., the port is strictly a tagged port), the value zero will indicate that.

By default, the port VLAN ID is automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise port-vlan-id ports e 1/2/4 to 1/2/12
```

The untagged VLAN ID will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
Port VLAN ID: 99
```

Syntax: [no] lldp advertise port-vlan-id ports ethernet *port-list* | **all**

802.3 capabilities

Except for Power-via-MDI information, the RUCKUS device will advertise the following 802.3 attributes when LLDP is enabled on a global basis:

- Link aggregation information
- MAC/PHY configuration and status
- Maximum frame size
- Power-via-MDI information (not automatically advertised)

Link aggregation TLV

The **link-aggregation** time, length, value (TLV) indicates the following:

- Whether the link is capable of being aggregated
- Whether the link is currently aggregated
- The LAG interface

RUCKUS devices advertise link aggregation information about standard link aggregation (LACP) as well as static trunk configuration.

By default, link-aggregation information is automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise link-aggregation ports e 1/2/12
```

Syntax: [no] lldp advertise link-aggregation ports ethernet *port-list* | **all**

The link aggregation advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
Link aggregation: not capable
```

MAC and PHY configuration status

The MAC and PHY configuration and status TLV includes the following information:

- Auto-negotiation capability and status
- Speed and duplex mode
- Flow control capabilities for auto-negotiation
- maximum port speed advertisement
- If applicable, indicates if the above settings are the result of auto-negotiation during link initiation or of a manual set override action

The advertisement reflects the effects of the following CLI commands:

- speed-duplex

- flow-control
- gig-default
- link-config

By default, the MAC/PHY configuration and status information are automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise mac-phy-config-status ports e 1/2/4 to 1/2/12
```

The MAC/PHY configuration advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ 802.3 MAC/PHY       : auto-negotiation enabled
   Advertised capabilities: 10baseT-HD, 10baseT-FD, 100baseTX-HD, 100baseTX-FD,
   fdxSPause, fdxBPause, 1000baseT-HD, 1000baseT-FD
   Operational MAU type: 100BaseTX-FD
```

Syntax:[no] lldp advertise mac-phy-config-status ports ethernet *port-list* | **all**

Maximum frame size

The maximum frame size TLV provides the maximum 802.3 frame size capability of the port. This value is expressed in octets and includes the four-octet Frame Check Sequence (FCS). The default maximum frame size is 1522. The advertised value may change depending on whether the **aggregated-vlan** or **jumbo** CLI commands are in effect.

By default, the maximum frame size is automatically advertised when LLDP is enabled on a global basis. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise max-frame-size ports e 1/2/4 to 1/2/12
```

The maximum frame size advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
Maximum frame size: 1522 octets
```

Syntax:[no] lldp advertise max-frame-size ports ethernet *port-list* | **all**

Power-via-MDI

The power-via-MDI TLV provides general information about Power over Ethernet (POE) capabilities and status of the port. It indicates the following:

- POE capability (supported or not supported)
- POE status (enabled or disabled)
- Power Sourcing Equipment (PSE) power pair - indicates which pair of wires is in use and whether the pair selection can be controlled. The RUCKUS implementation always uses pair A, and cannot be controlled.
- Power class - Indicates the range of power that the connected powered device has negotiated or requested.

  NOTE
  The power-via-MDI TLV described in this section applies to LLDP. There is also a power-via-MDI TLV for LLDP-MED devices, which provides extensive POE information. Refer to Extended power-via-MDI information on page 154.

To advertise the power-via-MDI information, enter a command such as the following.

```
device(config)#lldp advertise power-via-mdi ports e 1/2/4 to 1/2/12
```

The power-via-MDI advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ 802.3 Power via MDI: PSE port, power enabled, class 0
    Power Pair         : A (not controllable)
```

Syntax:[no] lldp advertise power-via-mdi ports ethernet *port-list* | **all**

LLDP-MED configuration

This section provides the details for configuring LLDP-MED.

The following table lists the global and interface-level tasks and the default behavior/value for each task.

TABLE 33 LLDP-MED configuration tasks and default behavior / value

Task	Default behavior / value
Global CONFIG-level tasks	
Enabling LLDP-MED on a global basis	Disabled
Enabling SNMP notifications and Syslog messages for LLDP-MED topology change	Disabled
Changing the Fast Start Repeat Count	The system automatically sets the fast start repeat count to 3 when a Network Connectivity Device receives an LLDP packet from an Endpoint that is newly connected to the network. **NOTE** The LLDP-MED fast start mechanism is only intended to run on links between Network Connectivity devices and Endpoint devices. It does not apply to links between LAN infrastructure elements, including between Network Connectivity devices, or to other types of links.
Interface-level tasks	
Defining a location ID	Not configured
Defining a network policy	Not configured

Enabling LLDP-MED

When LLDP is enabled globally, LLDP-MED is enabled if the LLDP-MED capabilities TLV is also enabled. By default, the LLDP-MED capabilities TLV is automatically enabled. To enable LLDP, refer to Enabling and disabling LLDP on page 133.

NOTE
LLDP-MED is not enabled on ports where the LLDP operating mode is receive only or transmit only. LLDP-MED is enabled on ports that are configured to both receive and transmit LLDP packets and have the LLDP-MED capabilities TLV enabled.

Enabling SNMP notifications and Syslog messages for LLDP-MED topology changes

SNMP notifications and Syslog messages for LLDP-MED provide management applications with information related to topology changes. For example, SNMP notifications can alert the system whenever a remote Endpoint device is connected to or removed from a local port.

SNMP notifications identify the local port where the topology change occurred, as well as the device capability of the remote Endpoint device that was connected to or removed from the port.

When you enable LLDP-MED SNMP notifications, corresponding Syslog messages are enabled as well. When you enable LLDP-MED SNMP notifications, the device will send traps and Syslog messages when an LLDP-MED Endpoint neighbor entry is added or removed.

SNMP notifications and corresponding Syslog messages are disabled by default. To enable them, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp enable snmp med-topo-change-notifications ports e 1/4/4 to 1/4/6
```

Syntax:[no] lldp enable snmp med-topo-change-notifications ports ethernet *port-list* | **all**

Changing the fast start repeat count

The fast start feature enables a Network Connectivity Device to initially advertise itself at a faster rate for a limited time when an LLDP-MED Endpoint has been newly detected or connected to the network. This feature is important within a VoIP network, for example, where rapid availability is crucial for applications such as emergency call service location (E911).

The fast start timer starts when a Network Connectivity Device receives the first LLDP frame from a newly detected Endpoint.

The LLDP-MED fast start repeat count specifies the number of LLDP packets that will be sent during the LLDP-MED fast start period. By default, the device will send three packets at one-second intervals. If desired, you can change the number of packets the device will send per second, up to a maximum of 10.

> **NOTE**
> The LLDP-MED fast start mechanism is only intended to run on links between Network Connectivity devices and Endpoint devices. It does not apply to links between LAN infrastructure elements, including between Network Connectivity devices, or to other types of links.

To change the LLDP-MED fast start repeat count, enter commands such as the following.

```
device(config)#lldp med fast-start-repeat-count 5
```

The above command causes the device to send five LLDP packets during the LLDP-MED fast start period.

Syntax: [no] lldp medfast-start-repeat-count *value*

where value is a number from 1 to 10, which specifies the number of packets that will be sent during the LLDP-MED fast start period. The default is 3.

Defining a location id

The LLDP-MED Location Identification extension enables the RUCKUS device to set the physical location that an attached Class III Endpoint will use for location-based applications. This feature is important for applications such as IP telephony, for example, where emergency responders need to quickly determine the physical location of a user in North America that has just dialed 911.

For each port, you can define one or more of the following location ID formats:

- Geographic location (coordinate-based)
- Civic address

- Emergency Call Services (ECS) Emergency Location Identification Number (ELIN)

The above location ID formats are defined in the following sections.

Coordinate-based location

Coordinate-based location is based on the IETF RFC 3825 [6] standard, which specifies a Dynamic Host Configuration Protocol (DHCP) option for the coordinate-based geographic location of a client.

When you configure an Endpoint location information using the coordinate-based location, you specify the latitude, longitude, and altitude, along with resolution indicators (a measure of the accuracy of the coordinates), and the reference datum (the map used for the given coordinates).

To configure a coordinate-based location for an Endpoint device, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp med location-id coordinate-based latitude
-78.303 resolution 20 longitude 34.27 resolution 18 altitude meters 50 resolution 16 wgs84
```

Syntax: [no] lldp med location-id coordinate-based latitude *degrees* **resolution** *bits* **longitude** *degrees* **resolution** *bits* **altitude floors** *number* **resolution** *bits* | **meters** *number* **resolution** *bits datum*

latitude degrees is the angular distance north or south from the earth equator measured through 90 degrees. Positive numbers indicate a location north of the equator and negative numbers indicate a location south of the equator.

resolution bits specifies the precision of the value given for latitude. A smaller value increases the area within which the device is located. For latitude, enter a number between 1 and 34.

longitude degrees is the angular distance from the intersection of the zero meridian. Positive values indicate a location east of the prime meridian and negative numbers indicate a location west of the prime meridian.

resolution bits specifies the precision of the value given for longitude. A smaller value increases the area within which the device is located. For longitude resolution, enter a number between 1 and 34.

altitude floors number is the vertical elevation of a building above the ground, where 0 represents the floor level associated with the ground level at the main entrance and larger values represent floors that are above (higher in altitude) floors with lower values. For example, 2 for the 2nd floor. Sub-floors can be represented by non-integer values. For example, a mezzanine between floor 1 and floor 2 could be represented as 1.1. Similarly, the mezzanines between floor 4 and floor 5 could be represented as 4.1 and 4.2 respectively. Floors located below ground level could be represented by negative values.

resolution bits specifies the precision of the value given for altitude. A smaller value increases the area within which the device is located. For floors resolution, enter the value 0 if the floor is unknown, or 30 if a valid floor is being specified.

altitude meters number is the vertical elevation in number of meters, as opposed to floors.

resolution bits specifies the precision of the value given for altitude. A smaller value increases the area within which the device is located. For meters resolution, enter a value from 0 to 30.

Datum is the map used as the basis for calculating the location. Specify one of the following:

- **wgs84** - (geographical 3D) - World Geodesic System 1984, CRS Code 4327, Prime Meridian Name: Greenwich
- **nad83-navd88** - North American Datum 1983, CRS Code 4269, Prime Meridian Name: Greenwich; The associated vertical datum is the North American Vertical Datum of 1988 (NAVD88). Use this datum when referencing locations on land. If land is near tidal water, use nad83-mllw (below).
- **nad83-mllw** - North American Datum 1983, CRS Code 4269, Prime Meridian Name: Greenwich; The associated vertical datum is mean lower low water (MLLW). Use this datum when referencing locations on water, sea, or ocean.

Example coordinate-based location configuration

The following shows an example coordinate-based location configuration for the Sears Tower, at the following location.

103rd Floor233 South Wacker DriveChicago, IL 60606

```
device(config)#lldp med location-id coordinate-based latitude 41.87884 resolution 18 longitude 87.63602
resolution 18 altitude floors 103 resolution 30 wgs84
```

The above configuration shows the following:

- Latitude is 41.87884 degrees north (or 41.87884 degrees).
- Longitude is 87.63602 degrees west (or 87.63602 degrees).
- The latitude and longitude resolution of 18 describes a geo-location area that is latitude 41.8769531 to latitude 41.8789062 and extends from -87.6367188 to -87.6347657 degrees longitude. This is an area of approximately 373412 square feet (713.3 ft. x 523.5 ft.).
- The location is inside a structure, on the 103rd floor.
- The WGS 84 map was used as the basis for calculating the location.

Example coordinate-based location advertisement

The coordinate-based location advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ MED Location ID
    Data Format: Coordinate-based
    Latitude Resolution  : 20 bits
    Latitude Value       : -78.303 degrees
    Longitude Resolution : 18 bits
    Longitude Value      : 34.27 degrees
    Altitude Resolution  : 16 bits
    Altitude Value       : 50. meters
    Datum                : WGS 84
```

Configuring civic address location

When you configure a media Endpoint location using the address-based location, you specify the location the entry refers to, the country code, and the elements that describe the civic or postal address.

To configure a civic address-based location for LLDP-MED, enter commands such as the following at the global configuration mode of the CLI.

```
device(config)# lldp med location-id civic-address refers-to client country US elem 1 CA elem 3 "San Jose"
elem 6 "120 Holger Way" elem 24 95134 elem 27 5 elem 28 551 elem 29 office elem 23 "John Doe"
```

Syntax: [no] lldp med location-id civic-address refers-to *elem* **country** *country code* **elem** *CA type value* [**elem** *CA type value*] [**elem** *CA type value*] **....**

refers-to elem describes the location that the entry refers to. Specify one of the following:

- client
- dhcp-server
- network-element

where **dhcp-server** or **network-element** should only be used if it is known that the Endpoint is in close physical proximity to the DHCP server or network element.

country code is the two-letter ISO 3166 country code in capital ASCII letters.

- CA - Canada
- DE - Germany
- JP - Japan
- KR - Korea

- US - United States

CA type is a value from 0 - 255, that describes the civic address element. For example, a CA type of 24 specifies a postal or zip code. Valid elements and their types are listed in the following table.

value is the actual value of the elem CA type , above. For example, 95134 for the postal or zip code. Acceptable values are also listed in the following table.

NOTE
If the value of an element contains one or more spaces, use double quotation marks (") at the beginning and end of the string. For example, `elem 3 "San Jose"` .

TABLE 34 Elements used with civic address

Civic Address (CA) type	Description	Acceptable values / examples
0	Language	The ISO 639 language code used for presenting the address information.
1	National subdivisions (state, canton, region, province, or prefecture)	Examples: Canada - Province Germany - State Japan - Metropolis Korea - Province United States - State
2	County, parish, gun (JP), or district (IN)	Examples: Canada - County Germany - County Japan - City or rural area Korea - County United States - County
3	City, township, or shi (JP)	Examples: Canada - City or town Germany - City Japan - Ward or village Korea - City or village United States - City or town
4	City division, borough, city district, ward, or chou (JP)	Examples: Canada - N/A Germany - District Japan - Town Korea - Urban district United States - N/A

TABLE 34 Elements used with civic address (continued)

Civic Address (CA) type	Description	Acceptable values / examples
5	Neighborhood or block	Examples: Canada - N/A Germany - N/A Japan - City district Korea - Neighborhood United States - N/A
6	Street	Examples: Canada - Street Germany - Street Japan - Block Korea - Street United States - Street
16	Leading street direction	N (north), E (east), S (south), W (west), NE, NW, SE, SW
17	Trailing street suffix	N (north), E (east), S (south), W (west), NE, NW, SE, SW
18	Street suffix	Acceptable values for the United States are listed in the United States Postal Service Publication 28 [18], Appendix C. Example: Ave, Place
19	House number	The house number (street address) Example: 1234
20	House number suffix	A modifier to the house number. It does not include parts of the house number. Example: A, 1/2
21	Landmark or vanity address	A string name for a location. It conveys a common local designation of a structure, a group of buildings, or a place that helps to locate the place. Example: UC Berkeley
22	Additional location information	An unstructured string name that conveys additional information about the location. Example: west wing
23	Name (residence and office occupant)	Identifies the person or organization associated with the address. Example: Textures Beauty Salon
24	Postal / zip code	The valid postal / zip code for the address. Example: 95054-1234
25	Building (structure)	The name of a single building if the street address includes more than one building or if the building name is helpful in identifying the location. Example: Law Library

TABLE 34 Elements used with civic address (continued)

Civic Address (CA) type	Description	Acceptable values / examples
26	Unit (apartment, suite)	The name or number of a part of a structure where there are separate administrative units, owners, or tenants, such as separate companies or families who occupy that structure. Common examples include suite or apartment designations. Example: Apt 27
27	Floor	Example: 4
28	Room number	The smallest identifiable subdivision of a structure. Example: 7A
29	Placetype	The type of place described by the civic coordinates. For example, a home, office, street, or other public space. Example: Office
30	Postal community name	When the postal community name is defined, the civic community name (typically CA type 3) is replaced by this value. Example: Alviso
31	Post office box (P.O. box)	When a P.O. box is defined, the street address components (CA types 6, 16, 17, 18, 19, and 20) are replaced with this value. Example: P.O. Box 1234
32	Additional code	An additional country-specific code that identifies the location. For example, for Japan, this is the Japan Industry Standard (JIS) address code. The JIS address code provides a unique address inside of Japan, down to the level of indicating the floor of the building.
128	Script	The script (from ISO 15924 [14]) used to present the address information. Example: Latn **NOTE** If not manually configured, the system assigns the default value **Latn**
255	Reserved	

Example civic address location advertisement

The Civic address location advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device **(show lldp local-info)**.

```
+ MED Location ID
    Data Format: Civic Address
    Location of: Client
    Country    : "US"
    CA Type    : 1
    CA Value   : "CA"
    CA Type    : 3
    CA Value   : "San Jose"
    CA Type    : 6
    CA Value   : "120 Holger Way"
    CA Type    : 24
```

```
    CA Value    : "95134"
    CA Type     : 27
    CA Value    : "5"
    CA Type     : 28
    CA Value    : "551"
    CA Type     : 29
    CA Value    : "office"
    CA Type     : 23
    CA Value    : "John Doe"
```

Configuring emergency call service

The Emergency Call Service (ECS) location is used specifically for Emergency Call Services applications.

When you configure a media Endpoint location using the emergency call services location, you specify the Emergency Location Identification Number (ELIN) from the North America Numbering Plan format, supplied to the Public Safety Answering Point (PSAP) for ECS purposes.

To configure an ECS-based location for LLDP-MED, enter a command such as the following at the Global CONFIG level of the CLI.

```
device(config)#lldp med location-id ecs-elin 4083335745
```

Syntax: [no] lldp med location-id ecs-elin *number* **ports ethernet** *port-list* | **all**

number is a number from 10 to 25 digits in length.

Example ECS ELIN location advertisements

The ECS ELIN location advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ MED Location ID
    Data Format: ECS ELIN
    Value      : 4083335745
```

Defining an LLDP-MED network policy

An LLDP-MED network policy defines an Endpoint VLAN configuration (VLAN type and VLAN ID) and associated Layer 2 and Layer 3 priorities that apply to a specific set of applications on a port.

> **NOTE**
> This feature applies to applications that have specific real-time network policy requirements, such as interactive voice or video services. It is not intended to run on links other than between Network Connectivity devices and Endpoints, and therefore does not advertise the multitude of network policies that frequently run on an aggregated link.

To define an LLDP-MED network policy for an Endpoint, enter a command such as the following.

```
device(config)#lldp med network-policy application voice tagged vlan 99 priority 3 dscp 22 port e 1/2/6
```

The network policy advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ MED Network Policy
    Application Type  : Voice
    Policy Flags      : Known Policy, Tagged
    VLAN ID           : 99
    L2 Priority       : 3
    DSCP Value        : 22
```

NOTE
Endpoints will advertise a policy as "unknown" in the **show lldp neighbor detail** command output, if it is a policy that is required by the Endpoint and the Endpoint has not yet received it.

LLDP-MED network policy configuration syntax

The CLI syntax for defining an LLDP-MED network policy differs for tagged, untagged, and priority tagged traffic. Refer to the appropriate syntax, below.

For tagged traffic

Syntax: [no] lldp med network-policy application *application type* **taggedvlan** *vlan ID* **priority** *0-7* **dscp** *0-63* **ports ethernet** *port-list* | **all**

For untagged traffic

Syntax:[no] lldp med network-policy application *application type* **untagged dscp** *0-63* **ports ethernet** *port-list* | **all**

For priority-tagged traffic

Syntax:[no] lldp med network-policy application *application type* **priority-tagged priority** *0-7* **dscp** *0-63* **ports ethernet** *port-list* | **all**

application type indicates the primary function of the applications defined by this network policy. Application type can be one of the following:

- **guest-voice** - Limited voice service for guest users and visitors with their own IP telephony handsets or similar devices that support interactive voice services.
- **guest-voice-signaling** - Limited voice service for use in network topologies that require a different policy for guest voice signaling than for guest voice media.
- **softphone-voice** - Softphone voice service for use with multi-media applications that work in association with VoIP technology, enabling phone calls direct from a PC or laptop. Softphones do not usually support multiple VLANs, and are typically configured to use an untagged VLAN or a single tagged data-specific VLAN. Note that when a network policy is defined for use with an untagged VLAN, the Layer 2 priority field is ignored and only the DSCP value is relevant.
- **streaming-video** - Applies to broadcast- or multicast-based video content distribution and similar applications that support streaming video services requiring specific network policy treatment. Video applications that rely on TCP without buffering would not be an intended use of this application type.
- **video-conferencing** - Applies to dedicated video conferencing equipment and similar devices that support real-time interactive video/audio services.
- **video-signaling** - For use in network topologies that require a separate policy for video signaling than for video media. Note that this application type should not be advertised if all the same network policies apply as those advertised in the video conferencing policy TLV.
- **voice** - For use by dedicated IP telephony handsets and similar devices that support interactive voice services.
- **voice-signaling** - For use in network topologies that require a different policy for voice signaling than for voice media. Note that this application type should not be advertised if all the same network policies apply as those advertised in the voice policy TLV.
- *tagged vlan vlan id* specifies the tagged VLAN that the specified application type will use.
- *untagged* indicates that the device is using an untagged frame format.
- *priority-tagged* indicates that the device uses priority-tagged frames. In this case, the device uses the default VLAN (PVID) of the ingress port.
- *priority 0 -7* indicates the Layer 2 priority value to be used for the specified application type. Enter 0 to use the default priority.

- *dscp 0 - 63* specifies the Layer 3 Differentiated Service codepoint priority value to be used for the specified application type. Enter 0 to use the default priority.

LLDP-MED attributes advertised by the RUCKUS device

LLDP-MED attributes are only advertised on a port if LLDP-MED is enabled (which is done by enabling the LLDP-MED capabilities TLV), the port operating mode is *receive* and *transmit* (the default), and the port has received an LLDP-MED advertisement from an Endpoint. By default, the RUCKUS device will automatically advertise the following LLDP-MED attributes when the above criteria are met:

- LLDP-MED capabilities
- Location ID
- Network policy
- Power-via-MDI information

NOTE
Although the Location ID and Network policy attributes are automatically advertised, they will have no effect until they are actually defined.

LLDP-MED capabilities

When enabled, LLDP-MED is enabled, and the LLDP-MED capabilities TLV is sent whenever any other LLDP-MED TLV is sent. When disabled, LLDP-MED is disabled and no LLDP-MED TLVs are sent.

The LLDP-MED capabilities advertisement includes the following information:

- The supported LLDP-MED TLVs
- The device type (Network Connectivity device or Endpoint (Class 1, 2, or 3))

By default, LLDP-MED information is automatically advertised when LLDP-MED is enabled. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise med-capabilities ports e 1/2/4 to 1/2/12
```

NOTE
Disabling the LLDP-MED capabilities TLV disables LLDP-MED.

To re-enable the LLDP-MED Capabilities TLV (and LLDP-MED) after it has been disabled, enter a command such as the following.

```
device(config)#lldp advertise med-capabilities ports e 1/2/4 to 1/2/12
```

The LLDP-MED capabilities advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ MED capabilities: capabilities, networkPolicy, location, extendedPSE    MED device type : Network
Connectivity
```

Syntax: [no] lldp advertisemed-capabilities ports ethernet *port-list* | **all**

Extended power-via-MDI information

The extended Power-via-MDI TLV enables advanced power management between LLDP-MED Endpoints and Network Connectivity Devices.

This TLV provides significantly more information than the 802.1AB Power-via-MDI TLV referenced in 802.3 capabilities on page 142. For example, this TLV enables an Endpoint to communicate a more precise required power level, thereby enabling the device to allocate less power to the Endpoint, while making more power available to other ports.

The LLDP-MED Power-via-MDI TLV advertises an Endpoint IEEE 802.3af power-related information, including the following:

- **Power type** - indicates whether the LLDP-MED device transmitting the LLPDU is a power sourcing device or a powered device:
  - **Power sourcing device/equipment (PSE)** - This is the source of the power, or the device that integrates the power onto the network. Power sourcing devices/equipment have embedded POE technology. In this case, the power sourcing device is the RUCKUS POE device.
  - **Powered device (PD)** - This is the Ethernet device that requires power and is situated on the other end of the cable opposite the power sourcing device.
- **Power source** - The power source being utilized by a PSE or PD, for example, primary power source, backup power source, or unknown.

For Endpoint devices, the power source information indicates the power capability of the Network Connectivity Device it is attached to. When the Network Connectivity device advertises that it is using its primary power source, the Endpoint should expect to have uninterrupted access to its available power. Likewise, if the Network Connectivity device advertises that it is using backup power, the Endpoint should not expect continuous power. The Endpoint may additionally choose to power down non-essential subsystems or to conserve power as long as the PSE is advertising that it is operating on backup power.

NOTE
RUCKUS devices always advertise the power source as "unknown".

- **Power priority** - The in-line power priority level for the PSE or PD:
  - 3 - low
  - 2 - high
  - 1 - critical
  - unknown
- **Power level** - The total power, in tenths of watts, required by a PD from a PSE, or the total power a PSE is capable of sourcing over a maximum length cable based on its current configuration.

If the exact power is not known for a PSE or PD, it will advertise the power level associated with its 802.3af power class listed in the following table.

TABLE 35 802.3af power classes

Power class	Minimum power level output at the PSE	Maximum power levels at the PD
0	15.4 watts	0.44 - 12.95 watts
1	4.0 watts	0.44 - 3.84 watts
2	7.0 watts	3.84 - 6.49 watts
3	15.4 watts	6.49 - 12.95 watts

For a PD (Endpoint device), the power level represents the maximum power it can consume during normal operations in its current configuration, even if its actual power draw at that instance is less than the advertised power draw.

For a PSE (Network Connectivity device), the power level represents the amount of power that is available on the port at the time. If the PSE is operating in reduced power (i.e., it is using backup power), the reduced power capacity is advertised as long as the condition persists.

By default, LLDP-MED power-via-MDI information is automatically advertised when LLDP-MED is enabled, the port is a POE port, and POE is enabled on the port. To disable this advertisement, enter a command such as the following.

```
device(config)#no lldp advertise med-power-via-mdi ports e 1/2/4 to 1/2/12
```

The LLDP-MED power-via-MDI advertisement will appear similar to the following on the remote device, and in the CLI display output on the RUCKUS device (**show lldp local-info**).

```
+ MED Extended Power via MDI
    Power Type     : PSE device
    Power Source   : Unknown Power Source
    Power Priority : Low (3)
    Power Value    : 6.5 watts (PSE equivalent: 7005 mWatts)
```

Syntax:[no] lldp advertise med-power-via-mdi ports ethernet *port-list* | **all**

Displaying LLDP statistics and configuration settings

You can use the following CLI **show** commands to display information about LLDP settings and statistics:

- **show lldp** - Displays a summary of the LLDP configuration settings.
- **show lldp statistics** - Displays LLDP global and per-port statistics.
- **show lldp neighbors** - Displays a list of the current LLDP neighbors.
- **show lldp neighbors detail** - Displays the details of the latest advertisements received from LLDP neighbors.
- **show lldp local-info** - Displays the details of the LLDP advertisements that will be transmitted on each port.

This above **show** commands are described in this section.

LLDP configuration summary

To display a summary of the LLDP configuration settings on the device, enter the **show lldp** command at any level of the CLI.

The following shows an example report.

```
device#show lldp
LLDP transmit interval           : 10 seconds
LLDP transmit hold multiplier    : 4  (transmit TTL: 40 seconds)
LLDP transmit delay              : 1 seconds
LLDP SNMP notification interval  : 5 seconds
LLDP reinitialize delay          : 1 seconds
LLDP-MED fast start repeat count : 3
LLDP maximum neighbors           : 392
LLDP maximum neighbors per port  : 4
```

Syntax: show lldp

The following table describes the information displayed by the **show lldp statistics** command.

Field	Description
LLDP transmit interval	The number of seconds between regular LLDP packet transmissions.
LLDP transmit hold multiplier	The multiplier used to compute the actual time-to-live (TTL) value of an LLDP advertisement. The TTL value is the transmit interval multiplied by the transmit hold multiplier.
LLDP transmit delay	The number of seconds the LLDP agent will wait after transmitting an LLDP frame and before transmitting another LLDP frame.

Field	Description
LLDP SNMP notification interval	The number of seconds between transmission of SNMP LLDP traps (lldpRemTablesChange) and SNMP LLDP-MED traps (lldpXMedTopologyChangeDetected).
LLDP reinitialize delay	The minimum number of seconds the device will wait from when LLDP is disabled on a port, until a request to re-enable LLDP on that port will be honored.
LLDP-MED fast start repeat count	The number of seconds between LLDP frame transmissions when an LLDP-MED Endpoint is newly detected.
LLDP maximum neighbors	The maximum number of LLDP neighbors for which LLDP data will be retained, per device.
LLDP maximum neighbors per port	The maximum number of LLDP neighbors for which LLDP data will be retained, per port.

Displaying LLDP statistics

The **show lldp statistics** command displays an overview of LLDP neighbor detection on the device, as well as packet counters and protocol statistics. The statistics are displayed on a global basis.

The following shows an example report.

```
device#show lldp statistics
Last neighbor change time: 23 hours 50 minutes 40 seconds ago
Neighbor entries added          : 14
Neighbor entries deleted        : 5
Neighbor entries aged out       : 4
Neighbor advertisements dropped : 0
Port       Tx Pkts    Rx Pkts    Rx Pkts    Rx Pkts    Rx TLVs    Rx TLVs Neighbors
             Total      Total  w/Errors Discarded Unrecognz Discarded  Aged Out
1            60963      75179         0          0          0          0         4
2                0          0         0          0          0          0         0
3            60963      60963         0          0          0          0         0
4            60963     121925         0          0          0          0         0
5                0          0         0          0          0          0         0
6                0          0         0          0          0          0         0
7                0          0         0          0          0          0         0
8                0          0         0          0          0          0         0
9                0          0         0          0          0          0         0
10           60974          0         0          0          0          0         0
11               0          0         0          0          0          0         0
12               0          0         0          0          0          0         0
13               0          0         0          0          0          0         0
14               0          0         0          0          0          0         0
```

Syntax: show lldp statistics

NOTE

You can reset LLDP statistics using the CLI command **clear LLDP statistics** . Refer to Resetting LLDP statistics on page 162.

The following table describes the information displayed by the **show lldp statistics** command.

Field	Description
Last neighbor change time	The elapsed time (in hours, minutes, and seconds) since a neighbor last advertised information. For example, the elapsed time since a neighbor was last added, deleted, or its advertised information changed.
Neighbor entries added	The number of new LLDP neighbors detected since the last reboot or since the last time the **clear lldp statistics** all command was issued.
Neighbor entries deleted	The number of LLDP neighbors deleted since the last reboot or since the last time the **clear lldp statistics all** command was issued.

Field	Description
Neighbor entries aged out	The number of LLDP neighbors dropped on all ports after the time-to-live expired. Note that LLDP entries age out naturally when a port cable or module is disconnected or when a port becomes disabled. However, if a disabled port is re-enabled, the system will delete the old LLDP entries.
Neighbor advertisements dropped	The number of valid LLDP neighbors the device detected, but could not add. This can occur, for example, when a new neighbor is detected and the device is already supporting the maximum number of neighbors possible. This can also occur when an LLDPDU is missing a mandatory TLV or is not formatted correctly.
Port	The local port number.
Tx Pkts Total	The number of LLDP packets the port transmitted.
Rx Pkts Total	The number of LLDP packets the port received.
Rx Pkts w/Errors	The number of LLDP packets the port received that have one or more detectable errors.
Rx Pkts Discarded	The number of LLDP packets the port received then discarded.
Rx TLVs Unrecognz	The number of TLVs the port received that were not recognized by the LLDP local agent. Unrecognized TLVs are retained by the system and can be viewed in the output of the **show LLDP neighbors** detail command or retrieved through SNMP.
Rx TLVs Discarded	The number of TLVs the port received then discarded.
Neighbors Aged Out	The number of times a neighbor information was deleted because its TTL timer expired.

Displaying LLDP neighbors

The **show lldp neighbors** command displays a list of the current LLDP neighbors per port.

The following shows an example report.

```
device# show lldp neighbors

Lcl Port Chassis ID      Port ID         Port Description     System Name
1        0000.0034.0fc0  0000.0034.0fc0  GigabitEthernet9/1   FastIron ICX 7~
1        0000.0001.4000  0000.0001.4000  GigabitEthernet0/1/1 FastIron ICX 7~
3        0000.0011.0200  0000.0011.0203  GigabitEthernet4     FastIron ICX 7~
4        0000.0011.0200  0000.0011.0202  GigabitEthernet3     FastIron ICX 7~
4        0000.0011.0200  0000.0011.0210  GigabitEthernet17    FastIron ICX 7~
15       0000.0011.0200  0000.0011.020f  GigabitEthernet16    FastIron ICX 7~
16       0000.0011.0200  0000.0011.020e  GigabitEthernet15    FastIron ICX 7~
17       0000.0011.0200  0000.0011.0211  GigabitEthernet18    FastIron ICX 7~
```

Syntax:show lldp neighbors

The following table describes the information displayed by the **show lldp neighbors** command.

Field	Description
Lcl Port	The local LLDP port number.
Chassis ID	The identifier for the chassis. RUCKUS devices use the base MAC address of the device as the Chassis ID.
Port ID	The identifier for the port. RUCKUS devices use the permanent MAC address associated with the port as the port ID.

Field	Description
Port Description	The description for the port. RUCKUS devices use the ifDescr MIB object from MIB-II as the port description.
System Name	The administratively-assigned name for the system. RUCKUS devices use the sysName MIB object from MIB-II, which corresponds to the CLI **hostname** command setting. **NOTE** A tilde (~) at the end of a line indicates that the value in the field is too long to display in full and is truncated.

Displaying LLDP neighbors detail

The **show lldp neighbors detail** command displays the LLDP advertisements received from LLDP neighbors.

The following shows an example **show lldp neighbors detail** report.

NOTE
The **show lldp neighbors detail** output will vary depending on the data received. Also, values that are not recognized or do not have a recognizable format, may be displayed in hexadecimal binary form.

```
device#show lldp neighbors detail ports e 1/1/9
Local port: 1/1/9
  Neighbor: 0000.0018.cc03, TTL 101 seconds
    + Chassis ID (network address): 10.43.39.151
    + Port ID (MAC address): 0000.0018.cc03
    + Time to live: 120 seconds
    + Port description    : "LAN port"
    + System name         : "regDN 1015,MITEL 5235 DM"
    + System description  : "regDN 1015,MITEL 5235 DM,h/w rev 2,ASIC rev 1,f/w\
                             Boot 02.01.00.11,f/w Main 02.01.00.11"
    + System capabilities : bridge, telephone
      Enabled capabilities: bridge, telephone
    + Management address (IPv4): 10.43.39.151
    + 802.3 MAC/PHY          : auto-negotiation enabled
      Advertised capabilities: 10BaseT-HD, 10BaseT-FD, 100BaseTX-HD,
                               100BaseTX-FD
      Operational MAU type   : 100BaseTX-FD
    + MED capabilities: capabilities, networkPolicy, extendedPD
      MED device type : Endpoint Class III
    + MED Network Policy
      Application Type  : Voice
      Policy Flags      : Known Policy, Tagged
      VLAN ID           : 300
      L2 Priority       : 7
      DSCP Value        : 7
    + MED Extended Power via MDI
      Power Type     : PD device
      Power Source   : Unknown Power Source
      Power Priority : High (2)
      Power Value    : 6.2 watts (PSE equivalent: 6656 mWatts)
    + MED Hardware revision : "PCB Version: 2"
    + MED Firmware revision : "Boot 02.01.00.11"
    + MED Software revision : "Main 02.01.00.11"
    + MED Serial number     : ""
    + MED Manufacturer      : "Mitel Corporation"
    + MED Model name        : "MITEL 5235 DM"
    + MED Asset ID          : ""
```

A backslash (\) at the end of a line indicates that the text continues on the next line.

Except for the following field, the fields in the above output are described in the individual TLV advertisement sections in this chapter.

Field	Description
Neighbor	The source MAC address from which the packet was received, and the remaining TTL for the neighbor entry.

Syntax: show lldp neighbors detail [**ports ethernet** *port-list* | **all**]

If you do not specify any ports or use the keyword **all**, by default, the report will show the LLDP neighbor details for all ports.

Displaying LLDP configuration details

The **show lldp local-info** command displays the local information advertisements (TLVs) that will be transmitted by the LLDP agent.

NOTE

The **show lldp local-info** output will vary based on LLDP configuration settings.

The following shows an example report.

```
device# show lldp local-info ports e 1/1/20
Local port: 1/1/20
  + Chassis ID (MAC address): 0000.0033.e2c0
  + Port ID (MAC address): 0000.0033.e2d3
  + Time to live: 40 seconds
  + System name: "ICX7450SP-ADV Router"
  + Port description: "GigabitEthernet20"
  + System description  : "Ruckus Wireless, Inc. ICX_ADV_ROUTER_SOFT_PACKAGE,
    SW: Version 08.0.40q030T213 Compiled on Thu Jul 16 06:27:06 2015 labeled as ICXR08040"
  + System capabilities : bridge
    Enabled capabilities: bridge
  + 802.3 MAC/PHY       : auto-negotiation enabled
    Advertised capabilities: 10BaseT-HD, 10BaseT-FD, 100BaseTX-HD,
                             100BaseTX-FD, fdxSPause, fdxBPause, 1000BaseT-HD,
                             1000BaseT-FD
    Operational MAU type: 100BaseTX-FD
  + 802.3 Power via MDI: PSE port, power enabled, class 2
    Power Pair          : A (not controllable)
  + Link aggregation: not capable
  + Maximum frame size: 1522 octets
  + MED capabilities: capabilities, networkPolicy, location, extendedPSE
    MED device type : Network Connectivity
  + MED Network Policy
    Application Type  : Voice
    Policy Flags      : Known Policy, Tagged
    VLAN ID           : 99
    L2 Priority       : 3
    DSCP Value        : 22
  + MED Network Policy
    Application Type  : Video Conferencing
    Policy Flags      : Known Policy, Tagged
    VLAN ID           : 100
    L2 Priority       : 5
    DSCP Value        : 10
  + MED Location ID
    Data Format: Coordinate-based location
    Latitude Resolution  : 20 bits
    Latitude Value       : -78.303 degrees
    Longitude Resolution : 18 bits
    Longitude Value      : 34.27 degrees
    Altitude Resolution  : 16 bits
    Altitude Value       : 50. meters
    Datum                : WGS 84
+ MED Location ID
    Data Format: Civic Address
```

```
    Location of: Client
    Country    : "US"
    CA Type    : 1
    CA Value   : "CA"
    CA Type    : 3
    CA Value   : "San Jose"
    CA Type    : 6
    CA Value   : "120 Holger Way"
    CA Type    : 24
    CA Value   : "95134"
    CA Type    : 27
    CA Value   : "5"
    CA Type    : 28
    CA Value   : "551"
    CA Type    : 29
    CA Value   : "office"
    CA Type    : 23
    CA Value   : "John Doe"
  + MED Location ID
    Data Format: ECS ELIN
    Value      : "4083335745"
  + MED Extended Power via MDI
    Power Type     : PSE device
    Power Source   : Unknown Power Source
    Power Priority : Low (3)
    Power Value    : 6.5 watts (PSE equivalent: 7005 mWatts) + Port VLAN ID: 99
  + Management address (IPv4): 10.1.1.121
  + VLAN name (VLAN 99): "Voice-VLAN-99"
```

NOTE

The contents of the **show** output will vary depending on which TLVs are configured to be advertised.

A backslash (\) at the end of a line indicates that the text continues on the next line.

The fields in the above output are described in the individual TLV advertisement sections in this chapter.

Syntax: show lldp local-info [**ports ethernet** *port-list* | **all**]

If you do not specify any ports or use the keyword **all** , by default, the report will show the local information advertisements for all ports.

LLDP port ID subtype configuration for E-911

The Link Layer Discovery Protocol (LLDP) port ID subtype configuration determines the information that is advertised as the port ID. To support Enhanced 9-1-1 (E-911), the LLDP port ID subtype can be configured to advertise information about the physical location of a port.

NOTE

By default, the LLDP port ID subtype to advertise is set to 3, and the MAC address is advertised as the port ID. Configuration of an alternate LLDP port ID subtype to advertise is also supported.

E-911 (or E911) is a system that is used in North America to link people who dial 911 requesting emergency call services with the appropriate public resources.

The E-911 system routes a 911 call to the Public Service Answering Point (PSAP) that has jurisdiction over the physical location of the 911 caller. To connect the caller with the correct PSAP, the E-911 system must know the location of the caller. An Automatic Location Information (ALI) database is maintained on behalf of local governments and can be used to determine the location (street address) of a caller based on the caller ID.

However, in some situations the street address alone is not sufficient to rapidly locate the 911 caller. For example, when the 911 caller is an employee in a large office complex and the emergency services arrive at the street address, they would need additional information to quickly locate the caller; for example, it would be helpful to know that the call originated from Cube 2500 on Floor 5 in Building 2.

In a VoIP network, the physical location of a caller can be tracked by associating physical location information with the network port through which the caller accesses the network.

RUCKUS network device ports can advertise physical location information by way of the LLDP port ID subtype that is advertised.

The following LLDP port ID subtypes are supported:

- 1—Interface alias as defined in RFC 2863 and stored in the ifAlias MIB object.
- 3—MAC address.
- 5—Interface name as defined in RFC 2863 and stored in the ifName MIB object.
- 7—Locally assigned identifier as defined in RFC 2863. RUCKUS devices advertise the information stored in the ifIndex MIB object.

Port ID subtypes 1, 5, and 7 can be configured to hold information about the physical location of the port.

The LLDP port ID subtype to be advertised is configured using the **lldp advertise port-id-subtype** command.

Configuring the LLDP port ID subtype to advertise

The Link Layer Discovery Protocol (LLDP) port ID subtype determines the specific information that is advertised as the port ID. You can configure the LLDP port ID subtype to advertise for a specific port, for a range of ports, or for all LLDP-capable ports.

The LLDP port ID subtype advertises previously configured information. To ensure that the physical location of a port is available for advertisement when the port ID subtype to advertise is set to 1, 5, or 7, the port location is configured by using the **lldp med location-id civic-address**, **lldp med location-id coordinate-based**, or **lldp med location-id ecs-elin** command.

By default, the LLDP port ID subtype to advertise is set to 3 and the MAC address is advertised as the port ID. Complete the following steps to configure the advertisement of an alternate port ID subtype.

1. From privileged EXEC mode, enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Specify the LLDP port ID subtype to advertise.

   Port ID subtype 1 advertises the interface alias (taken from the ifAlias MIB object) as the port ID. The following example shows how to advertise port ID subtype 1 for interface 1/2/4.

   ```
   device(config)# lldp advertise port-id-subtype 1 ports ethernet 1/2/4
   ```

3. To view the port ID information that is advertised, use a **show** command such as **show lldp neighbors detail** on an LLDP neighbor device. In the following example, the advertised port ID is "Building2Floor5Cube2500".

```
device# show lldp neighbors detail

Local port: 1/2/4
  Neighbor: 748e.f8f9.55b1, TTL 94 seconds
    + Chassis ID (MAC address): 748e.f8f9.5580
    + Port ID (interface alias): Building2Floor5Cube2500
       + Time to live: 120 seconds
    + System name         : "ICX7750-48F Router"
    + Port description    : "40GigabitEthernet6/2/1"
    + System capabilities : bridge, router
      Enabled capabilities: bridge, router
    + 802.3 MAC/PHY          : auto-negotiation supported, but disabled
      Operational MAU type   : Other
    + Link aggregation: not capable
    + Maximum frame size: 1522 octets
    + Port VLAN ID: 1
    + Management address (IPv4): 10.20.159.105
```

The Port ID shown in this example (Building2Floor5Cube2500) was previously configured by using the **port-name** command in interface configuration mode.

Resetting LLDP statistics

To reset LLDP statistics, enter the **clear lldp statistics** command at the Global CONFIG level of the CLI. The RUCKUS device will clear the global and per-port LLDP neighbor statistics on the device (refer to Displaying LLDP statistics on page 156).

```
device#clear lldp statistics
```

Syntax: clear lldp statistics [**ports ethernet** *port-list* | **all**]

If you do not specify any ports or use the keyword **all** , by default, the system will clear lldp statistics on all ports.

Clearing cached LLDP neighbor information

The RUCKUS device clears cached LLDP neighbor information after a port becomes disabled and the LLDP neighbor information ages out. However, if a port is disabled then re-enabled before the neighbor information ages out, the device will clear the cached LLDP neighbor information when the port is re-enabled.

If desired, you can manually clear the cache. For example, to clear the cached LLDP neighbor information for port e 1/1/20, enter the following command at the Global CONFIG level of the CLI.

```
device#clear lldp neighbors ports e 1/1/20
```

Syntax: clear lldp neighbors [**ports ethernet** *port-list* | **all**]

If you do not specify any ports or use the keyword **all** , by default, the system will clear the cached LLDP neighbor information for all ports.

Power over Ethernet

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Power over Ethernet overview

This section provides an overview of the requirements for delivering power over the LAN as defined by the Institute of Electrical and Electronics Engineers Inc. (IEEE) in specifications 802.3af (PoE) and 802.3at (PoE+).

FastIron PoE devices provide Power over Ethernet, compliant with the standards described in the IEEE 802.3af specification for delivering inline power. RUCKUS devices are compliant with both the 802.3af and 802.3at specifications. The 802.3af specification defined the original standard for delivering power over existing network cabling infrastructure, enabling multicast-enabled full streaming audio and video applications for converged services, such as Voice over IP (VoIP), Wireless Local Area Access (WLAN) points, IP surveillance cameras, and other IP technology devices. The 802.3at specification expands the standards to support higher power levels for more demanding powered devices, such as video IP phones, pan-tilt-zoom cameras, and high-power outdoor antennas for wireless access points. Except where noted, this document uses the term PoE to refer to PoE and PoE+.

For a list of the FastIron devices and modules that support PoE, PoE+, Power over HDBaseT (PoH), or a combination, refer to the *RUCKUS FastIron Features and Standards Support Matrix*.

PoE technology eliminates the need for an electrical outlet and dedicated UPS near IP powered devices. With power-sourcing equipment such as a FastIron PoE device, power is consolidated and centralized in wiring closets, improving the reliability and resilience of the network.

Power over Ethernet terms used in this chapter

The following terms are introduced in this chapter:

- **IP powered device (PD)** or **power-consuming device** - The Ethernet device that requires power. It is situated on the end of the cable opposite the power-sourcing equipment.
- **PoE+** - Covered by IEEE 802.at, provides up to 25.5 Watts of power.
- **PoH** - Covered by IEEE 802.3at 2009 and sometimes called power over HDBaseT, provides up to 95 Watts of power to power-consuming devices.
- **Power-sourcing device** or **Power-sourcing equipment (PSE)** - The source of the power, or the device that integrates the power onto the network. Power sourcing devices and equipment have embedded PoE technology. The FastIron PoE device is a power sourcing device.

Power over Ethernet 802.1br stack support

You can configure and monitor PoE functionality from the core ICX 7750 stack. This feature is supported on ICX 7750, ICX 7250, and ICX 7450 devices.

PoE can now be managed and monitored from a single point for all connected port extenders with the PoE driver running on an ICX 7450 and the configuration and monitoring run from an ICX 7750 device.

Methods for delivering Power over Ethernet

There are two methods for delivering Power over Ethernet (PoE) as defined in the 802.3af and 802.3at specifications:

- **Endspan** - Power is supplied through the Ethernet ports on a power-sourcing device. With the Endspan solution, power can be carried over the two data pairs (Alternative A) or the two spare pairs (Alternative B).
- **Midspan** - Power is supplied by an intermediate power-sourcing device placed between the switch and the PD. With the Midspan solution, power is carried over the two spare pairs (Alternative B).

With both methods, power is transferred over four conductors, between the two pairs. 802.3af- and 802.3at-compliant PDs are able to accept power from either set of pairs.

RUCKUS PoE devices use the Endspan method, compliant with the 802.3af and 802.3at standards.

The Endspan and Midspan methods are described in more detail in the following sections.

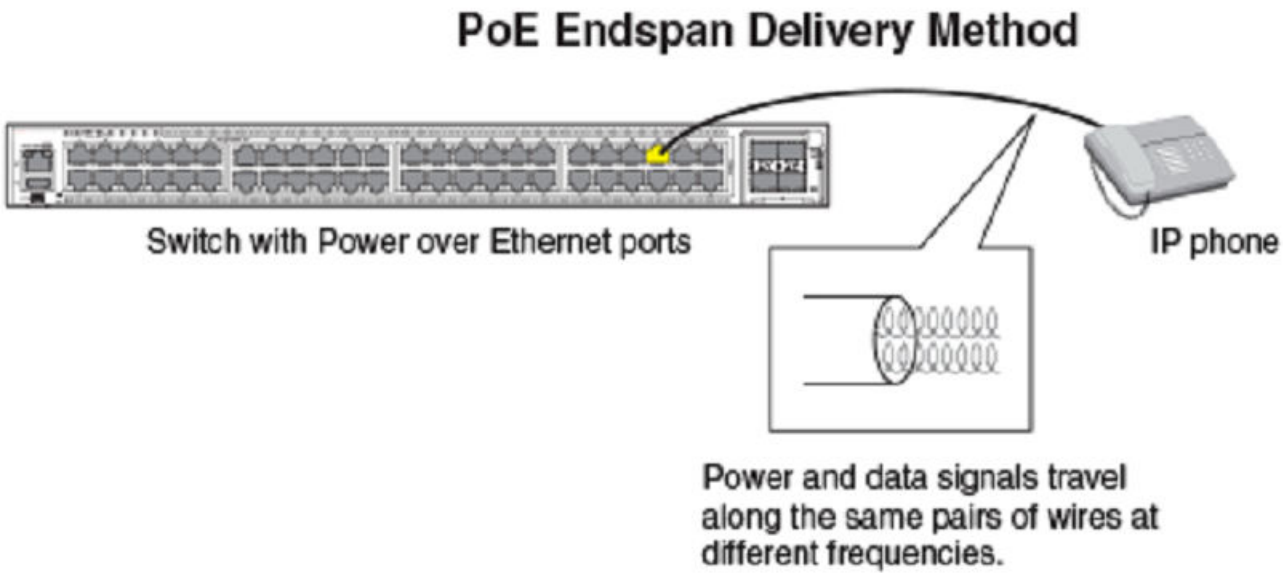
> **NOTE**
> All 802.3af- and 802.3at-compliant power-consuming devices are required to support both application methods defined in the 802.3af and 802.3at specification.

PoE endspan method

The PoE Endspan method uses the Ethernet switch ports on power-sourcing equipment, such as a RUCKUSFastIron PoE switch, which has embedded PoE technology to deliver power over the network.

With the Endspan solution, there are two supported methods of delivering power. In Alternative A, four wires deliver data and power over the network. Specifically, power is carried over the live wire pairs that deliver data as illustrated in the following figure. In Alternative B, the four wires of the spare pairs are used to deliver power over the network. RUCKUS PoE devices support Alternative A.

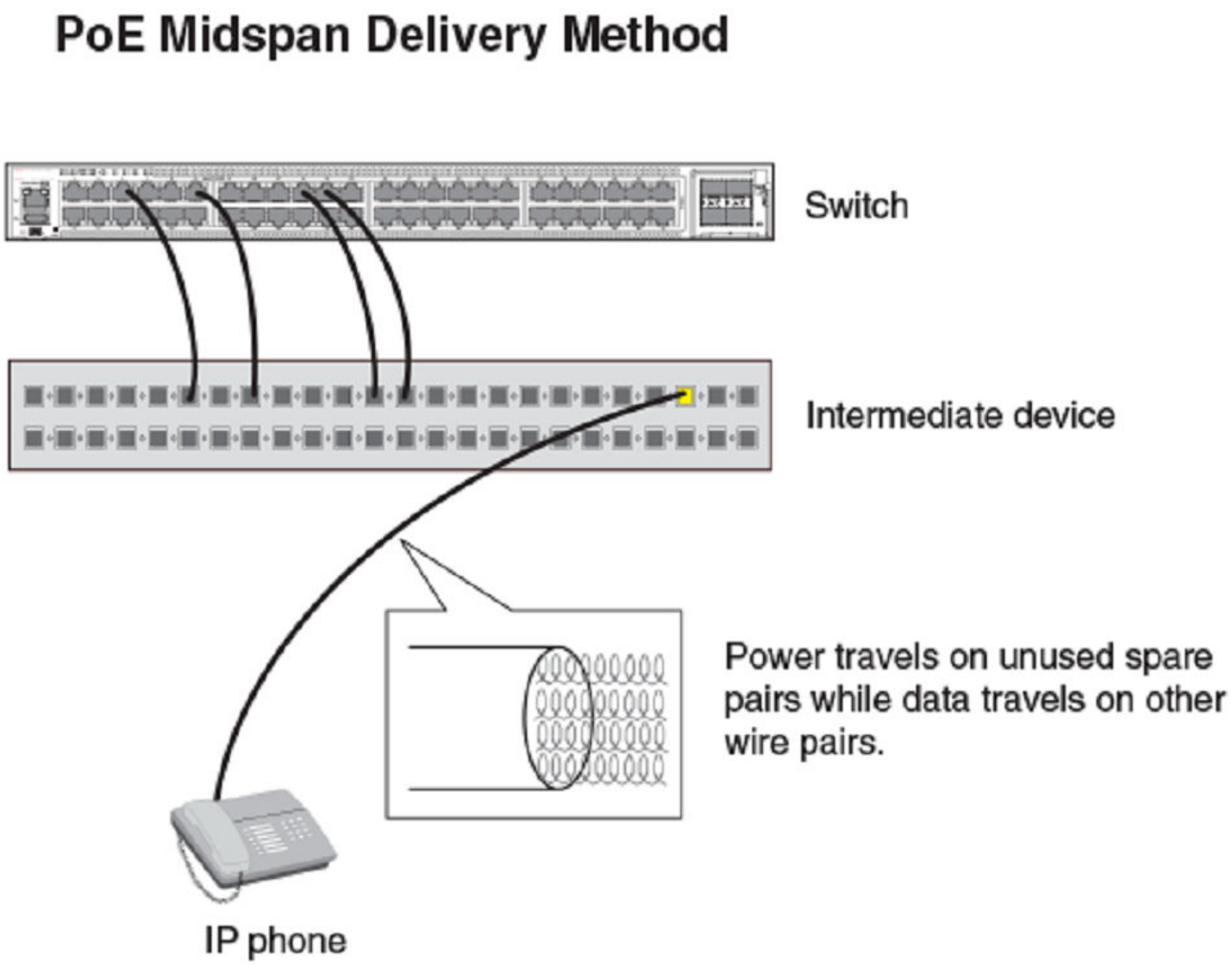
The Endspan method is shown in the following illustration.



PoE midspan method

The PoE Midspan method uses an intermediate device, usually another PD, to inject power into the network. The intermediate device is positioned between the switch and the PD and delivers power over the network using the spare pairs of wires (Alternative B). The intermediate device has multiple channels (typically 6 to 24), and each of the channels has data input and a data-plus-power RJ-45 output connector.

The Midspan method is illustrated in the following figure.



PoE autodiscovery

PoE autodiscovery is a detection mechanism that identifies whether an installed device is 802.3af- or 802.3at-compatible. When you plug a device into an Ethernet port that is capable of providing inline power, the autodiscovery mechanism detects whether the device requires power and how much power is needed. The autodiscovery mechanism also has a disconnect protection mechanism that shuts down the power once a PD has been disconnected from the network or when a faulty PD has been detected. This feature enables safe installation and prevents high-voltage damage to equipment.

PoE autodiscovery is achieved by periodically transmitting current or test voltages that can detect when a PD is attached to the network. When an 802.3af- or 802.3at-compatible device is plugged into a PoE, PoE+, or PoH port, the PD reflects test voltage back to the power-sourcing device (the RUCKUS device), ultimately causing the power to be switched on. Devices not compatible with 802.3af do not reflect test voltage back to the power-sourcing device.

Power class

A power class determines the amount of power a PD receives from power-sourcing equipment. When a valid PD is detected, the FastIron PoE device performs power classification by inducing a specific voltage and measuring the current consumption of the PD. Depending on the measured current, the appropriate class is assigned to the PD. PDs that do not support classification are assigned a class of 0 (zero). The following table shows the different power classes and their respective power consumption needs.

TABLE 36 Power classes for PDs

Class	Usage	Power (watts) from Power-Sourcing Device		
		Standard PoE	PoE+	Power over HDBaseT (PoH)
0	default	15.4	15.4	15.4
1	optional	4	4	4
2	optional	7	7	7
3	optional	15.4	15.4	15.4
4	optional	N/A	30[9]	95

Power management is enhanced to enable the port and also power up the legacy PD or Class 1, Class 2, or Class 3 PDs even if the available power is less than 30 Watts. In releases prior to 08.0.70, the default power reservation of 30W placed the ports in denied state when the available power is less than 30W. The port remains to stay in denied state even if you want to use lower class PDs on the ports. With the new enhancement, the device monitors the denied ports every 5 seconds and at every instance, if the available power is less than 30W but has more than Class 1/2/3 power, the ports are enabled and if the PD is detected in these Classes, it would get powered. This process continues until all denied ports are monitored for PD detection or the available power is less than 4W. The PDs will not be powered up if the available power is less than Class 1 PD power (4W).

TABLE 37 Power requirement for ports and PD detection

Available System Power	Power Reservation for PD detection
> Class 4 Power (>30W)	30W
> Class 3 Power (between 30W - 15.4W)	15.4W
> Class 2 Power (between 15.4W - 7W)	7W
> Class 1 Power (between 7W - 4W)	4W
< Class 1 Power (between 4W - 0W)	Ports will be in disabled state (power denied state)

PoE overdrive

In releases prior to 08.0.61, a PD could negotiate only for a power lower than the limit defined by the power class of PD through the LLDP messages. Beginning with 08.0.61 release, PoE overdrive feature allows the Class 0 and Class 4 PD to negotiate for power greater than 30-watt allocation (Refer to Table 38 and Table 39 for PoE overdrive support details). The maximum power that can be processed based on LLDP negotiation is limited to the hardware capability of the PSE. If the PD negotiates for power more than the hardware limit, the PSE allocates only up to the hardware capability of the PSE.

PoE overdrive is enabled by default. The user can explicitly enable PoE overdrive using the **inline power overdrive** command and is supported only on PoH and PoE+ ports. The **no** form of the command prevents the PDs from sending further power overdrive request. However, the power

[9] First eight ports of ICX 7450-24P or ICX 7450-48P supply 95w unless PD negotiates lower power requirement through LLDP protocol messages. First 16 ports of ICX 7150-48ZP supplies 95w unless PD negotiates lower power requirement through LLDP messages.

allocated to the PDs based on the earlier PoE overdrive request remains valid. PoE overdrive is valid only on 2-pair ports and 2-pair operation mode on 4-pair ports. The PoE overdrive allocation varies depending on the hardware SKUs as shown in the following table.

TABLE 38 PoE overdrive limit

ICX platforms	PoE overdrive allocation at PSE	PoE overdrive allocation usable at PD
ICX 7150-48ZP	45W	35W received at PD
ICX 7450 (all SKUs)	N/A	N/A
ICX 7650-48ZP	45W	35W received at PD
ICX 7650-48P	45W	35W received at PD

TABLE 39 PDs allowed for POE overdrive

Ruckus AP	Minimum Software Release
R720	3.5.1

Power specifications

The 802.3af (PoE) standard limits power to 15.4 watts (44 to 50 volts) from the power-sourcing device, in compliance with safety standards and existing wiring limitations. Though limited by the 802.3af standard, 15.4 watts of power was ample for most PDs, which consumed an average of 5 to 12 watts of power (IP phones, wireless LAN access points, and network surveillance cameras each consume an average of 3.5 to 9 watts of power). The 802.3at 2008 (PoE+) standard nearly doubles the power, providing 30 watts (52 to 55 volts) from the power-sourcing device.

NOTE
PoH ports on RUCKUS devices allocate 95 watts for 4-pair PDs.

The PoE power supply provides power to the PoE circuitry block and ultimately to PoE power-consuming devices. The number of PoE power-consuming devices that one PoE power supply can support depends on the number of watts required by each power-consuming device and the capacity of the power supply or power supplies. Each PoE+ port supports a maximum of 30 watts of power per power-consuming device. Each PoH port supports a maximum of 95 watts of power.

By default, a FastIron device pre-allocates power of 30 watts for a PoE+ configured port, and 95 watts for a PoH port.

As an example, if each PoE power-consuming device attached to a FastIron PoE device is budgeted to consume 30 watts of power, one 720- or 748-watt power supply can power up to 24 PoE ports. FastIron platforms support either a second power supply or an external power supply (EPS) to augment PoE power budget, depending on the product. Refer to the power supply specifications in the RUCKUS FastIron hardware installation guide for the appropriate FastIron device.

Power over Ethernet cabling requirements

The 802.3af and 802.3at standards currently support PoE and PoE+ on 10/100/1000-Mbps Ethernet ports operating over standard Category 5 unshielded twisted pair (UTP) cable or better. If your network uses cabling categories less than Category 5, you cannot implement PoE without first upgrading your cables to Category 5 UTP cable or better. PoH has the following cabling requirements based on distance:

- Cat 5e - 25 meters
- Cat 6/6a - 55 meters
- Cat 7 - 100 meters.

Supported powered devices

RUCKUS PoE devices support a wide range of IP powered devices, including the following:

- Voice over IP (VoIP) phones
- Wireless LAN access points
- IP surveillance cameras

The following sections briefly describe these IP powered devices.

VoIP

Voice over IP (VoIP) is the convergence of traditional telephony networks with data networks. VoIP uses the existing data network infrastructure as the transport system for both services. Voice is traditionally transported on a network that uses circuit-switching technology, but data networks are built on packet-switching technology. To achieve this convergence, technology has been developed to take a voice signal, which originates as an analog signal, and transport it within a digital medium. This is done by devices such as VoIP telephones that receive the originating tones and place them in UDP packets. The size and frequency of these UDP packets depends on the coding / decoding (CODEC) technology that has been implemented in the VoIP telephone or device. The VoIP control packets use TCP/IP format.

IP surveillance cameras

IP surveillance technology provides digital streaming of video over Ethernet, providing real-time, remote access to video feeds from cameras.

The main benefit of using IP surveillance cameras on the network is that you can view surveillance images from any computer on the network. If you have access to the Internet, you can securely connect from anywhere in the world to view a chosen facility or even a single camera from your surveillance system. By using a Virtual Private Network (VPN) or the company intranet, you can manage password-protected access to images from the surveillance system. Similar to secure payment over the Internet, images and information are kept secure and can be viewed only by approved personnel.

Auto Firmware download

Beginning with 08.0.70 release, PoE firmware file would be bundled with FastIron image and gets copied to `rootfs` of the ICX and is automatically installed or upgraded as part of unit bootup. That is, manual intervention is not required to choose the corresponding firmware version for each FasIron image version. During every bootup, the firmware version installed in the system is compared with the firmware version in the `rootfs` file. If there is difference in the version, the firmware from `rootfs` file will be installed. Once the firmware installation is complete, the user-defined or default PoE configuration is applied on the controller for PoE functionality. In a stacking environment, firmware installation happens on every local unit simultaneously even if the Master unit is not elected.

NOTE
When PoE firmware installation is in progress, the ports do not deliver power to the connected PDs and causes delay in availability of PoE functionality.

Firmware image file types

Beginning with FastIron 08.0.61 release, a unified PoE firmware is used across the supported devices.

TABLE 40 PoE Firmware file

Product	PoE Firmware
ICX 7450, ICX 7250, ICX 7150, and ICX 7650	icx7xxx_poe_02.1.0.b002.fw

PoE and CPU utilization

Depending on the number of PoE-configured ports that have active power devices, there may be a slight and noticeable increase of up to 15 percent in CPU utilization. This is normal behavior for PoE and in typical scenarios does not affect the functionality of other features on the switch.

Auto enabling of PoE

PoE is enabled by default and power is automatically allocated to all PoE-capable ports on bootup. As the 'inline power' configuration is applied on all PoE-capable ports by default, PD is powered up as soon as it is connected to the port. If the PoE power allocation needs to be disabled on bootup, use the **no inline power** command and do write memory. Upon reboot, all the saved PoE configurations would get applied and PoE will not be enabled.

For a stack member or PE, master unit sends the default “inline power” configuration or non-default PoE configuration while joining the stack or SPX system. Until then power is not applied on the member or PE unit ports. If there is no master unit detected after member bootup, the ports will not be enabled with power until master comes up.

Decoupling and coupling of PoE with datalink operations

Although PoE and datalink operations are functionally independent of each other, some datalink operations affect the operational behavior of PoE ports. To overcome this limitation, data link operation is decoupled with inline power by default. In the default state, the datalink operational behavior on a PoE port does not affect the power state of the powered device (PD) that is connecting to the port.

From 08.0.70b release onwards, user can override the default behavior of datalink decoupling using the **inline power couple-datalink** command. This command links the behavior of PoE configuration with interface disable or interface enable configuration. When they are linked, the **interface disable** command also removes the power on the port (disables power when interface is disabled).

The following are some datalink operations that can affect the operational state of the PoE on PoE ports:

- Using the **disable** command on the power sourcing equipment (PSE) port interface.
- LAG operational changes can affect the PoE power state if datalink coupling is enabled. That is power on LAG ports are impacted when LAG is undeployed, when the **disable** command is issued on LAG port, or when an interface is deleted from the LAG.

In situations where datalink operations tamper with PoE configurations and disable the power on the port, the interface has to be enabled so as to get the power enabled. To reinstate the default setting of datalink decouple, user must configure the **inline power** command on the interface.

> **NOTE**
> The **no** function of the **inline power couple-datalink** command does not restore the default setting but only disables the power on the port.

Upgrade and downgrade considerations

Upgrade impact: A configuration assuming default as no inline power will have a behavior change, as all ports will get powered. So if a user does not want PoE on a port, it has to be disabled after boot. The **decouple-datalink** keyword in the PoE configuration will be ignored upon upgrade to 08.0.70 release.

Downgrade impact: After a downgrade, all PDs will be powered down and the user has to specifically enable inline power on the ports. No impact for the **decouple-datalink** configuration keyword. However, the **inline power couple-datalink** command will not be recognized by the downgraded version.

ISSU Impact: If there is change in firmware version between FastIron images where image upgrade is happening with ISSU feature, there will be increase in time taken for upgrade. Because, there is a chance that a PD might be taking power from two units of the stack, it requires the ISSU to

wait to reload another unit until firmware upgrade finishes on one unit. If firmware upgrade is happening on one unit, that unit will not be delivering power to the PD and during this time if another unit is reloaded, PD loses power from both the units. So, only after firmware upgrade is finished and power is stabilized on all the ports, ISSU can start upgrading the image on the next unit. This consideration is not applicable for PE ports as all the PEs are reloaded together for ISSU upgrade.

Backward compatibility

New PoE configuration file is not backward compatible with respect to the default **inline power** and **inline power couple-datalink** configurations. Other configurations of **inline power power-limit** command are backward compatible.

Enabling and disabling Power over Ethernet

NOTE

PoE is enabled by default and power is automatically allocated to all PoE-capable ports on bootup. If the PoE power allocation is disabled on bootup using the **no inline power** command and the configuration is saved (**write memory**), all the saved PoE configurations would get applied and PoE will not be enabled upon reboot. In such a scenario, PoE can be enabled as explained below.

To enable a port to receive inline power for power-consuming devices after changing the default behavior, use the **inline power** command for the appropriate port. Here is an example.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# inline power
```

Once you have entered the commands to enable inline power, the console displays the following message after PD is powered.

```
device(config-if-e1000-1/1/1)# PoE Info: Power enabled on port 1/1/1.
```

The following example disables inline power on a range of ports.

```
device# configure terminal
device(config)# interface ethernet 1/1/1 to 1/1/48
device(config-mif-1/1/1-1/1/48)# no inline power
PoE: Power disabled on port 1/1/1 because of admin off.
PoE: Power disabled on port 1/1/2 because of admin off.
PoE: Power disabled on port 1/1/3 because of admin off.
PoE: Power disabled on port 1/1/4 because of admin off.
PoE: Power disabled on port 1/1/5 because of admin off.
PoE: Power disabled on port 1/1/6 because of admin off.
PoE: Power disabled on port 1/1/7 because of admin off.
PoE: Power disabled on port 1/1/8 because of admin off.
PoE: Power disabled on port 1/1/9 because of admin off.
PoE: Power disabled on port 1/1/10 because of admin off.
PoE: Power disabled on port 1/1/11 because of admin off.
PoE: Power disabled on port 1/1/12 because of admin off.
PoE: Power disabled on port 1/1/13 because of admin off.
PoE: Power disabled on port 1/1/14 because of admin off.
PoE: Power disabled on port 1/1/15 because of admin off.
PoE: Power disabled on port 1/1/16 because of admin off.
PoE: Power disabled on port 1/1/17 because of admin off.
PoE: Power disabled on port 1/1/18 because of admin off.
PoE: Power disabled on port 1/1/19 because of admin off.
PoE: Power disabled on port 1/1/20 because of admin off.
PoE: Power disabled on port 1/1/21 because of admin off.
PoE: Power disabled on port 1/1/22 because of admin off.
PoE: Power disabled on port 1/1/23 because of admin off.
PoE: Power disabled on port 1/1/24 because of admin off.
PoE: Power disabled on port 1/1/25 because of admin off.
PoE: Power disabled on port 1/1/26 because of admin off.
PoE: Power disabled on port 1/1/27 because of admin off.
PoE: Power disabled on port 1/1/28 because of admin off.
```

```
PoE: Power disabled on port 1/1/29 because of admin off.
PoE: Power disabled on port 1/1/30 because of admin off.
PoE: Power disabled on port 1/1/31 because of admin off.
PoE: Power disabled on port 1/1/32 because of admin off.
PoE: Power disabled on port 1/1/33 because of admin off.
PoE: Power disabled on port 1/1/34 because of admin off.
PoE: Power disabled on port 1/1/35 because of admin off.
PoE: Power disabled on port 1/1/36 because of admin off.
PoE: Power disabled on port 1/1/37 because of admin off.
PoE: Power disabled on port 1/1/38 because of admin off.
PoE: Power disabled on port 1/1/39 because of admin off.
PoE: Power disabled on port 1/1/40 because of admin off.
PoE: Power disabled on port 1/1/41 because of admin off.
PoE: Power disabled on port 1/1/42 because of admin off.
PoE: Power disabled on port 1/1/43 because of admin off.
PoE: Power disabled on port 1/1/44 because of admin off.
PoE: Power disabled on port 1/1/45 because of admin off.
PoE: Power disabled on port 1/1/46 because of admin off.
PoE: Power disabled on port 1/1/47 because of admin off.
PoE: Power disabled on port 1/1/48 because of admin off.
```

NOTE

Inline power should not be configured between two switches, as it may cause unexpected behavior.

NOTE

FastIron PoE and PoE+ devices can automatically detect whether a power-consuming device is 802.3af- or 802.3at-compliant.

Multiple PoE controller support

ICX device can support multiple vendor PoE chip set and initialize PoE functionality if a supported chipset vendor is detected. The factory configured PoE Signature is available in the EEPROM and the software reads the signature from the EEPROM and identifies the PoE controller hardware by the software. This feature is supported only on ICX 7650-48ZP and ICX7650-48P platforms. In 08.0.70 release, only Microsemi PoE Controller Hardware is supported.

Support for PoE legacy power-consuming devices

RUCKUS PoE devices support most legacy power-consuming devices (devices not compliant with 802.3af 802.3at), as well as all 802.3af- and 802.3at-compliant devices. However, legacy PD detection is disabled by default. You can enable support for legacy PoE power-consuming devices globally or on multiple interfaces and also at port level using the **legacy-inline-power** command where non-standard PDs are connected.

With global configuration enabled, if the **legacy-inline-power** is configured at the interface level, it will be displayed in the interface level running configuration. Port-level legacy power-consuming device detection cannot be disabled from the global configuration mode. That is, when the **legacy-inline-power** configuration is removed globally (from enable configuration), it is not required for the user to configure **legacy-inline power** on the individual ports where it was already enabled. When the legacy PD detection support is disabled, 802.3af- and 802.3at-compliant devices are not affected. By default, the inline-power command reserves 30 watts. On Power over HDBaseT (PoH) ports, inline-power reserves 95 watts.

NOTE

Legacy PD detection should not be enabled on ports where power-consuming devices are not connected.

Enabling the detection of PoE power requirements advertised through CDP

Many power-consuming devices, such as Cisco VoIP phones and other vendors' devices, use the Cisco Discovery Protocol (CDP) to advertise their power requirements to power-sourcing devices, such as RUCKUS PoE devices. RUCKUS power-sourcing equipment is compatible with Cisco and other vendors' power consuming devices and can detect and process power requirements for these devices automatically.

NOTE

If you configure a port with a maximum power level or a power class for a power-consuming device, the power level or power class takes precedence over the CDP power requirement. If you want a device to adhere to the CDP power requirement, do not configure a power level or power class on the associated port.

Command syntax for PoE power requirements

To enable the RUCKUS device to detect CDP power requirements, enter the following commands.

```
device# configure terminal
device(config)# cdp run
```

Use the **no** form of the command to disable the detection of CDP power requirements.

Setting the maximum power level for a PoE power-consuming device

When PoE is enabled on a port to which a power-consuming device, or PD, is attached, by default, a FastIron PoE device supplies 15.4 watts of power at the RJ-45 jack, minus any power loss through the cables. A PoE+ device supplies either 15.4 or 30 watts of power (depending on the type of PD connected to the port), minus any power loss through the cables. A PoH device supplies 15.4, 30, or 95 watts of power (depending on the type of PD connected to the port), minus any power loss through the cables.

As an example, a PoE port with a default maximum power level of 15.4 watts receives a maximum of 12.95 watts of power after 2.45 watts of power loss through the cable. This is compliant with the IEEE 802.3af and 802.3at specifications for delivering inline power. Devices that are configured to receive less PoE power, for example, 4.0 watts of power, experience a lower rate of power loss through the cable.

If desired, you can manually configure the maximum amount of power that the FastIron PoE device supplies at the RJ-45 jack.

Considerations for setting power levels

Consider the following when enabling this feature:

- There are two ways to configure the power level for a PoE or PoE+ power-consuming device. The first method is discussed in this section. The other method is provided in the section Setting the power class for a PoE power-consuming device on page 174. For each PoE port, you can configure either a maximum power level or a power class. You cannot configure both. You can, however, configure a maximum power level on one port and a power class on another port.
- The RUCKUS PoE, or PoE+ device adjusts the power on a port only if there are available power resources. If power resources are not available, the following message is displayed on the console and in the Syslog:

```
PoE: Failed power allocation of 30000 mwatts on port 1/1/21. Will retry when more power budget.
```

- If you are not using PoH devices in any of the first 8 ports of the ICX7450-48P or ICX7450-24P, RUCKUS recommends that you limit the power on those ports using the **inline power power-limit** command. Limiting power with the **inline power power-by-class 4** command does not work for the ICX7450 because Class 4 encompasses 30-95W. However, Class 4 on units that do not support PoH or High Power is still 30W.
- FastIron devices pre-allocate power as per the configured maximum power for a physically operational PoE or PoE+ configured port.

Configuring power levels command syntax

To configure the maximum power level for a power-consuming device, use the **inline power power-limit** command as shown in the following example.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# inline power power-limit 14000
```

These commands enable inline power on interface ethernet 1 in slot 1 of unit 1 and set the PoE power level to 14,000 milliwatts (14 watts).

Syntax: inline power power-limit *power-level*

The *power level* variable is the maximum power level in number of milliwatts. The following values are supported:

- **PoE** - Enter a value from 1000 through 15,400. The default is 15,400.
- **PoE+** - Enter a value from 1000 through 30,000. The default is 30,000.
- **PoH** - Enter a value from 1000 through 95,000. The default is 95,000. Value is always adjusted to nearest multiple of 5.

  NOTE
  Do not configure a power level higher than the default listed. Setting the power level higher than the default could damage the PD.

For information about resetting the maximum power level, refer to Resetting PoE parameters on page 176.

Setting the power class for a PoE power-consuming device

A power class specifies the maximum amount of power that a RUCKUS PoE, PoE+, or PoH device supplies to a power-consuming device. The following table shows the different power classes and their respective maximum power allocations.

TABLE 41 Power classes for PDs

Class	Usage	Power (watts) from Power-Sourcing Device		
		Standard PoE	PoE+	Power over HDBaseT (PoH)
0	default	15.4	15.4	15.4
1	optional	4	4	4
2	optional	7	7	7
3	optional	15.4	15.4	15.4
4	optional	15.4	30	95

Refer to Considerations for setting power levels on page 173 for essential information. Consider the following points when setting the power class for a PoE power-consuming device.

- The power class includes any power loss through the cables. For example, a PoE port with a power class of 3 (15.4 watts) receives a maximum of 12.95 watts of power after 2.45 watts of power loss through the cable. This is compliant with the IEEE 802.3af and 802.3at specifications for delivering inline power. Devices that are configured to receive less PoE power, for example, class 1 devices (4.0 watts), experience a lower rate of power loss through the cable.

- The RUCKUS PoE, PoE+, or PoH device adjusts the power on a port only if there are available power resources. If power resources are not available, the following message is displayed on the console and in the Syslog:

```
PoE: Failed power allocation of 30000 mwatts on port 1/1/21. Will retry when more power budget.
```

Setting the power class command syntax

To configure the power class for a PoE power consuming device, enter commands such as the following.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# inline power power-by-class 4
Warning: Inline power configuration on port 1/1/1 has been modified.
device(config-if-e1000-1/1/1)# show inline power 1

Power Capacity:         Total is 720000 mWatts. Current Free is 690000 mWatts.

Power Allocations:      Requests Honored 3 times


Port   Admin   Oper    ---Power(mWatts)---  PD Type  PD Class  Pri  Fault/
        State   State   Consumed  Allocated                          Error
-----------------------------------------------------------------------------
 1/1/1 On      On         14460      30000  802.3af  Class 3     3  n/a
```

These commands enable inline power on interface ethernet 1 in slot 1 of unit 1 and set the power class to 2.

For information about resetting the power class, refer to Resetting PoE parameters on page 176.

Setting the inline power priority for a PoE port

In a configuration where PoE power-consuming devices collectively have a greater demand for power than the PoE power supply or supplies can provide, the FastIron PoE device must place the PoE ports that it cannot power in *standby* or *denied* mode (waiting for power) until the available power increases. The available power increases when one or more PoE ports are powered down, or, if applicable, when an additional PoE power supply is installed in the FastIron PoE device.

When PoE ports are in *standby* or *denied* mode (waiting for power) and the FastIron PoE device receives additional power resources, by default, the device allocates newly available power to the standby ports in priority order, with the highest priority ports first, followed by the next highest priority ports, and so on. Within a given priority, standby ports are considered in ascending order, by slot number and then by port number, provided enough power is available for the ports. For example, PoE port 1/1/11 should receive power before PoE port 1/2/1. However, if PoE port 1/1/11 needs 12 watts of power and PoE port 1/2/1 needs 10 watts of power, but only 11 watts of power become available on the device, the FastIron PoE device allocates the power to port 1/2/1 because it does not have sufficient power for port 1/1/11.

You can configure an *inline power priority* on PoE ports, so that ports with a higher inline power priority take precedence over ports with a low inline power priority. For example, if a new PoE port comes online and the port is configured with a high priority, if necessary (if power is already fully allocated to power consuming devices), the FastIron PoE device removes power from a PoE port or ports that have a lower priority and allocates the power to the PoE port that has the higher value.

Ports that are configured with the same inline power priority are given precedence based on the slot number and port number in ascending order, provided enough power is available for the port. For example, if both PoE port 1/1/2 and PoE port 1/2/1 have a high inline power priority value, PoE port 1/1/2 receives power before PoE port 1/2/1. However, if PoE port 1/1/2 needs 12 watts of power and PoE port 1/2/1 needs 10 watts of power, but only 11 watts of power become available on the device, the FastIron PoE device allocates the power to PoE port 1/2/1 because it does not have sufficient power for port 1/1/2. By default, all ports are configured with a low inline power priority.

Resetting PoE parameters

You can override or reset PoE port parameters including power priority, power class, and maximum power level. To do so, you must specify each PoE parameter in the CLI command line.

Changing a PoE port power priority from low to high

To change a PoE port power priority from low (the default value) to high and keep the current maximum configured power level of 3000, enter commands such as the following.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# inline power priority 2 power-limit 3000
```

You must specify both the inline power priority and the maximum power level (**power-limit** command), even though you are keeping the current configured maximum power level at 3000. If you do not specify the maximum power level, the device will apply the default value. Also, you must specify the inline power priority before specifying the power limit.

Changing a port power class from 2 to 3

To change a port power class from 2 (7 watts maximum) to 3 (15.4 watts maximum) and keep the current configured power priority of 2, enter commands such as the following.

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# inline power priority 2 power-by-class 3
```

You must specify both the power class and the inline power priority, even though you are not changing the power priority. If you do not specify the power priority, the device will apply the default value of 3 (low priority). Also, you must specify the inline power priority before specifying the power class.

The following example sets PoE parameters on interface 2/1/1 in stack unit 12.

```
device# configure terminal
device(config)# stack unit 12
device(config)# interface ethernet 2/1/1
device(config-if-e1000-2/1/1)# inline power priority 3 power-limit 14000
```

Inline power on PoE LAG ports

The inline power on Power over Ethernet (PoE) LAG ports is enabled by default.

To disable inline power on any member LAG port, use the **no inline power** command on the LAG ports as the interface configuration mode is not available for LAG ports to run the command. After configuring inline power on PoE ports, you can verify the configuration using the **show running-config** command. If you have configured inline power on a regular PoE port in either global configuration or interface configuration mode, the inline power configuration commands display under the interface configuration level. If a regular PoE port becomes a PoE LAG port, or a PoE LAG port is configured under global configuration mode, the inline power configuration commands display under the global configuration level. If a LAG is removed, the inline power configuration commands for all ports display under the interface configuration level.

Configuring inline power on PoE ports in a LAG

Perform the following steps to configure and deploy a link aggregation group (LAG) on the required PoE ports on both the power sourcing equipment (PSE) and the PD. This task also enables inline power on the PoE ports.

1. Configure a LAG.

   ```
   device(config)# lag "mylag" static id 5
   ```

   This command configured a static LAG named mylag with an ID of 5.
2. Configure ports into the LAG membership.

   ```
   device(config-lag-mylag)# ports ethernet 1/1/1 to 1/1/4
   ```

   This command entered the four ports, 1/1/1, 1/1/2, 1/1/3, and 1/1/4, into LAG membership.
3. Configure inline power on a member port of the LAG with the power-by-class option.

   ```
   device(config)# inline power ethernet 1/1/1 power-by-class 3
   ```
4. Configure inline power on a member port with the default option.

   ```
   device(config)# inline power ethernet 1/1/2
   ```

   This command configured inline power on port 1/1/2 with the default option.
5. Configure inline power on a member port with the power management option.

   ```
   device(config)# inline power ethernet 1/1/3 priority 2
   ```

   This command configured inline power on port 1/1/3 with power management option 2.
6. Configure inline power on a member port, specifying the actual power value.

   ```
   device(config)# inline power ethernet 1/1/4 power-limit 12000
   ```

   This command configured inline power on the port 1/1/4, specifying an power value of 12000 mWatts.

Fanless mode support on ICX 7150

Fanless mode enables the device to operate with the fans disabled while providing a PoE budget of 150 watts. That is, when fanless mode is enabled, the fan speed is set to zero RPM, thus allowing the device to operate silently.

NOTE
Fanless mode is supported only on ICX 7150-24P and ICX 7150-48P devices.

Fanless mode can be enabled only if the PoE power allocation is less than or equal to 150W. If the PoE power allocation is more than 150W, PoE load must be reduced by removing PoE interfaces manually or by unplugging PoE devices.

Fanless mode does not depend on the variations in the PoE power allocation and is not triggered based on the thermal policy. Fanless mode must be enabled manually using the **chassis fanless** command. If fanless mode is disabled, the fan speed is reset to auto and the PoE budget is reinstated to the default value. In a stacking configuration, fanless mode can be enabled only from active console, and cannot be enabled from any member units including standby units.

NOTE
Even if fanless mode is configured on a switch, fans will be turned on temporarily during boot up or reboot and will be turned off after the boot up.

Displaying Power over Ethernet information

The show commands described in this section are available for viewing PoE operational status, PD data, and PoE power supply status.

Displaying PoE operational status

The **show inline power** command displays operational information about Power over Ethernet.

You can view the PoE operational status for the entire device, for a specific PoE module only, or for a specific interface only. In addition, you can use the **show inline power detail** command to display in-depth information about PoE power supplies. To display PoE data specific to PD ports, use the **show inline power pd** command.

The following example displays **show inline power** command output for a PoE device.

```
device# show inline power

Power Capacity:         Total is 720000 mWatts. Current Free is 384000 mWatts.

Power Allocations:      Requests Honored 146 times


Port   Admin   Oper    ---Power(mWatts)---  PD Type  PD Class  Pri  Fault/
        State   State   Consumed  Allocated                          Error
-----------------------------------------------------------------------
1/1/1  On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/2  On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/3  On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/4  On      On          6573       7000  802.3af  Class 2     3  n/a
1/1/5  On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/6  On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/7  On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/8  On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/9  On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/10 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/11 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/12 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/13 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/14 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/15 On      On          5915       7000  802.3af  Class 2     3  n/a
1/1/16 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/17 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/18 On      On          6573       7000  802.3af  Class 2     3  n/a
1/1/19 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/20 On      On          6573       7000  802.3af  Class 2     3  n/a
1/1/21 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/22 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/23 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/24 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/25 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/26 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/27 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/28 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/29 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/30 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/31 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/32 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/33 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/34 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/35 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/36 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/37 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/38 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/39 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/40 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/41 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/42 On      On          6479       7000  802.3af  Class 2     3  n/a
```

```
1/1/43 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/44 On      On          6479       7000  802.3af  Class 2     3  n/a
1/1/45 On      On          6291       7000  802.3af  Class 2     3  n/a
1/1/46 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/47 On      On          6385       7000  802.3af  Class 2     3  n/a
1/1/48 On      On          6385       7000  802.3af  Class 2     3  n/a
--------------------------------------------------------------------------
Total                   306950     336000
```

Displaying PoE data specific to PD ports

The **show inline power pd** command displays operational information specific to the PD ports.

This command displays information about the number of PD ports available, how much PD power is available to PSE, how much PD power is currently switched to PSE, and the PD port level status.

If a PD module is present, then the command displays the following global power information for the PD ports:

- Total PD power available to PSE
- Total PD power switched to PSE

In the absence of valid PSU power, the total PD power switched is equal to that available to PSE, as shown in the following example.

```
device# show inline power pd

Number of PD Ports: 2
Total PD Power Available to PSE: 22400
Total PD Power Switched to PSE: 22400
Port   Oper    Oper     Fault/
       State   Mode     Error
--------------------------------
1/2/1  On      802.3at  n/a
1/2/2  On      802.3at  n/a
```

The following shows an example of the **show inline power pd** display output on a PoE device with the internal PSU up and no PD ports on.

```
device# show inline power pd

Number of PD Ports: 2
Total PD Power Available to PSE: 0
Total PD Power Switched to PSE: 0

Port   Oper    Oper     Fault/
       State   Mode     Error
--------------------------------
1/2/1  Off     n/a      n/a
1/2/2  Off     n/a      n/a
```

The following shows an example of the **show inline power pd** display output on a PoE device with the internal PSU up and one PD port on in the AT mode.

```
device# show inline power pd

Number of PD Ports: 2
Total PD Power Available to PSE: 0
Total PD Power Switched to PSE: 0

Port   Oper    Oper     Fault/
       State   Mode     Error
--------------------------------
1/2/1  On      802.3at  n/a
1/2/2  Off     n/a      n/a
```

The following shows an example of the **show inline power pd** display output on a PoE device with the internal PSU down and two PD ports on in the AT mode.

```
device# show inline power pd

Number of PD Ports: 2
Total PD Power Available to PSE: 22400
Total PD Power Switched to PSE: 22400

Port   Oper    Oper     Fault/
       State   Mode     Error
--------------------------------
1/2/1  On      802.3at  n/a
1/2/2  On      802.3at  n/a
```

Displaying detailed information about PoE power supplies

The **show inline power detail** command displays detailed operational information about the PoE power supplies in FastIron PoE switches.

The following is an example of **show inline power detail** command output for an ICX 7250 stack.

```
device# show inline power detail

Power Supply Data On stack 1:
++++++++++++++++++

Power Supply Data:
++++++++++++++++++

Power Supply #1:
        Max Curr:       13.3 Amps
        Voltage:        54.0 Volts
        Capacity:       720 Watts
Power Supply #2:
        Max Curr:       6.6 Amps
        Voltage:        54.0 Volts
        Capacity:       360 Watts
Power Supply #3:
        Max Curr:       6.6 Amps
        Voltage:        54.0 Volts
        Capacity:       360 Watts


POE Details Info. On Stack 1 :

General PoE Data:
+++++++++++++++++

Firmware
Version
----------------
01.2.1 Build 003

Cumulative Port State Data:
+++++++++++++++++++++++++++

#Ports    #Ports     #Ports   #Ports    #Ports       #Ports     #Ports
Admin-On  Admin-Off  Oper-On  Oper-Off  Off-Denied   Off-No-PD  Off-Fault
-------------------------------------------------------------------------
48        0          0        48        0            47         1

Cumulative Port Power Data:
+++++++++++++++++++++++++++

#Ports  #Ports  #Ports        Power       Power
Pri: 1  Pri: 2  Pri: 3  Consumption  Allocation
---------------------------------------------
0       0       48          0.0   W     0.0   W
```

The following example provides details on an ICX 7250 connected to an EPS.

```
device# show chassis

The stack unit 1 chassis info:

Power supply 1 (NA - AC - PoE) present, status ok
Power supply 1 Fan Air Flow Direction:  Front to Back
Power supply 2 (NA - DC - PoE) present, status ok

Fan 1 ok, speed (manual): [[1]]<->2
Fan 2 ok, speed (manual): [[1]]<->2

Fan controlled temperature:
        Rule 1/2 (MGMT THERMAL PLANE): 49.0 deg-C
        Rule 2/2 (PoE THERMAL PLANE): 40.5 deg-C

Fan speed switching temperature thresholds:
        Rule 1/2 (MGMT THERMAL PLANE):
                Speed 1: NM<----->93       deg-C
                Speed 2:       82<----->105 deg-C (shutdown)
        Rule 2/2 (PoE THERMAL PLANE):
                Speed 1: NM<----->58       deg-C
                Speed 2:       49<----->105 deg-C (shutdown)

Fan 1 Air Flow Direction:  Front to Back
Fan 2 Air Flow Direction:  Front to Back
Slot 1 Current Temperature: 49.0 deg-C (Sensor 1), 39.5 deg-C (Sensor 2)
Slot 2 Current Temperature: NA
        Warning level.......: 100.0 deg-C
        Shutdown level......: 105.0 deg-C
Boot Prom MAC : cc4e.24b4.906c
Management MAC: cc4e.24b4.906c

device# show inline power

Power Capacity:         Total is 720000 mWatts. Current Free is 0 mWatts.

Power Allocations:      Requests Honored 82 times


Port   Admin   Oper    ---Power(mWatts)---  PD Type  PD Class  Pri  Fault/
        State   State   Consumed  Allocated                          Error
-------------------------------------------------------------------------
 1/1/1 On      On         28264      30000  802.3at  Class 4     3  n/a
 1/1/2 On      On         28921      30000  802.3at  Class 4     3  n/a
 1/1/3 On      On         28170      30000  802.3at  Class 4     3  n/a
 1/1/4 On      On         28170      30000  802.3at  Class 4     3  n/a
 1/1/5 On      On         28452      30000  802.3at  Class 4     3  n/a
 1/1/6 On      On         28170      30000  802.3at  Class 4     3  n/a
 1/1/7 On      On         28452      30000  802.3at  Class 4     3  n/a
 1/1/8 On      On         28358      30000  802.3at  Class 4     3  n/a
 1/1/9 On      On         28170      30000  802.3at  Class 4     3  n/a
1/1/10 On      On         28170      30000  802.3at  Class 4     3  n/a
1/1/11 On      On         28170      30000  802.3at  Class 4     3  n/a
1/1/12 On      On         28170      30000  802.3at  Class 4     3  n/a
1/1/13 On      On         28264      30000  802.3at  Class 4     3  n/a
1/1/14 On      On         28264      30000  802.3at  Class 4     3  n/a
1/1/15 On      On         26010      30000  802.3at  Class 4     3  n/a
1/1/16 On      On         28358      30000  802.3at  Class 4     3  n/a
1/1/17 On      On         28546      30000  802.3at  Class 4     3  n/a
1/1/18 On      On         28640      30000  802.3at  Class 4     3  n/a
1/1/19 On      On         28640      30000  802.3at  Class 4     3  n/a
1/1/20 On      On         28640      30000  802.3at  Class 4     3  n/a
1/1/21 On      On         28640      30000  802.3at  Class 4     3  n/a
1/1/22 On      On         28640      30000  802.3at  Class 4     3  n/a
1/1/23 On      On         28452      30000  802.3at  Class 4     3  n/a
1/1/24 On      On         28640      30000  802.3at  Class 4     3  n/a
-------------------------------------------------------------------------
Total                    679371     720000
```

```
device# show inline power detail

Power Supply Data On stack 1:
++++++++++++++++++

Power Supply Data:
++++++++++++++++++

Power Supply #1:
        Max Curr:       6.6 Amps
        Voltage:        54.0 Volts
        Capacity:       360 Watts
Power Supply #2:
        Max Curr:       6.6 Amps
        Voltage:        54.0 Volts
        Capacity:       360 Watts


POE Details Info. On Stack 1 :


General PoE Data:
+++++++++++++++++

Firmware
Version
----------------
01.6.1 Build 009

Cumulative Port State Data:
++++++++++++++++++++++++++

#Ports    #Ports     #Ports   #Ports    #Ports       #Ports     #Ports
Admin-On  Admin-Off  Oper-On  Oper-Off  Off-Denied   Off-No-PD  Off-Fault
-------------------------------------------------------------------------
24        0          24       0         0            0          0

Cumulative Port Power Data:
++++++++++++++++++++++++++

#Ports  #Ports  #Ports        Power       Power
Pri: 1  Pri: 2  Pri: 3  Consumption  Allocation
-----------------------------------------------
0       0       24        679.371 W   720.0   W
```

The following is an example of **show inline power detail** command output for an ICX 7150 device.

```
device# show inline power detail
Power Supply Data On unit 1:
++++++++++++++++++
Power Supply Data:
++++++++++++++++++

power supply 1 is not present
Power Supply #2:
        Max Curr:       13.8 Amps
        Voltage:        54.0 Volts
        Capacity:       748 Watts


POE Details Info. On Unit 1 :


General PoE Data:
+++++++++++++++++

Firmware
Version
----------------
01.6.7 Build 013
```

```
Hardware
Version
-----------------
V1R3

Cumulative Port State Data:
++++++++++++++++++++++++++

#Ports    #Ports     #Ports   #Ports    #Ports       #Ports     #Ports
Admin-On  Admin-Off  Oper-On  Oper-Off  Off-Denied   Off-No-PD  Off-Fault
-------------------------------------------------------------------------
30        2          7        25        0            23         2
Cumulative Port Power Data:
++++++++++++++++++++++++++

#Ports  #Ports  #Ports        Power       Power
Pri: 1  Pri: 2  Pri: 3  Consumption  Allocation
---------------------------------------------
1       0       29         43.900 W   470.000 W
```

Troubleshooting

The following scenarios describe issues that affect PoE functionality and the actions required to overcome those issues:

- Ports connected to legacy PDs with 10-Mbps uplink port speed are treated as non-PD ports and therefore, power is not supplied to the legacy PDs. This occurs in two scenarios:
  - Scenario 1: When a PSE port is configured with 10M and connected to PDs with 10-Mbps uplink port speed.
  - Scenario 2: When a PSE port is in auto-negotiation mode (default mode) and the PD is in the powered state; and if the PD is power cycled using **no inline power** followed by **inline power** commands.

  Ruckus recommends one of the following configurations to overcome the limitation and get the PDs out of the non-PD state:

  - Ensure that the data link operation is decoupled from inline power using the **inline power couple-datalink** command and power cycle the PDs by disabling and re-enabling the interface.
  - Keep the port at the default speed (auto-negotiation mode) and then configure **disable** and **enable** on the interface.
- PoE functionality on some ports will not be available when the device (PoE chip) fails during operation. These ports show up as "internal hardware fault" in the **show inline power** command output. In such scenarios, remove the PDs and configure the **no inline power** command on the affected ports. A syslog message is generated that shows the specific ports that are offline due to device failure. Refer to the *RUCKUS FastIron Monitoring Configuration Guide* for syslog details.

```
device# show inline power

Power Capacity:         Total is 740000 mWatts. Current Free is 721700 mWatts.

Power Allocations:      Requests Honored 48 times


 Port    Admin   Oper    ---Power(mWatts)---  PD Type   PD Class   Pri  Fault/
         State   State   Consumed  Allocated                         Error
-------------------------------------------------------------------------------
  7/1/1 On      On           7000      12000  802.3af   Class 3     3  n/a
  7/1/2 On      Off             0          0  n/a       n/a         3  n/a
  7/1/3 On      Off             0          0  n/a       n/a         3  n/a
  7/1/4 On      Off             0          0  n/a       n/a         3  n/a
  7/1/5 On      Off             0          0  n/a       n/a         3  n/a
  7/1/6 On      Off             0          0  n/a       n/a         3  n/a
  7/1/7 On      Off             0          0  n/a       n/a         3  n/a
  7/1/8 On      Off             0          0  n/a       n/a         3  n/a
  7/1/9 On      Off             0          0  n/a       n/a         3  internal h/w fault
 7/1/10 On      Off             0          0  n/a       n/a         3  internal h/w fault
 7/1/11 On      Off             0          0  n/a       n/a         3  internal h/w fault
 7/1/12 On      Off             0          0  n/a       n/a         3  internal h/w fault
```

```
 7/1/13 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/14 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/15 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/16 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/17 On      Off            0          0  n/a      n/a         3  n/a
 7/1/18 On      Off            0          0  n/a      n/a         3  n/a
 7/1/19 On      Off            0          0  n/a      n/a         3  n/a
 7/1/20 On      Off            0          0  n/a      n/a         3  n/a
 7/1/21 On      Off            0          0  n/a      n/a         3  n/a
 7/1/22 On      Off            0          0  n/a      n/a         3  n/a
 7/1/23 On      Off            0          0  n/a      n/a         3  n/a
 7/1/24 On      Off            0          0  n/a      n/a         3  n/a
 7/1/25 On      Off            0          0  n/a      n/a         3  n/a
 7/1/26 On      Off            0          0  n/a      n/a         3  n/a
 7/1/27 On      Off            0          0  n/a      n/a         3  n/a
 7/1/28 On      Off            0          0  n/a      n/a         3  n/a
 7/1/29 On      Off            0          0  n/a      n/a         3  n/a
 7/1/30 On      Off            0          0  n/a      n/a         3  n/a
 7/1/31 On      Off            0          0  n/a      n/a         3  n/a
 7/1/32 On      Off            0          0  n/a      n/a         3  n/a
 7/1/33 On      Off            0          0  n/a      n/a         3  n/a
 7/1/34 On      Off            0          0  n/a      n/a         3  n/a
 7/1/35 On      Off            0          0  n/a      n/a         3  n/a
 7/1/36 On      On          1800       6300  Legacy   n/a         3  n/a
 7/1/37 On      Off            0          0  n/a      n/a         3  n/a
 7/1/38 On      Off            0          0  n/a      n/a         3  n/a
 7/1/39 On      Off            0          0  n/a      n/a         3  n/a
 7/1/40 On      Off            0          0  n/a      n/a         3  n/a
 7/1/41 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/42 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/43 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/44 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/45 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/46 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/47 On      Off            0          0  n/a      n/a         3  internal h/w fault
 7/1/48 On      Off            0          0  n/a      n/a         3  internal h/w fault
-------------------------------------------------------------------------------
 Total                      8800      18300
```

- If PDs consuming high power are connected in consecutive ports and the ambient temperature is high, the device can become overheated. In such scenarios, distribute the load so that each of the 8-port groups (ports 1-8, 9-16, and so on) have equal power consumption.
- If the voltage applied from an external source is detected on the PoE port, new PDs cannot get powered on this unit. In such a scenario, configure the **no inline power** command on all switch-to-switch connected ports of this unit and peer units to resolve the issue.

```
device(config)# show inline power 1

Power Capacity:         Total is 748000 mWatts. Current Free is 748000 mWatts.

Power Allocations:      Requests Honored 48 times


Port   Admin   Oper   ---Power(mWatts)---   PD Type  PD Class  Pri  Fault/
       State   State  Consumed  Allocated                        Error
-------------------------------------------------------------------------
1/1/1   Off    Off       0         0          n/a      n/a      3    n/a
1/1/2   On     Off       0         0          n/a      n/a      3    n/a
1/1/3   On     Off       0         0          n/a      n/a      3    n/a
1/1/4   Off    Off       0         0          n/a      n/a      3    n/a
1/1/5   On     Off       0         0          n/a      n/a      3    n/a
1/1/6   On     Off       0         0          n/a      n/a      3    n/a
1/1/7   On     Off       0         0          n/a      n/a      3    n/a
1/1/8   On     Off       0         0          n/a      n/a      3    voltage applied from ext src
1/1/9   On     Off       0         0          n/a      n/a      3    n/a
1/1/10  On     Off       0         0          n/a      n/a      3    non-standard PD
1/1/11  Off    Off       0         0          n/a      n/a      3    n/a
1/1/12  On     Off       0         0          n/a      n/a      3    n/a
1/1/13  On     Off       0         0          n/a      n/a      3    n/a
1/1/14  Off    Off       0         0          n/a      n/a      3    n/a
```

```
1/1/15  On     Off       0       0          n/a      n/a      3    n/a
1/1/16  On     Off       0       0          n/a      n/a      3    n/a
1/1/17  On     Off       0       0          n/a      n/a      3    n/a
1/1/18  Off    Off       0       0          n/a      n/a      3    n/a
1/1/19  On     Off       0       0          n/a      n/a      3    n/a
1/1/20  On     Off       0       0          n/a      n/a      3    n/a
1/1/21  Off    Off       0       0          n/a      n/a      3    n/a
1/1/22  On     Off       0       0          n/a      n/a      3    voltage applied from ext src
1/1/23  On     Off       0       0          n/a      n/a      3    voltage applied from ext src
1/1/24  On     Off       0       0          n/a      n/a      3    n/a
------------------------------------------------------------------------------
Total                    0       0
```

- If voltage applied from an external source is detected from another PoE port, a PD on the port cannot be powered on due to the power being injected on another port of this unit. In such a scenario, configure the **no inline power** command on all switch-to-switch connected ports of this unit and peer units to resolve the issue.
- If non-standard (legacy) PDs are not getting powered, use the **legacy-inline-power** command at the interface level. A syslog is not generated in this scenario.

```
device(config-if-e1000-1/1/1)# legacy-inline-power
device(config-if-e1000-1/1/1)# show running interface ethernet 1/1/1
interface ethernet 1/1/1
 legacy-inline-power
!
```

SNMP

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SNMP overview

SNMP is a set of protocols for managing complex networks. SNMP sends messages, called protocol data units (PDUs), to different parts of a network. SNMP-compliant devices, called agents, store data about themselves in Management Information Bases (MIBs) and return this data to the SNMP requesters.

There are several methods you can use to secure SNMP access. They included the following:

- Using ACLs to restrict SNMP access
- Restricting SNMP access to a specific IP address
- Restricting SNMP access to a specific VLAN
- Disabling SNMP access

This section presents additional methods for securing SNMP access to RUCKUS devices.

Restricting SNMP access using ACL, VLAN, or a specific IP address constitute the first level of defense when the packet arrives at a RUCKUS device. The next level uses one of the following methods:

- Community string match In SNMP versions 1 and 2
- User-based model in SNMP version 3

SNMP views are incorporated in community strings and the user-based model.

SNMP community strings

SNMP versions 1 and 2 use community strings to restrict SNMP access.

- To access a read-only management session using the Web Management Interface, enter the default username and password which are “get” and “public” respectively in the Web.
- To access a read-write management session using the Web Management Interface, configure a read-write community string using the CLI. Then log on using "set" as the user name and the read-write community string you configure as the password.

You can configure as many additional read-only and read-write community strings as you need. The number of strings you can configure depends on the memory on the device. There is no practical limit.

The Web Management Interface supports only one read-write session at a time. When a read-write session is open on the Web Management Interface, subsequent sessions are read-only, even if the session login is “set” with a valid read-write password.

NOTE
As an alternative to the SNMP community strings, you can secure Web management access using local user accounts or ACLs.

Encryption of SNMP community strings

The software automatically encrypts SNMP community strings. Users with read-only access or who do not have access to management functions in the CLI cannot display the strings. For users with read-write access, the strings are encrypted in the CLI but are shown in the clear in the Web Management Interface.

Encryption is enabled by default. You can disable encryption for individual strings or trap receivers if desired. Refer to the next section for information about encryption.

Adding an SNMP community string

You can assign SNMP community strings, and indicate if the string is encrypted or clear. By default, the string is encrypted.

To add an encrypted community string, enter commands such as the following.

```
device(config)# snmp-server community private rw
device(config)# write memory
```

Syntax: snmp-server community [**0** | **1**] *string* **ro** | **rw** [**view** *viewname*] [*standard-ACL-name* | *standard-ACL-id*]

The *string* parameter specifies the community string name. The string can be up to 32 characters long.

The **ro** | **rw** parameter specifies whether the string is **read-only (ro)** or **read-write (rw)**.

NOTE
If you issue a **no snmp-server community public ro** command and then enter a **write memory** command to save that configuration, the read-only "public" community string is removed and will have no SNMP access. If for some reason the device is brought down and then brought up, the "no snmp-server community public ro" command is restored in the system and the read-only "public" community string has no SNMP access.

The **0** | **1** parameter affects encryption for display of the string in the running-config and the startup-config file. Encryption is enabled by default. When encryption is enabled, the community string is encrypted in the CLI regardless of the access level you are using. In the Web Management Interface, the community string is encrypted at the read-only access level but is visible at the read-write access level.

The encryption option can be omitted (the default) or can be one of the following:

- **0** - Disables encryption for the community string you specify with the command. The community string is shown as clear text in the running-config and the startup-config file. Use this option if you do not want the display of the community string to be encrypted.
- **1** - Assumes that the community string you enter is encrypted, and decrypts the value before using it.

NOTE
If you want the software to assume that the value you enter is the clear-text form, and to encrypt display of that form, do not enter **0** or **1** . Instead, omit the encryption option and allow the software to use the default behavior.

NOTE
If you specify encryption option **1**, the software assumes that you are entering the encrypted form of the community string. In this case, the software decrypts the community string you enter before using the value for authentication. If you accidentally enter option 1 followed by the clear-text version of the community string, authentication will fail because the value used by the software will not match the value you intended to use.

The command in the example above adds the read-write SNMP community string "private". When you save the new community string to the startup-config file (using the **write memory** command), the software adds the following command to the file.

```
snmp-server community 1
encrypted-string
 rw
```

To add a non-encrypted community string, you must explicitly specify that you do not want the software to encrypt the string. Here is an example.

```
device(config)#snmp-server community 0 private rw
device(config)#write memory
```

The command in this example adds the string "private" in the clear, which means the string is displayed in the clear. When you save the new community string to the startup-config file, the software adds the following command to the file.

```
snmp-server community 0 private rw
```

The *view viewname* parameter is optional. It allows you to associate a view to the members of this community string. Enter up to 32 alphanumeric characters. If no view is specified, access to the full MIB is granted. The view that you want must exist before you can associate it to a community string. Here is an example of how to use the view parameter in the community string command.

```
device(config)#snmp-s community myread ro view sysview
```

The command in this example associates the view "sysview" to the community string named "myread". The community string has read-only access to "sysview". For information on how to create views, refer to SNMP v3 configuration examples on page 204.

The *standard-ACL-name | standard-ACL-id* parameter is optional. It allows you to specify which ACL group will be used to filter incoming SNMP packets. You can enter either the ACL name or its ID. Here are some examples.

```
device(config)#snmp-s community myread ro view sysview 2
device(config)#snmp-s community myread ro view sysview myACL
```

The command in the first example indicates that ACL group 2 will filter incoming SNMP packets; whereas, the command in the second example uses the ACL group called "myACL" to filter incoming packets.

NOTE

To make configuration changes, including changes involving SNMP community strings, you must first configure a read-write community string using the CLI. Alternatively, you must configure another authentication method and log on to the CLI using a valid password for that method.

Displaying the SNMP community strings

To display the configured community strings, enter the following command at any CLI level.

```
device#show snmp server
Contact: Marshall
Location: Copy Center
Community(ro): public
Community(rw): private
Traps
                    Cold start: Enable
                       Link up: Enable
                     Link down: Enable
                Authentication: Enable
     Locked address violation: Enable
         Power supply failure: Enable
                   Fan failure: Enable
          Temperature warning: Enable
                 STP new root: Enable
          STP topology change: Enable
                         ospf: Enable
```

```
 Total Trap-Receiver Entries: 4
Trap-Receiver IP Address       Community
     1                 10.95.6.211
     2                 10.95.5.21
```

Syntax: show snmp server

NOTE

If display of the strings is encrypted, the strings are not displayed. Encryption is enabled by default.

User-based security model

SNMP version 3 (RFC 2570 through 2575) introduces a User-Based Security model (RFC 2574) for authentication and privacy services.

SNMP version 1 and version 2 use community strings to authenticate SNMP access to management modules. This method can still be used for authentication. In SNMP version 3, the User-Based Security model of SNMP can be used to secure against the following threats:

- Modification of information
- Masquerading the identity of an authorized entity
- Message stream modification
- Disclosure of information

SNMP version 3 also supports View-Based Access Control Mechanism (RFC 2575) to control access at the PDU level. It defines mechanisms for determining whether or not access to a managed object in a local MIB by a remote principal should be allowed. For more information, refer to SNMP v3 configuration examples on page 204.)

Configuring your NMS

In order to use the SNMP version 3 features.

1. Make sure that your Network Manager System (NMS) supports SNMP version 3.
2. Configure your NMS agent with the necessary users.
3. Configure the SNMP version 3 features in RUCKUS devices.

Configuring SNMP version 3 on RUCKUS devices

Follow the steps given below to configure SNMP version 3 on RUCKUS devices.

1. Enter an engine ID for the management module using the **snmp-server engineid** command if you will not use the default engine ID.Refer to Defining the engine id on page 191.
2. Create views that will be assigned to SNMP user groups using the **snmp-server view** command. refer to SNMP v3 configuration examples on page 204 for details.
3. Create ACL groups that will be assigned to SNMP user groups using the **access-list** command.
4. Create user groups using the **snmp-server group** command.Refer to Defining an SNMP group on page 191.
5. Create user accounts and associate these accounts to user groups using the **snmp-server user** command.Refer to Defining an SNMP user account on page 192.

   If SNMP version 3 is not configured, then community strings by default are used to authenticate access.

Defining the engine id

A default engine ID is generated during system start up. To determine what the default engine ID of the device is, enter the **show snmp engineid** command and find the following line:

```
Local SNMP Engine ID: 800007c70300e05290ab60
```

See the section Displaying the Engine ID on page 202 for details.

The default engine ID guarantees the uniqueness of the engine ID for SNMP version 3. If you want to change the default engine ID, enter the **snmp-server engineid local** command.

```
device(config)#snmp-server engineid local 800007c70300e05290ab60
```

Syntax: [no] snmp-server engineid local *hex-string*

The *local* parameter indicates that engine ID to be entered is the ID of this device, representing an SNMP management entity.

NOTE
Each user localized key depends on the SNMP server engine ID, so all users need to be reconfigured whenever the SNMP server engine ID changes.

NOTE
Since the current implementation of SNMP version 3 does not support Notification, remote engine IDs cannot be configured at this time.

The *hex-string* variable consists of 11 octets, entered as hexadecimal values. There are two hexadecimal characters in each octet. There should be an even number of hexadecimal characters in an engine ID.

The default engine ID has a maximum of 11 octets:

- Octets 1 through 4 represent the agent's SNMP management private enterprise number as assigned by the Internet Assigned Numbers Authority (IANA). The most significant bit of Octet 1 is "1". With Octet 1 always equal to "1", the first four octets in the default engine ID is always "800007c7" (which is 1991 in decimal).
- Octet 5 is always 03 in hexadecimal and indicates that the next set of values represent a MAC address.
- Octets 6 through 11 form the MAC address of the lowest port in the management module.

NOTE
Engine ID must be a unique number among the various SNMP engines in the management domain. Using the default engine ID ensures the uniqueness of the numbers.

Defining an SNMP group

SNMP groups map SNMP users to SNMP views. For each SNMP group, you can configure a read view, a write view, or both. Users who are mapped to a group will use its views for access control.

To configure an SNMP user group, enter a command such as the following.

```
device(config)#snmp-server group admin v3 auth read all write all
```

Syntax:[no] snmp-server group *groupname* { **v1** | **v2c** | **v3** { **auth** | **noauth** | **priv** } } [**access** { *standard-ACL-id* | **ipv6** *ipv6-ACL-name* }] [**read** *viewname*] [**write** *viewname*]

NOTE
This command is not used for SNMP version 1 and SNMP version 2. In these versions, groups and group views are created internally using community strings. (refer to SNMP community strings on page 187.) When a community string is created, two groups are created, based on the community string name. One group is for SNMP version 1 packets, while the other is for SNMP version 2 packets.

The *group groupname* parameter defines the name of the SNMP group to be created.

The **v1** , **v2c** , or **v3** parameter indicates which version of SNMP is used. In most cases, you will be using v3, since groups are automatically created in SNMP versions 1 and 2 from community strings.

The **auth** | **noauth** parameter determines whether or not authentication will be required to access the supported views. If auth is selected, then only authenticated packets are allowed to access the view specified for the user group. Selecting **noauth** means that no authentication is required to access the specified view. Selecting **priv** means that an authentication password will be required from the users.

The *access standard-ACL-id* parameter is optional. It allows incoming SNMP packets to be filtered based on the standard ACL attached to the group.

The **ipv6** *ipv6-ACL-name* option configures IPv6 ACL for SNMP group and allows incoming SNMP packets to be filtered based on the IPv6 ACL attached to the group.

The *read viewname | write viewname* parameter is optional. It indicates that users who belong to this group have either read or write access to the MIB.

The *viewname* variable is the name of the view to which the SNMP group members have access. If no view is specified, then the group has no access to the MIB.

The value of *viewname* is defined using the **snmp-server view** command. The SNMP agent comes with the "all" default view, which provides access to the entire MIB; however, it must be specified when creating the group. The "all" view also allows SNMP version 3 to be backwards compatibility with SNMP version 1 and version 2.

> **NOTE**
> If you will be using a view other than the "all" view, that view must be configured before creating the user group. Refer to the section SNMP v3 configuration examples on page 204, especially for details on the include | exclude parameters.

Defining an SNMP user account

The **snmp-server user** command does the following:

- Creates an SNMP user.
- Defines the group to which the user will be associated.
- Defines the type of authentication to be used for SNMP access by this user.
- Specifies one of the following encryption types used to encrypt the privacy password:
  - Data Encryption Standard (DES) - A symmetric-key algorithm that uses a 56-bit key.
  - Advanced Encryption Standard (AES) - The 128-bit encryption standard adopted by the U.S. government. This standard is a symmetric cipher algorithm chosen by the National Institute of Standards and Technology (NIST) as the replacement for DES.

Here is an example of how to create an SNMP User account.

```
device(config)#snmp-s user bob admin v3 access 2 auth md5 bobmd5 priv des bobdes
```

The CLI for creating SNMP version 3 users has been updated as follows.

Syntax: no snmp-server user *name groupname* **v3** [[**access** *standard-ACL-id*] [[**encrypted**] [**auth md5** *md5-password* | **sha** *sha-password*] [**priv** [**encrypted**] **des** *des-password-key* | **aes** *aes-password-key*]]]

The *name* parameter defines the SNMP user name or security name used to access the management module.

The *groupname* parameter identifies the SNMP group to which this user is associated or mapped. All users must be mapped to an SNMP group. Groups are defined using the **snmp-server group** command.

NOTE
The SNMP group to which the user account will be mapped should be configured before creating the user accounts; otherwise, the group will be created without any views. Also, ACL groups must be configured before configuring user accounts.

The **v3** parameter is required.

The *access standard-ACL-id* parameter is optional. It indicates that incoming SNMP packets are filtered based on the ACL attached to the user account.

NOTE
The ACL specified in a user account overrides the ACL assigned to the group to which the user is mapped. If no ACL is entered for the user account, then the ACL configured for the group will be used to filter packets.

The *encrypted* parameter means that the MD5 or SHA password will be a digest value. MD5 has 16 octets in the digest. SHA has 20. The digest string has to be entered as a hexadecimal string. In this case, the agent need not generate any explicit digest. If the *encrypted* parameter is not used, the user is expected to enter the authentication password string for MD5 or SHA. The agent will convert the password string to a digest, as described in RFC 2574.

The **auth md5 | sha** parameter is optional. It defines the type of encryption that the user must have to be authenticated. Choose between MD5 or SHA encryption. MD5 and SHA are two authentication protocols used in SNMP version 3.

The **md5-password** and **sha-password** define the password the user must use to be authenticated. These password must have a minimum of 8 characters. If the encrypted parameter is used, then the digest has 16 octets for MD5 or 20 octets for SHA.

NOTE
Once a password string is entered, the generated configuration displays the digest (for security reasons), not the actual password.

The *priv [encrypted]* parameter is optional after you enter the md5 or sha password. The **priv** parameter specifies the encryption type (DES or AES) used to encrypt the privacy password. If the **encrypted** keyword is used, do the following:

- If DES is the privacy protocol to be used, enter **des** followed by a 16-octet DES key in hexadecimal format for the *des-password-key* . If you include the encrypted keyword, enter a password string of at least 8 characters.
- If AES is the privacy protocol to be used, enter **aes** followed by the AES password key. For a small password key, enter 12 characters. For a big password key, enter 16 characters. If you include the encrypted keyword, enter a password string containing 32 hexadecimal characters.

SNMP parameter configuration

Use the procedures in this section to perform the following configuration tasks:

- Specify a Simple Network Management Protocol (SNMP) trap receiver.
- Specify a source address and community string for all traps sent by the device.
- Change the holddown time for SNMP traps
- Disable individual SNMP traps. (All traps are enabled by default.)
- Disable traps for CLI access that is authenticated by a local user account, a RADIUS server, or a TACACS/TACACS+ server.

Specifying an SNMP trap receiver

You can specify a trap receiver to ensure that all SNMP traps sent by the RUCKUS device go to the same SNMP trap receiver or set of receivers, typically one or more host devices on the network. When you specify the host, you also specify a community string. The RUCKUS device sends all the SNMP traps to the specified hosts and includes the specified community string. Administrators can therefore filter for traps from a RUCKUS device based on IP address or community string.

When you add a trap receiver, the software automatically encrypts the community string you associate with the receiver when the string is displayed by the CLI or Web Management Interface. If you want the software to show the community string in the clear, you must explicitly specify this when you add a trap receiver. In either case, the software does not encrypt the string in the SNMP traps sent to the receiver.

To specify the host to which the device sends all SNMP traps, use one of the following methods.

To add a trap receiver and encrypt the display of the community string, enter commands such as the following.

To specify an SNMP trap receiver and change the UDP port that will be used to receive traps, enter a command such as the following.

```
device(config)# snmp-server host 10.2.2.2 0 mypublic port 200
device(config)# write memory
```

Syntax: snmp-server host *ip-addr* { **0** | **1** } *string* [**port** *value*]

The *ip-addr* parameter specifies the IP address of the trap receiver.

The *0* | *1* parameter specifies whether you want the software to encrypt the string (**1**) or show the string in the clear (**0**). The default is **0** .

The *string* parameter specifies an SNMP community string configured on the RUCKUS device. The string can be a read-only string or a read-write string. The string is not used to authenticate access to the trap host but is instead a useful method for filtering traps on the host. For example, if you configure each of your RUCKUS devices that use the trap host to send a different community string, you can easily distinguish among the traps from different RUCKUS devices based on the community strings.

The command in the example above adds trap receiver 10.2.2.2 and configures the software to encrypt display of the community string. When you save the new community string to the startup-config file (using the **write memory** command), the software adds the following command to the file.

```
snmp-server host 10.2.2.2 1
encrypted-string
```

To add a trap receiver and configure the software to encrypt display of the community string in the CLI and Web Management Interface, enter commands such as the following.

```
device(config)# snmp-server host 10.2.2.2 0 FastIron-12
device(config)# write memory
```

The *port value* parameter allows you to specify which UDP port will be used by the trap receiver. This parameter allows you to configure several trap receivers in a system. With this parameter, a network management application can coexist in the same system. RUCKUS devices can be configured to send copies of traps to more than one network management application.

Specifying a single trap source

You can specify a single trap source to ensure that all SNMP traps sent by the Layer 3 switch use the same source IP address. For configuration details, refer to "Specifying a single source interface for specified packet types" section in the *RUCKUS FastIron Layer 3 Routing Configuration Guide*.

Setting the SNMP trap holddown time

When a RUCKUS device starts up, the software waits for Layer 2 convergence (STP) and Layer 3 convergence (OSPF) before beginning to send SNMP traps to external SNMP servers. Until convergence occurs, the device might not be able to reach the servers, in which case the messages are lost.

By default, a RUCKUS device uses a one-minute holddown time to wait for the convergence to occur before starting to send SNMP traps. After the holddown time expires, the device sends the traps, including traps such as "cold start" or "warm start" that occur before the holddown time expires.

You can change the holddown time to a value from one second to ten minutes.

To change the holddown time for SNMP traps, enter a command such as the following at the global CONFIG level of the CLI.

```
device(config)# snmp-server enable traps holddown-time 30
```

The command in this example changes the holddown time for SNMP traps to 30 seconds. The device waits 30 seconds to allow convergence in STP and OSPF before sending traps to the SNMP trap receiver.

Syntax: [no] snmp-server enable traps holddown-time *seconds*

The *secs* parameter specifies the number of seconds and can be from 1 - 600 (ten minutes). The default is 60 seconds.

Disabling SNMP traps

RUCKUS devices come with SNMP trap generation enabled by default for all traps. You can selectively disable one or more of the following traps.

NOTE
By default, all SNMP traps are enabled at system startup.

SNMP Layer 2 traps

The following traps are generated on devices running Layer 2 software:

- SNMP authentication keys
- Power supply failure
- Fan failure
- Cold start
- Link up
- Link down
- Bridge new root
- Bridge topology change
- Locked address violation

SNMP Layer 3 traps

The following traps are generated on devices running Layer 3 software:

- SNMP authentication key
- Power supply failure
- Fan failure
- Cold start
- Link up
- Link down
- Bridge new root
- Bridge topology change
- Locked address violation

- BGP4
- OSPF
- VRRP
- VRRP-E

To stop link down occurrences from being reported, enter the following.

```
device(config)# no snmp-server enable traps link-down
```

Syntax: [no] snmp-server enable traps *trap-type*

SNMP ifIndex

On FastIron devices, SNMP Management Information Base (MIB) uses Interface Index (ifIndex) to assign a unique value to each port on a module or slot. The number of indexes that can be assigned per module is 64. On all IronWare devices, the system automatically assign 64 indexes to each module on the device. This value is not configurable.

Defining SNMP views

SNMP views are named groups of MIB objects that can be associated with user accounts to allow limited access for viewing and modification of SNMP statistics and system configuration. SNMP views can also be used with other commands that take SNMP views as an argument. SNMP views reference MIB objects using object names, numbers, wildcards, or a combination of the three. The numbers represent the hierarchical location of the object in the MIB tree. You can reference individual objects in the MIB tree or a subset of objects from the MIB tree.

To configure the number of SNMP views available on the RUCKUS device, enter the following command.

```
device(config)#system-max view 15
```

Syntax: system-maxview *number-of-views*

This command specifies the maximum number of SNMPv2 and v3 views that can be configured on a device. The number of views can be from 10 - 65536. The default is 10 views.

To add an SNMP view, enter one of the following commands.

```
device(config)#snmp-server view Maynes system included
device(config)#snmp-server view Maynes system.2 excluded
device(config)#snmp-server view Maynes 2.3.*.6 included
device(config)#write mem
```

NOTE

The **snmp-server view** command supports the MIB objects as defined in RFC 1445.

Syntax: [no] snmp-serverview *name mib_tree* **included** | **excluded**

The *name* parameter can be any alphanumeric name you choose to identify the view. The names cannot contain spaces.

The *mib_tree* parameter is the name of the MIB object or family. MIB objects and MIB sub-trees can be identified by a name or by the numbers called Object Identifiers (OIDs) that represent the position of the object or sub-tree in the MIB hierarchy. You can use a wildcard (*) in the numbers to specify a sub-tree family.

The **included** | **excluded** parameter specifies whether the MIB objects identified by the *mib_family* parameter are included in the view or excluded from the view.

NOTE
All MIB objects are automatically excluded from any view unless they are explicitly included; therefore, when creating views using the **snmp-server view** command, indicate which portion of the MIB you want users to access.

For example, you may want to assign the view called "admin" a community string or user group. The "admin" view will allow access to the RUCKUS MIBs objects that begin with the 1.3.6.1.4.1.1991 object identifier. Enter the following command.

```
device(config)#snmp-server view admin 1.3.6.1.4.1.1991 included
```

You can exclude portions of the MIB within an inclusion scope. For example, if you want to exclude the snAgentSys objects, which begin with 1.3.6.1.4.1.1991.1.1.2 object identifier from the admin view, enter a second command such as the following.

```
device(config)#snmp-server view admin 1.3.6.1.4.1.1991.1.1.2 excluded
```

NOTE
Note that the exclusion is within the scope of the inclusion.

To delete a view, use the no parameter before the command.

SNMP version 3 traps

RUCKUS devices support SNMP notifications in SMIv2 format. This allows notifications to be encrypted and sent to the target hosts in a secure manner.

Defining an SNMP group and specifying which view is notified of traps

The SNMP group command allows configuration of a viewname for notification purpose, similar to the read and write view. The default viewname is "all", which allows access to the entire MIB.

To configure an SNMP user group, first configure SNMPv3 views using the **snmp-server view** command. Refer to SNMP v3 configuration examples on page 204. Then enter a command such as the following.

```
device(config)#snmp-server group admin v3 auth read all write all
notify all
```

Syntax:[no] snmp-server group *groupname* { **v1** | **v2c** | **v3** { **auth** | **noauth** | **priv** } } [**access** { *standard-ACL-id* | **ipv6** *ipv6-ACL-name* }] [**notify** *viewname*] [**read** *viewname*] [**write** *viewname*]

The *group groupname* parameter defines the name of the SNMP group to be created.

The **v1** , **v2c** , or **v3** parameter indicates which version of SNMP to use. In most cases, you will use v3, since groups are automatically created in SNMP versions 1 and 2 from community strings.

The **auth** | **noauth** parameter determines whether or not authentication will be required to access the supported views. If auth is selected, then only authenticated packets are allowed to access the view specified for the user group. Selecting **noauth** means that no authentication is required to access the specified view. Selecting **priv** means that an authentication password will be required from the users.

The *access standard-ACL-id* allows incoming SNMP packets to be filtered based on the standard ACL attached to the group.

The **ipv6** *ipv6-ACL-name* option configures IPv6 ACL for SNMP group and allows incoming SNMP packets to be filtered based on the IPv6 ACL attached to the group.

The *read viewname | write viewname* parameter is optional. It indicates that users who belong to this group have either read or write access to the MIB.

The **notify** view allows administrators to restrict the scope of varbind objects that will be part of the notification. All of the varbinds need to be in the included view for the notification to be created.

The *viewname* variable is the name of the view to which the SNMP group members have access. If no view is specified, then the group has no access to the MIB.

Defining the UDP port for SNMP v3 traps

The SNMP host command enhancements allow configuration of notifications in SMIv2 format, with or without encryption, in addition to the previously supported SMIv1 trap format.

You can define a port that receives the SNMP v3 traps by entering a command such as the following.

```
device(config)#snmp-server host 192.168.4.11 version v3 auth security-name port 4/1
```

Syntax: [no] snmp-server host *ip-addr* | *ipv6-addr* **version** [**v1** | **v2c** *community-string* | **v3 auth** | **noauth** | **priv** *security-name*] [**port** *trap-UDP-port-number*]

The *ip-addr* parameter specifies the IP address of the host that will receive the trap.

For *version* , indicate one of the following

For SNMP version 1, enter **v1** and the name of the community string (community-string). This string is encrypted within the system.

> **NOTE**
> If the configured version is v2c, then the notification is sent out in SMIv2 format, using the community string, but in cleartext mode. To send the SMIv2 notification in SNMPv3 packet format, configure v3 with auth or privacy parameters, or both, by specifying a security name. The actual authorization and privacy values are obtained from the security name.

For SNMP version 2c, enter **v2** and the name of the community string. This string is encrypted within the system.

For SNMP version 3, enter one of the following depending on the authorization required for the host:

- – *v3 auth security-name* : Allow only authenticated packets.
- – *v3 no auth security-name* : Allow all packets.
- – *v3 priv security-name* : A password is required

For *port trap-UDP-port-number* , specify the UDP port number on the host that will receive the trap.

Trap MIB changes

To support the SNMP V3 trap feature, the RUCKUS Enterprise Trap MIB was rewritten in SMIv2 format, as follows:

- The MIB name was changed from FOUNDRY-SN-TRAP-MIB to FOUNDRY-SN-NOTIFICATION-MIB
- Individual notifications were changed to NOTIFICATION-TYPE instead of TRAP-TYPE.
- As per the SMIv2 format, each notification has an OID associated with it. The root node of the notification is snTraps (OID enterprise.foundry.0). For example, OID for snTrapRunningConfigChanged is {snTraps.73}. Earlier, each trap had a trap ID associated with it, as per the SMIv1 format.

Backward compatibility with SMIv1 trap format

The RUCKUS device will continue to support creation of traps in SMIv1 format, as before. To allow the device to send notifications in SMIv2 format, configure the device as described above. The default mode is still the original SMIv1 format.

SNMP MAC-notification trap support

The SNMP MAC-notification trap functionality allows an SNMPv3 trap to be sent to the SNMP manager when MAC addresses are added or deleted in the device. The SNMP manager or management software can then use these traps to define a security policy based on the requirement of the enterprise where the device is installed. With this functionality, management software can easily monitor the devices and build a security policy for enterprise networks.

Access ports can be manually configured to enable the MAC-notification feature. While enabling MAC-notification on a particular port, you can configure the interval at which the trap messages will be sent to management software, and the buffer size which maintains maximum trap events that can be maintained in the system. Ports enabled for MAC-notification will send SNMP traps to management software for various MAC address events such as addition, deletion, and MAC address movement.

The access devices in an enterprise network typically connect to the end host, and MAC-notification can be deployed on such devices on the access port only. An access port by definition is a port that connects to an end host and typically does not result in a network loop.

Requirements and limitations for MAC-notification trap support

The following requirements and limitations apply to MAC-notification trap support:

- MAC-notification is only supported on access ports.
- The network administrator must ensure that there are no loops in the ports enabled for MAC-notification, because high volume and frequent MAC address movement is not expected on the access port.
- The expected MAC scaling with the MAC-notification functionality is 800 MAC addresses per system, on the access ports where it is enabled. An extra buffer queue size is reserved to absorb any burst.
- The MAC-notification could be bursty in nature. This could be due to a set of hosts that could join at a specific time or a security policy change that could move a set of MAC addresses from one VLAN to another. Such bursty events need to be queued, resulting in delayed notifications to the management software.
- The number of events that can be queued is finite.
- All queued events are notified during the notification interval. The notification interval should be tuned based on the requirements of the enterprise. However, a very aggressive timer coupled with bursty traffic could load the system and result in a loss of MAC-notification events.
- Static and control MAC events are not considered for MAC-notification event generation.
- MAC-notification is supported at an interface level on a device. When enabled, each MAC address addition or deletion is logged as an event in a buffer-queue.
- MAC-notification is currently not supported on MCT (Multi Chassis Trunking).

Configuring SNMP traps for MAC-notification

The MAC-notification functionality is enabled by default when the device boots up. To configure the MAC-notification functionality on the device, follow these steps:

1. Use the **mac-notification interval** command with the specified interval value to enable MAC-notification.
2. Use the **interface ethernet** command with the specified Ethernet interface to enable MAC-notification on the individual interface.
3. Use the **snmp-server enable traps mac-notification** command to enable MAC-notification on the specified interface.
4. Use the **system-max mac-notification-buffer** command to change the value of the MAC-notification buffer size.

The following example shows enabling SNMP traps for MAC-notification on Ethernet interface 1/1/5:

```
device(config)# mac-notification interval 30
device(config)# interface ethernet 1/1/5
device(config-if-e1000-1/1/5)# snmp-server enable traps mac-notification
device(config-if-e1000-1/1/5)# exit
device (config)# system-max mac-notification-buffer 4000
```

Use the **show interfaces ethernet** command to check whether a MAC-notification SNMP trap is enabled or disabled on an interface. You can also use the **show mac-notification** command to view other statistics such as the configured interval, the number of traps sent, and the number of events sent.

MAC-notification events

NOTE

MAC-notifications for LAG should be enabled on the LAG interface.

When enabled, each MAC address addition or deletion is logged as an event in a buffer-queue. Each event is 11 bytes long and contains information about the following:

Value	Description
MAC address	The MAC address added or deleted on the device.
VLAN	The VLAN to which the MAC address is associated. The valid range is 1 to 4094.
Interface	The interface on which the MAC address is added or deleted.
Action	The event that occurred.

The following table lists the various events that can occur, along with the VLAN interface values and their interpretation for each event:

TABLE 42 MAC address notification events and values

Event	Action Value	Description	Expected action by management software	VLAN and port values
ADD-MAC	1	This event is generated when a new MAC address is learnt.	Management software should add the MAC address to its forwarding table.	(VLAN, Port)
REMOVE-MAC	2	This event is generated when the MAC address ages out.	Management software should delete the MAC address from its forwarding table.	(VLAN, Port)
REMOVE-ALL-MAC-ON-SYSTEM	3	This event is generated when all the MAC addresses on the system are flushed, for example, by using the **clear mac** command.	Management software should clear all the MAC addresses from its forwarding table.	(0, 0)
REMOVE-ALL-MAC-ON-PORT	4	This event is generated when all the MAC addresses on a particular port are flushed, for example, when the link goes down.	Management software should clear all the MAC addresses learnt on this particular port from its forwarding table.	(0, Port)
REMOVE-ALL-MAC-ON-VLAN	5	This event is generated when the MAC addresses learnt on all ports, in a particular VLAN are flushed, for example, by using the **no vlan** command.	Management software should clear all the MAC addresses learnt on this particular VLAN from its forwarding table.	(VLAN, 0)
REMOVE-ALL-MAC-ON-VLAN-PORT	6	This event is generated when the MAC addresses, are flushed for a particular port in a particular VLAN, for example by a protocol flush event.	Management software should clear all the MAC addresses learnt on this particular VLAN and port from its forwarding table.	(VLAN, Port)

TABLE 42 MAC address notification events and values (continued)

Event	Action Value	Description	Expected action by management software	VLAN and port values
MAC-MOVE	7	This event is generated when the MAC address moves from an old port to a new port in the same VLAN.	Management software should move the MAC address from the old port to the specified new port learnt in its forwarding table.	(VLAN, new port)

Working with MAC-notification events

- Each event stored in the buffer queue is in the order in which the event occurred in the system.
- The number of events that can be stored in the buffer queue is by default 4000. This value is configurable up to 16000 through the command line interface.
- An out-of-band buffer full event trap is sent to the management software in the event of a buffer full. The system then flushes the existing buffer queue.
- You can configure a periodic interval at which point a MAC-notification trap should be sent to the management software. The interval can range from 1 to 3600 seconds. The default is 3 seconds.
- Each trap message sent on the notification interval can have one or more MAC-notification events taken from the buffer queue in the first-in first-out order.
- One or more SNMP trap messages can be sent on the expiry of a MAC-notification interval. However, the maximum number of trap messages that can be sent is limited to 5.

Specifying an IPv6 host as an SNMP trap receiver

You can specify an IPv6 host as a trap receiver to ensure that all SNMP traps sent by the device will go to the same SNMP trap receiver or set of receivers, typically one or more host devices on the network. To do so, enter a command such as the following.

```
device(config)#snmp-server host ipv6 2001:DB8:89::13
```

Syntax: snmp-serverhost ipv6 *ipv6-address*

The *ipv6-address* must be in hexadecimal format using 16-bit values between colons as documented in RFC 2373.

SNMP v3 over IPv6

Some FastIron devices support IPv6 for SNMP version 3.

Restricting SNMP Access to an IPv6 Node

You can restrict SNMP access so that the RUCKUS device can only be accessed by the IPv6 host address that you specify. To do so, enter a command such as the following .

```
device(config)#snmp-client ipv6 2001:DB8:89::23
```

Syntax: snmp-clientipv6 *ipv6-address*

The *ipv6-address* must be in hexadecimal format using 16-bit values between colons as documented in RFC 2373.

Specifying an IPv6 host as an SNMP trap receiver

You can specify an IPv6 host as a trap receiver to ensure that all SNMP traps sent by the RUCKUS device will go to the same SNMP trap receiver or set of receivers, typically one or more host devices on the network. To do so, enter the **snmp-server host ipv6** command .

```
device(config)#snmp-server host ipv6 2001:DB8:89::13
```

Syntax: snmp-serverhost ipv6 *ipv6-address*

The *ipv6-address* must be in hexadecimal format using 16-bit values between colons as documented in RFC 2373.

Viewing IPv6 SNMP server addresses

Many of the existing **show** commands display IPv6 addresses for IPv6 SNMP servers. The following example shows output for the **show snmp server** command.

```
device#show snmp server
      Contact:
     Location:
Community(ro): .....
Traps
              Warm/Cold start: Enable
                      Link up: Enable
                    Link down: Enable
               Authentication: Enable
     Locked address violation: Enable
         Power supply failure: Enable
                  Fan failure: Enable
           Temperature warning: Enable
                 STP new root: Enable
           STP topology change: Enable
                         vsrp: Enable
  Total Trap-Receiver Entries: 4
Trap-Receiver IP-Address                Port-Number Community
     1        10.147.201.100
               162     .....
     2                2001:DB8::200
                                  162     .....
      3        10.147.202.100
               162     .....
      4                 2001:DB8::200
                                 162     .....
```

Displaying SNMP Information

This section lists the commands for viewing SNMP-related information.

Displaying the Engine ID

To display the engine ID of a management module, enter a command such as the following.

```
device#show snmp engineid
Local SNMP Engine ID: 800007c70300e05290ab60
Engine Boots: 3
Engine time: 5
```

Syntax: show snmp engineid

The engine ID identifies the source or destination of the packet.

The engine boots represents the number of times that the SNMP engine reinitialized itself with the same engine ID. If the engineID is modified, the boot count is reset to 0.

The engine time represents the current time with the SNMP agent.

Displaying SNMP groups

To display the definition of an SNMP group, enter a command such as the following.

```
device#show snmp group
groupname = exceptifgrp
security model = v3
security level = authNoPriv
ACL id = 0
IPv6 ACL name: ipv6acl
readview = exceptif
writeview =
none
```

Syntax: show snmp group

The value for security level can be one of the following.

Security level	Authentication
none	If the security model shows v1 or v2, then security level is blank. User names are not used to authenticate users; community strings are used instead.
noauthNoPriv	Displays if the security model shows v3 and user authentication is by user name only.
authNoPriv	Displays if the security model shows v3 and user authentication is by user name and the MD5 or SHA algorithm.

Displaying user information

To display the definition of an SNMP user account, enter a command such as the following.

```
device#show snmp user
username = bob
ACL id = 2
group = admin
security model = v3
group ACL id = 0
authtype = md5
authkey = 3aca18d90b8d172760e2dd2e8f59b7fe
privtype = des,  privkey = 1088359afb3701730173a6332d406eec
engine ID= 800007c70300e052ab0000
```

Syntax: show snmp user

Interpreting varbinds in report packets

If an SNMP version 3 request packet is to be rejected by an SNMP agent, the agent sends a report packet that contains one or more varbinds. The varbinds contain additional information, showing the cause of failures. An SNMP manager application decodes the description from the varbind. The following table presents a list of varbinds supported by the SNMP agent.

Varbind object Identifier	Description
1. 3. 6. 1. 6. 3. 11. 2. 1. 3. 0	Unknown packet data unit.

Varbind object Identifier	Description
1. 3. 6. 1. 6. 3. 12. 1. 5. 0	The value of the varbind shows the engine ID that needs to be used in the snmp-server engineid command
1. 3. 6. 1. 6. 3. 15. 1. 1. 1. 0	Unsupported security level.
1. 3. 6. 1. 6. 3. 15. 1. 1. 2. 0	Not in time packet.
1. 3. 6. 1. 6. 3. 15. 1. 1. 3. 0	Unknown user name. This varbind may also be generated: • If the configured ACL for this user filters out this packet. • If the group associated with the user is unknown.
1. 3. 6. 1. 6. 3. 15. 1. 1. 4. 0	Unknown engine ID. The value of this varbind would be the correct authoritative engineID that should be used.
1. 3. 6. 1. 6. 3. 15. 1. 1. 5. 0	Wrong digest.
1. 3. 6. 1. 6. 3. 15. 1. 1. 6. 0	Decryption error.

SNMP v3 configuration examples

The following sections present examples of how to configure SNMP v3.

Example 1

```
device(config)#snmp-s group admingrp v3 priv read all write all notify all
device(config)#snmp-s user adminuser admingrp v3 auth md5
auth password
 priv
privacy password
device(config)#snmp-s host
dest-ip
 version v3 privacy adminuser
```

Example 2

```
device(config)#snmp-server view internet internet included
device(config)#snmp-server view system system included
device(config)#snmp-server community ..... ro
device(config)#snmp-server community ..... rw
device(config)#snmp-server contact isc-operations
device(config)#snmp-server location sdh-pillbox
device(config)#snmp-server host 128.91.255.32 .....
device(config)#snmp-server group ops v3 priv read internet write system
device(config)#snmp-server group admin v3 priv read internet write internet
device(config)#snmp-server group restricted v3 priv read internet
device(config)#snmp-server user ops ops v3 encrypted auth md5 ab8e9cd6d46e7a270b8c9549d92a069 priv
encrypted des 0e1b153303b6188089411447dbc32de
device(config)#snmp-server user admin admin v3 encrypted auth md5 0d8a2123f91bfbd8695fef16a6f4207b priv
encrypted des 18e0cf359fce4fcd60df19c2b6515448
device(config)#snmp-server user restricted restricted v3 encrypted auth md5
261fd8f56a3ad51c8bcec1e4609f54dc priv encrypted des d32e66152f89de9b2e0cb17a65595f43
```

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