CONFIGURATION GUIDE

RUCKUS FastIron Management Configuration Guide, 09.0.10

Supporting FastIron Software Release 09.0.10

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Contents

Preface

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.commscope.com/ruckus 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://community.ruckuswireless.com
- 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.

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.commscope.com/ruckus .

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://commscopeuniversity.myabsorb.com/. The registration is a two-step process described in this video. You create a CommScope account and then register for, and request access for, CommScope University.

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.
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.

About This Document

New in This Document

The following table describes changes to this guide for all FastIron 09.0.10 releases.

TABLE 2 Summary of Enhancements in FastIron Release 09.0.10d

Feature	Description	Reference
Configuration Archive Auto-revert	New functionality has been added for the auto-revert feature.	Enabling Configuration Archive Auto-Revert on page 101
Configuring the Banner MOTD	Update for configuring from SmartZone	Configuring the CLI Banner on page 79

TABLE 3 Summary of Enhancements in FastIron Release 09.0.10a

Feature	Description	Reference
ICX-Management Configurable Custom Port	The **manager ssh-port** command allows you to specify a port for connecting to SmartZone.	Configuring a Custom Port Number for Connection to SmartZone on page 240
Precision Time Protocol (PTP) and Transparent Clock	Adds support for ICX 7150-48ZP model.	Precision Time Protocol on page 125
1G Breakout	1G Breakout enables the configuration of 1G speed on 10G breakout ports dynamically without performing reload. 1G Breakout does not mandate all the ports to be configured at the same speed, so that each port can work according to the configured speed setting (10G/1G speed).	1G Breakout Ports on page 78
Secure Wipe	The secure wipe feature securely erases the flash contents permanently so that contents cannot be retrieved after erase. This is primarily used for data sanitization.	Secure Wipe on page 89
Updates to address defects	Minor updates on content throughout to address defects.	All chapters.
Minor editorial updates	Minor editorial updates were made throughout the Configuration Guide.	All chapters.

Supported Hardware

This guide supports the following RUCKUS products:

- RUCKUS ICX 7850 Series Switches
- RUCKUS ICX 7650 Series Switches
- RUCKUS ICX 7550 Series Switches
- RUCKUS ICX 7450 Series Switches
- RUCKUS ICX 7250 Series Switches
- RUCKUS ICX 7150 Series Switches

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

Configuration Fundamentals

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     19040          5              0             0
Total     19040          5              0             0
```

Consideration for Accessing Factory Default Device

- To make the same first time access behavior from CLI, WEB or SSH, the console authentication and web authentication is enabled in device and the first time access (shipped from the factory) is possible with default local username **super** with password **sp-admin**.
- For the first time, users are authenticated using **super/sp-admin** credentials, which also ensures the password to be modified before providing the ICX device prompt for further operation.
- Necessary device configurations used for authentication are enabled by default in the device:

```
aaa authentication web-server default local
aaa authentication login default local
enable aaa console
no telnet server
username super password .....
(default local user super with password sp-admin)
```

- Once the user gets access to the box after modifying the password, the above configurations can be seen in running configuration. User is allowed to change any configurations in the box.
- Once password is modified for username "super" it is treated as any other local user in the device.
- Conditions with the below configurations are not enabled:
  - If the device has the startup configuration file in the flash during boot up.
  - If the FIPS mode is enabled in the device during boot up.
- Conditions with the below configurations are removed automatically after device boots up:
  - The above configurations will removed automatically in any of the below scenarios before the device is accessed from CLI, SSH or WEB.
  - If the device connects to SZ.

- if the configuration is pushed to the device via DHCP auto provisioning, before it's first time access from CLI, WEB or SSH.

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*.

Automation with Ansible

Ansible is open-source tool for software provisioning and configuration management. It is a flexible framework that is used in network automation through the use of networking modules, as documented by Ansible, and the use of playbooks.

Ansible documentation can be found at Ansible.com, and Ansible support for the RUCKUS ICX series of devices can be found at https://docs.ansible.com/ansible/latest/modules/list_of_network_modules.html#icx. Latest fixes and playbooks can be found at https://github.com/commscope-ruckus/Ansible-ICX-Module-Releases.

NOTE
The latest Ansible version may not always support ICX, so select the correct Ansible version from the drop-down menu on the left pane.

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
If configured for SNMP protocol, the **management source-interface** command 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.

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 **management vrf** command followed by the VRF name and the keyword **strict** as shown in the following example.

```
device(config)# management vrf telnet10 strict
```

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 **management source-interface protocol radius** 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 **management source-interface protocol tacacs** 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 the management VRF configuration while a TFTP file transfer is in progress.

> **NOTE**
> The TFTP source interface configuration command **management source-interface protocol tftp** 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 **management source-interface protocol syslog** 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 commands.

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

If the specified VRF is not pre-configured, command execution fails, and the following error message is displayed.

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

After a management VRF is configured, the following Syslog message is displayed.

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

Enter the **no management-vrf** 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
```

Management VRF 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, the VRF cannot be deleted or modified until you delete the management VRF. 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 **show vrf** command and specify the VRF for which you want to display IP information.

```
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
```

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
```

To display packet and session rejection statistics due to failure in management VRF validation, enter the **show management-vrf** 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
```

Ensure 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
```

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.

> **NOTE**
> Both **ip default-gateway** and **default-ipv6-gateway** commands can be used only with the switching image.

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
```

NOTE
The **management exclude** command is mutually exclusive with respect to the **management vrf strict** command. 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 **management vrf strict** command does 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 4 European Time Zones

Time Zone	Description
GMT	Greenwich Mean Time, UTC
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 5 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

TABLE 5 USA Time Zones (continued)

Time Zone	Description
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 6 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. ICX devices have the capability to retain date and time programmed in Real Time Clock(RTC) register even when power is removed from the device. However, ICX 7150 and ICX 7650 do not have this capability because they were designed without RTC battery, therefore they do not retain clock date and time in case of power outage. To avoid this, you should configure NTP server to manage the clock because time synchronization from NTP server overrides the switch clock.

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 ICX 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*.

Configuring Basic System Parameters

You can configure the basic system parameters from the global configuration mode.

1. Enter the global configuration mode.

```
device# configure terminal
```

2. Configure system administration information.

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

In the example, the system name, system contact, and location are configured for the RUCKUS device and the information is saved locally in the configuration file. When you configure a system name, the name replaces the default system in the CLI command prompt. The name, contact, and location each can be up to 255 alphanumeric characters.

3. Enable user-login details in syslog messages and traps from the global configuration mode.

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

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.

The following example shows how to configure basic system parameters.

```
device# configure terminal
device(config)# hostname zappa
device(config)# snmp-server contact Support Services
device(config)# snmp-server location Centerville
device(config)# end
device# write memory
device(config)# logging enable user-login
```

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
```

The first message 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 configuration 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.

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
```

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
```

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

TABLE 7 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

TABLE 7 System parameters in show default values command (continued)

Parameter	Definition
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
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

Password and Device Recovery

This section explains the following:

- How to reset login details if you have upgraded to FastIron 09.0.00 from a previous release.
- How to erase the startup configuration.

1. Press **Ctrl** and **Y** to enter OS configuration mode.

2. Enter **help** to access all configuration options in OS configuration mode.

```
OS> help

help
exit
remote_address
remote_gateway
show_remote
copy
reset_login
erase_startup_config
reboot

OS>
```

3. Choose from one of the following:

- **To reset login details:**

  Enter **reset_login** to reset login details.

```
OS> reset_login
This is a temporary login. Please reconfigure users once you login.
```

  NOTE
  You must enter **super** for Login and **sp-admin** for password.

  Enter the **exit** command to return to user EXEC mode. Press enter. You are prompted for your username (**super**) and password (**sp-admin**)

```
OS> exitOS> exit
Ruckus-ICX login:
Ruckus-ICX login: super
Password: sp-admin
```

- **To restore the device to factory default configuration:**

  Connect a console cable from the console port to the terminal server.

  NOTE
  You must have a console connection to erase the startup configuration. All connections and configurations from the system are lost when you enter the **erase_startup_config** command.

  NOTE
  Erasing the startup configuration is not recommened and should only be performed under the supervision of a RUCKUS support engineer.

  Enter **erase_startup_config** to erase the startup configuration.

```
OS> erase_startup_config
OS>
```

  Enter the **reboot** command to reboot the system.

```
OS> reboot
```

  When the system reboots, enter your username (**super**) and password (**sp-admin**).

The following example resets the username to super and the password to sp-admin, which is the default for FastIron 09.0.00. Press **Ctrl** and **Y** before performing the below steps.

```
OS> reset_login
This is a temporary login. Please reconfigure users once you login.
OS> exit

Ruckus-ICX login: super
Password: sp-admin
```

The following example resets the startup configuration and erases all configurations. You must have a console connection to perform this task. Perform this task only under the supervision of a RUCKUS support engineer. Press **Ctrl** and **Y** before performing the below steps.

```
OS> erase_startup_config
OS> reboot
INIT:
Ruckus-ICX login: Stopping irqbalance: OK
```

Forwarding Profiles

Forwarding Profiles allows for the configuration of the Unified Forwarding Table (UFT) so that it suits deployment requirements. A predefined forwarding profile can be selected based on scaling requirements. This UFT partition is configured during the initialization process and is effective after a system reload.

The Unified Forwarding Table (UFT) can house both logical Layer 2 and logical Layer 3 forwarding tables. By combining these tables into a single configurable resource, more memory resources can be assigned to heavily utilized logical tables at the expense of less-used tables. In this manner, the different scaling requirements for Layer 2 (MAC addresses) and Layer 3 (IPv4 and IPv6 routes) can be managed. The shared table can be partitioned so that it can be used for Layer 2 tables, Layer 3 tables, Algorithmic Longest Prefix Match (ALPM) tables, or Field Processor Exact Match (FPEM) tables, according to the needs of the user.

Three predefined forwarding profiles are supported. The following table shows information about the predefined forwarding profiles and the maximum system entries set for each profile.

Forwarding Profiles is supported for the following RUCKUS ICX platforms:

- ICX 7850
- ICX 7550

NOTE
The default forwarding profile is **profile1**.

TABLE 8 Maximum System Entries Set for a Forwarding Profile for ICX 7850 Devices

System-max entries	profile1 (L3: Layer 3)	profile2 (L2: Layer 2)	profile3 (SP: service provider)	profile4
MAC addresses	32768	294912	56320	163840
IPV4 routes	307200	16384	43008	131072
IPV6 routes	11264	4096	35840	11264
IGMP snooping cache entries	6144	6144	8192	6144
IGMP snooping group addresses	8192	8192	8192	8192
MLD snooping cache entries	2048	2048	6144	2048
MLD snooping group addresses	8192	8192	8192	8192
PIMv4 mcache entries	6144	6144	8192	6144

TABLE 8 Maximum System Entries Set for a Forwarding Profile for ICX 7850 Devices (continued)

System-max entries	profile1 (L3: Layer 3)	profile2 (L2: Layer 2)	profile3 (SP: service provider)	profile4
PIMv6 mcache entries	2048	2048	8192	2048
IP next-hop	62464	47104	57344	40960

TABLE 9 Maximum System Entries Set for a Forwarding Profile for ICX 7550 Devices

System-max entries	profile1	profile2	profile3
MAC addresses	16384	114688	32768
IPV4 routes	97280	8192	21504
IPV6 routes	8192	2048	17408
IGMP snooping cache entries	6144	6144	6144
IGMP snooping group addresses	6144	6144	6144
MLD snooping cache entries	2048	2048	2048
MLD snooping group addresses	8192	8192	8192
PIMv4 mcache entries	6144	6144	6144
PIMv6 mcache entries	2048	2048	2048
IP next hops	21504	21504	21504

TABLE 10 Maximum System Entries Set for a Forwarding Profile for ICX 7550 Devices for a Switch Image

System-max entries	profile2
MAC addresses	114688
IPV4 routes	8192
IPV6 routes	2048
IGMP snooping cache entries	8192
IGMP snooping group addresses	6144
MLD snooping cache entries	2048
MLD snooping group addresses	8192
PIMv4 mcache entries	6144
PIMv6 mcache entries	2048
IP next hops	21504

Configuration Considerations for Forwarding Profiles

The following configuration considerations apply to Forwarding Profiles:

- Forwarding profiles are only supported on ICX 7850 and ICX 7550 devices.
- The UFT is configured during the initialization process. The configuration is based on the forwarding profile selected.
- When the forwarding profile is changed using the **forwarding-profile** command, the maxium system parameters for IPv4 routes, IPv6 routes, MAC addressess, IGMP groups, MLD groups, PIM mcache, PIMv6 mcache, and next hops take the value from the configured profile. The IP route default VRF, IP route VRF, IPv6 route VRF, and IPv6 default VRF are reset.
- The default forwarding profile is profile1.
- For ICX 7850 devices, there are four profiles available. For ICX 7550 devices, , for router images, there are three profiles available.
- When uRPF is enabled, IPv4 route and IPv6 route scaling numbers are reduced.

- In previous FastIron releases that supported a UFT, the Layer 2 table and Layer 3 table sizes were fixed and the UFT partition could not be changed.
- The UFT shared table partition can be changed only during the initialization process. The selected forwarding profile is available after a reload.
- When profile3 (SP: Service provider) is used for ICX 7850 devices, PIMv4 and PIMv6 can simultaneously scale to 8192 mcache entries each.
- For ICX 7550 devices for switch images, only profile2 (L2: Layer 2) is supported.

Configuring a Forwarding Profile

Complete the following steps to change a forwarding profile. The following example configures the predefined forwarding profile “profile2” for an ICX 7850 device. The default forwarding profile "profile1" is overwritten and the maximum system (system-max) parameters are reset.

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

```
device# configure terminal
```

2. Enter the **forwarding-profile** command with the **profile2** keyword to change the forwarding profile from the default.

```
device(config)# forwarding-profile profile2

Perform a write mem and reload for profile2 profile to take effect
```

After using the **forwarding-profile** command, you must use the **write-memory** and **reload** commands to place the change into effect.

The following example configures the predefined non-default forwarding profile “profile2” for an ICX 7850 device.

```
ICX7850# configure terminal
ICX7850(config)# forwarding-profile profile2

Perform a write mem and reload for profile2 profile to take effect
```

The following example configures the default forwarding profile “profile1” for an ICX 7850 device if the forwarding profile “profile2” has been configured.

```
ICX7850# configure terminal
device(config)# forwarding-profile profile1

Perform a write mem and reload for profile1 profile to take effect
```

The following example configures the predefined non-default forwarding profile “profile3” for an ICX 7850 device.

```
ICX7850# configure terminal
ICX7850(config)# forwarding-profile profile3

Perform a write mem and reload for profile3 profile to take effect
```

The following example configures the predefined non-default forwarding profile “profile4” for an ICX 7850 device.

```
ICX7850# configure terminal
ICX7850(config)# forwarding-profile profile4

Perform a write mem and reload for profile4 profile to take effect
```

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 7850 Device Port Regions

ICX 7850 device has only one port region. All ports belong to region 0.

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.

Specifying a Port Address

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

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

- Unit: Specifies the unit ID.
- Slot: Specifies the slot number.
- Port: Specifies the port number in the slot.

TABLE 11 Specifying Data Port Address

ICX Devices	Unit/Slot/Port
ICX 7850, ICX 7650, ICX 7550, ICX 7450, ICX 7250, ICX 7150	1/1/1 to 1/1/24 or 1/1/48

TABLE 12 Specifying Stacking Port Address

ICX Devices	Unit/Slot/Port
ICX 7850, ICX 7650, ICX 7550, ICX 7450, ICX 7250, ICX 7150	1/1/1 to 12/1/1

Specifying Management Port

The management port number is always 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 Basic Port Parameters

You can configure basic port parameters from the global configuration mode.

1. Enter the global configuration mode.

```
device# configure terminal
```

2. Specify a port address for a data port, stacking port, or management port.
   - Specifying a data port.

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

   - Specifying a stacking port.

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

   - Specifying a management port.

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

3. Configure a multi-port static MAC address.

   ```
   device(config)# vlan 30
   device(config-vlan-30)# static-mac-address 0000.0063.67ff ethernet 1/1/1 to 1/1/6 priority 7
   ```

   In the example, a static entry for a server with a MAC address of 0000.0063.67ff and a priority of 7 is added.

4. Assign port names from the interface configuration mode using one of the following methods.
   - Assigning a name to a port.

     ```
     device(config)# interface ethernet 1/1/1
     device(config-if-e1000-1/1/1)# port-name Mike
     ```

   - Assigning same name to a range of ports.

     ```
     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
     ```

   - Assigning same name to individual multiple ports.

     ```
     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
     ```

   You can assign text strings as port 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.

The following example shows how to configure basic port parameters. The Ethernet ports from 1/4/2 through 1/4/4 are assigned a static MAC address 0000.0063.67ff with priority 7. The Ethernet port 1/4/2 is assigned a name, Mike.

```
device# configure terminal
device(config)# vlan 30
device(config-vlan-30)# static-mac-address 0000.0063.67ff ethernet 1/1/1 to 1/1/6 priority 7
device(config)# interface ethernet 1/4/2
device(config-if-e1000-1/4/2)# port-name Mike
```

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
```

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

TABLE 13 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.
Duplex	Specifies duplex mode.
Speed	Specifies the link speed.
Trunk	Specifies the trunk status.
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
```

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.

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

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.

The following example changes the port speed of a four port group to 10 Mbps operating in full-duplex mode for an ICX 7850-48F device.

```
ICX-7850# configure terminal
ICX-7850(config)# interface ethernet 1/1/45 to 1/1/48
ICX-7850(config-if-e1000-1/1/8)# speed-duplex 10g-full
```

NOTE

For Ruckus ICX 7850-48F, SFP28 devices, ports are grouped into fours. For example, ports 1/1/1 to 1/1/4 are one group and ports 1/1/5 to 1/1/8 are another group, and so on. All ports in a four-port group must be configured to the same value. This restriction does not apply if configuring values between 1G and 10G.

Auto-negotiation

Auto-negotiation allows a port to communicate with the peer port to determine the optimal speed and duplex mode for the connection.

TABLE 14 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	10G-full-master	10G-full-slave	25G-full[4]
1G Cu (fixed ports)	Y (default)	Y[5]	Y	Y[5]	Y	Y	Y	Y	N	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] 25G ports are supported on ICX7850-48F. These ports can be configured at 25G speed only in groups of 4 ports or sets of groups of 4 ports e.g. 1/1/1-1/1/4, 1/1/1-1/1/8.
[5] On ICX 7150 and ICX 7250, 1G copper uplink ports do not support half duplex.

ICX 7550-24ZP and ICX 7550-48ZP 1G copper ports does not support 100M half-duplex.

TABLE 14 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	10G-full-master	10G-full-slave	25G-full[4]
2.5G Cu (fixed ports)[6]	Y	N	N	N	Y[7][8][9]	Y	Y	Y	Y[10]	Y	Y	N	N	N	N	N	N	N
10G Cu (fixed ports)	Y (default)	N	N	N	Y	Y	Y	Y	Y[10]	Y [10]	Y[10]	Y[10]	Y[10]	Y[10]	Y	Y	Y	N
1G Fiber + GBIC SFP	Y (default)	N	Y	N	Y	Y	N	N	N	N	N	N	N	N	N	N	N	N
10G Fiber + GBIC SFPP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y(default)	N	N	N
1G Fiber + 100-fx	N	N	N	N	Y (default)	N	N	N	N	N	N	N	N	N	N	N	N	N
1G Fiber + 1G SFP	Y	N	N	N	N	Y (default)	N	N	N	N	N	N	N	N	N	N	N	N
1G Fiber + 10G SFPP (avoid)	N	N	N	N	N	N[11]	N	N	N	N	N	N	N	N	N	N	N	N
10G Fiber + 1G SFP	Y	N	N	N	N	Y (default)	N	N	N	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] 25G ports are supported on ICX7850-48F. These ports can be configured at 25G speed only in groups of 4 ports or sets of groups of 4 ports e.g. 1/1/1-1/1/4, 1/1/1-1/1/8.
[6] 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.
[7] 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.
[8] 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.
[9] ICX 7150-C08 doesn't support EEE feature, hence 100 Mbps speed configuration is not supported on this device when it is connected to MultiGig ports.
[10] 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.

ICX 7650-24ZP has 6 full Multigig ports and 18 ports of speed 100/1000/2500Mbps supporting 802.3bz and NBase-T.

ICX 7650-48ZP has 12 full Multigig ports and 36 ports of speed 100/1000/2500Mbps supporting 802.3bz and NBase-T.
[11] To be supported, use 10Gb optics at 10Gb and 1Gb optics at 1Gb.

TABLE 14 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	10G-full-master	10G-full-slave	25G-full[4]
10G Fiber + SFPP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y (default)	N	N	N
25G Fiber + 1G SFP	Y[12]	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N
25G Fiber + GBIC, SFP	N	N	N	N	N	Y	N	N	N	N	N	N	N	N	N	N	N	N (default)
25G Fiber + SFPP	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y	N	N	N (default)
25G Fiber + SFP28	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	Y (default)
40G Fiber	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
100G Fiber	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N

NOTE

RUCKUS ICX Compact Switches do not support auto-neg on module 3. To bring up a 1Gbps link on these ports, issue the **gig-default neg-off** or equivalent command on the partner port.

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

[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] 25G ports are supported on ICX7850-48F. These ports can be configured at 25G speed only in groups of 4 ports or sets of groups of 4 ports e.g. 1/1/1-1/1/4, 1/1/1-1/1/8.
[12] 25G ports in ICX 7850-48F requires the remote end to disable the auto-neg using the command **gig-default**, which is applicable only for fiber ports with 1G optic.

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.

> **NOTE**
> If a non ICX7850-48F 25G fiber port is connected to ICX7850-48F 25G port at 1G speed, then for ICX switches disable the "auto-negotiation" of that port using the **gig-default neg-off** command. For non ICX switches, an equivalent command or configuration that is vendor specific is used.

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).

Configuring maximum port speed advertisement

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
```

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
```

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
```

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.

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.

  NOTE
  The neg-full-auto mode is not supported on RUCKUS ICX 7K devices.

- 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 15 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 16 List of invalid configurations

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

TABLE 17 List of invalid configurations

ICX 7450 (10G fiber port) configuration	Link Partner - ICX 7450 / 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 symmetrical 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.

Configuring Flow Control

By default, flow control is enabled globally on all full-duplex ports.

1. Enter the global configuration mode.

```
device# configure terminal
```

2. Enable flow control negotiation.

```
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, flow control is enabled or disabled depending on the peer advertisement. When flow control is enabled globally and auto-negotiation is on, flow control is 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.

3. Re-enable flow control on all ports.

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

   When flow control is enabled globally, you can disable and re-enable it on individual ports.

The following example shows how to configure flow control on Ethernet port, 1/1/21.

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

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
```

Symmetrical Flow Control

In addition to asymmetric flow control, RUCKUS devices support symmetrical flow control (SFC), meaning the ports can both receive and transmit 802.3x PAUSE frames.

Symmetrical 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. Symmetrical 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.

Configuration Notes and Feature Limitations for Symmetrical Flow Control

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

- Symmetrical flow control is supported on all 1G,10G, 40G, and 100G data ports on ICX devices.

- Symmetrical flow control is not supported on stacked ports or across units in a stack. If you are using symmetrical 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.
  - Symmetrical 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 symmetrical 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. Similarly, in switches like ICX 7450 which has two devices (packet processors), pause frames are not propogated from one packet processor to another.
  - 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 symmetrical 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 symmetrical flow control:
  - 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 symmetrical 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 **symmetrical-flow-control** is enabled, symmetrical flow control will be disabled and trust dscp will be placed into effect. Make sure you do not enable incompatible QoS features when symmetrical flow control is enabled on the device.

Configuring Symmetrical Flow Control

Symmetrical flow control (SFC) is globally disabled by default. However, because flow control is enabled by default on all ports, these ports will always honor received 802.3x Pause frames, irrespective of whether symmetrical flow control is enabled or disabled.

To configure symmetrical flow control, priority flow control (PFC) must be disabled.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Enable symmetrical flow control globally or on all priorities.

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

   Enables SFC on priorities from 0 through 4. Enabling SFC using the **symmetrical-flow-control enable** command is recommended.

   ```
   device(config)# symmetrical-flow-control enable all-priorities
   ```

   CAUTION
   Enabling SFC on all priorities is not recommended as it can cause network instability.

3. Enable flow control in various modes in interface configuration mode.

```
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# flow-control generate-only
device(config-if-e1000-1/1/1)# flow-control honor-only
device(config-if-e1000-1/1/1)# flow-control both
```

The following example shows how to configure symmetrical flow control for priorities from 0 through 4 in generate-only mode.

```
device# configure terminal
device(config)# symmetrical-flow-control enable
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# flow-control generate-only
```

Displaying Symmetrical Flow Control Status

You can display the SFC status by using the **show symmetrical-flow-control** command.

The following example displays the SFC status for **symmetrical-flow-control enable** command.

```
device(config)# show symmetrical-flow-control
Global Symmetrical Flow Control Status: Enable on Priorities (0-4)
```

The following example displays the SFC status for **symmetrical-flow-control enable all-priorities** command.

```
device(config)# show symmetrical-flow-control
Global Symmetrical Flow Control Status: Enable on all priorities
```

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
```

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.

All RUCKUS ICX 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 a FastIron 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.

```
device(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.

```
device(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.

```
device(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.

```
device# configure terminal
device(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.
device(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
!
!

device(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 step 5 of Configuring Port Loopback Detection on page 62.

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.

Configuring Port Loopback Detection

Loop detection is disabled by default. Loop detection can be enabled on a physical port or on a VLAN.

1. Enter the global configuration mode.

```
device# configure terminal
```

2. Enable loop detection on a physical port (strict mode) or on a VLAN (loose mode).

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

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

3. Exit the interface or VLAN configuration mode and enter the global configuration mode.

```
device(config-if-e10000-1/1/1)# exit
device(config-vlan-10)# exit
```

4. Set global loop detection interval.

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

When loop detection is enabled, the loop detection time unit is 0.1 second, with a default of 10 (one second). The loop detection intercal ranges from 1 (one tenth of a second) through 300 (30 seconds). In the example, **loop-detection-interval** is set to 5 seconds (50 x 0.1).

5. Configure the device to automatically re-enable ports that were disabled due to loop detection.

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

6. Specify the recovery time interval.

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

By default, the device will wait for 300 seconds before re-enabling the ports. You can optionally change this interval to a value from 10 through 65535 seconds. In the example, the device is configured to wait for 120 seconds (2 minutes) before re-enabling the ports.

7. Clear loop detection statistics.

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

The **clear loop-detection** command clears the loop detection statistics and re-enables all the ports that are in Err-Disable state because of loop detection.

The following example shows how to enable loop detection on a port, 1/1/1.

```
device# configure terminal
device(config)# interface 1/1/1
device(config-if-e1000-1/1/1)# loop-detection
device(config-if-e10000-1/1/1)# exit
device(config)# loop-detection-interval 50
device(config)# errdisable recovery interval 120
```

The following example shows how to enable loop detection on a VLAN, VLAN-10.

```
device# configure terminal
device(config)# vlan 10
device(config-vlan-10)# loop-detection
device(config-vlan-10)# exit
device(config)# loop-detection-interval 50
device(config)# errdisable recovery interval 120
```

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.

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
```

The following table describes the output fields for this command.

TABLE 18 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 7450, and ICX 7250 devices.

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 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. (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 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
```

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

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

4. 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)# 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 19 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
```

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
```

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
```

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.

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
```

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)
```

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

TABLE 20 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
```

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 21 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.
Vlan-id	The VLAN ID of the port where the MAC address movement was detected.

Overview of Breakout Ports

100/40-Gbps cable can be used on ICX 7850 standalone units to break out certain 40-Gbps ports into four 10-Gbps subports and 100-Gbps ports into four 25-Gbps subports respectively.

The breakout ports can be broken out only when stacking is not enabled, and any interface-level configuration must be removed before it can be broken out into subports.

NOTE
Beginning with FastIron 08.0.90, any stacking port can serve as a breakout port as long as the **stack enable** command is not configured. However, the stacking ports are always displayed in three-tuple format (x/y/z) even when they have been configured as breakout ports. For example, if port 1/2/1 is a breakout port, it appears in general configuration or **show** command output as 1/2/1:1; however, any output that shows the port as a stack-port configuration displays the port as 1/2/1.

NOTE
ICX 7850 devices do not need to be in store-and-forward mode for breakout ports to be functional.

Ports available for breakout are shown for each supported model in the following table. Refer to the *RUCKUS ICX 7850 Switch Hardware Installation Guide* and *RUCKUS ICX 7550 Switch Hardware Installation Guide* for information on installing breakout cables.

NOTE
On the ICX 7550, breakout is supported only on module 2 stacking and uplink ports.

TABLE 22 ICX 7850 Ports Available for Breakout

	ICX 7850-32Q	ICX 7850-48F	ICX 7850-48FS
Module 1	1/1/1 through 1/1/12 (12 ports)	N/A	N/A
Module 2	1/2/1 through 1/2/12 (12 ports)	1/2/1 through 1/2/8	1/2/1 through 1/2/8
Module 3	1/3/1 through 1/3/8 (8 ports)	N/A	N/A

TABLE 23 ICX 7550 Ports Available for Breakout

ICX 7550 Models	Uplink Ports	Breakout Ports	Supported Speed
ICX 7550 24 ICX 7550 48 ICX 7550 24P ICX 7550 48P	Slot 2 : Port 1 and Port 2	1/2/1 through 1/2/2 Each port is 1/2/1:1 to 1/2/1:4 and 1/2/2:1 to 1/2/2:4	40-Gbps uplink (4x10-Gbps) breakout

TABLE 23 ICX 7550 Ports Available for Breakout (continued)

ICX 7550 Models	Uplink Ports	Breakout Ports	Supported Speed
ICX7550 24ZP ICX7550 24F	Slot 2 – Port 2	Breakout is not supported in default mode Uplink-100-Gbps mode supports (4x10-Gbps) and 4/25-Gbps breakout Breakout is supported in only on 1/2/2 in uplink-100-Gbps mode	100-Gbps uplink or 40-Gbps uplink (4x10-Gbps) breakout or (4x25-Gbps) breakout
ICX7550 48ZP ICX7550 48F	Slot 2 – Port 1 and Port 2	Breakout is not supported in default mode Uplink-100-Gbps mode supports (4x10-Gbps) and 4/25-Gbps breakout Breakout is supported in on 1/2/1 and 1/2/2 in uplink-100-Gbps mode	100-Gbps uplink or 40-Gbps uplink (4x10-Gbps) breakout or (8x25-Gbps) breakout

The RUCKUS ICX ICX 7550-48P, ICX 7550-24F, ICX 7550-24ZP, and ICX 7550-48ZP models can operate in both default and uplink-100-Gbps breakout modes. For the default mode (that is, in 40-Gbps uplink mode) eight 10-Gbps breakout ports are available on 1/2/1 and 1/2/2.

In the uplink-100-Gbps, the ICX 7550-48P and ICX 7550-48ZP models have eight 10-Gbps and eight 25-Gbps breakout ports available on 1/2/1 and 1/2/2.

In the uplink-100-Gbps mode, the ICX 7550-24F and ICX 7550-24ZP models have four 10-Gbps and four 25-Gbps breakout ports availabe on 1/2/2 only.

Configuring Breakout Ports and SubPorts

You can configure breakout ports in global configuration mode. After successful configuration and activation of breakout, the subports are available for configuration. By default, all main 40-Gbps ports are configured to come up in 40-Gbps mode.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure the breakout port.

```
device(config)# breakout ethernet 1/1/11
device# write memory
device# reload
```

NOTE
ICX 7550 24ZP,48ZP,24F, and 48F require configuring "slot 2 uplink-100g" in the first place before configuring breakout.

The **breakout ethernet** command divides the ports into subports when a breakout cable is attached.

The **breakout ethernet** command first checks the existing configuration on the port. If an existing configuration is detected, an error message is displayed to indicate that the prior configuration must be removed. Then, the **breakout ethernet** command must be rerun and the resulting configuration must be saved and reloaded before the four 10-Gbps subports are created.

3. Configure the subports.

```
device(config)# interface ethernet 1/1/11:1 to 1/1/11:4
```

In the example, port 1/1/11 has been configured for breakout into four 25-Gbps subports. Subports are denoted by special four-tuple notation to indicate unit, slot, port, and subport.

NOTE
Once breakout is removed and the device is reloaded, the subports and their configuration are also removed.

Displaying Information for Breakout Ports

Use the **show breakout** command output 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 subports, pending reload.

The following example displays breakout port information.

```
device# show breakout

Unit-Id: 1

Port       Module Exist    Module Conf     breakout_conf   breakout_oper
1/1/1      Yes             No              No              No
1/1/2      Yes             No              No              No
1/1/3      Yes             No              No              No
1/1/4      Yes             No              No              No
1/1/5      Yes             No              No              No
1/1/6      Yes             No              No              No
1/1/7      Yes             No              No              No
1/1/8      Yes             No              No              No
1/1/9      Yes             No              Yes             Yes
1/1/10     Yes             No              No              No
1/1/11     Yes             No              No              No
1/1/12     Yes             No              No              No
1/2/1      Yes             No              No              No
1/2/2      Yes             No              No              No
1/2/3      Yes             No              No              No
1/2/4      Yes             No              No              No
1/2/5      Yes             No              Yes             Yes
1/2/6      Yes             No              No              No
1/2/7      Yes             No              No              No
1/2/8      Yes             No              No              No
1/2/9      Yes             No              No              No
1/2/10     Yes             No              No              No
1/2/11     Yes             No              No              No
1/2/12     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
1/3/7      Yes             No              No              No
1/3/8      Yes             No              No              No
```

Setting Module 2 to Uplink-100-Gbps Mode

Breakout is supported only on module 2 in all ICX 7550 models. Use the **slot 2 uplink-100g** command to set module 2 uplink-100-Gbps mode on the ICX 7550-24ZP, ICX 7550-48ZP, ICX 7550-24F, and ICX 7550-48F models.

NOTE
The **slot 2 uplink-100g** command is not allowed if slot 3 has the ICX 7600-2X40GQ 2-port 80-Gbps module present or configured. Also, if slot 3 is in operational slot profile mode, then slot 3 cannot configure or turn on the ICX 7600-2X40GQ 2-port 80-Gbps module after insertion.

1. Enter global configuration mode.

```
ICX7550-48F Router# configure terminal
```

2. Enter the slot 2 uplink-100g command to configure module 2.

```
ICX7550-48F Router(config)# slot 2 uplink-100g

Changes require reload to take effect. Please do write memory and then reload or power cycle!!!
Slot 2 will be operating in uplink mode with 100Gbps speed after reload

ICX7550-48F Router(config)# exit
ICX7550-48F Router# write memory
ICX7550-48F Router# reload
```

3. Enter the **show running-config** command to display the running configuration.

```
ICX7550-48F Router# show running-config
Current configuration:
ver 08.0.95devT243
stack unit 1
module 1 icx7550-48f-port-management-module
module 2 icx7550-100g-2port-200g-module
stack mac 54ec.2f24.f8b6
slot 2 uplink-100g
```

The following example shows how to return to default mode.

```
ICX7550-48F Router(config)# no slot 2 uplink-100g
Changes require reload to take effect. Please do write memory and then reload or power cycle!!!
Slot 2 will be operating in default mode after reload.
```

Removing Breakout Configuration

Use the **no breakout ethernet** command to remove the breakout configuration.

Enter the **no breakout ethernet** command for an individual port or port range. However, for the restored port configuration to take effect, you must also use the **write memory** command and then use the **reload** command to update the unit's configuration.

1G Breakout Ports

1G Breakout enables the configuration of 1G speed on 10G broken ports dynamically without performing reload. 1G Breakout does not mandate all the broken ports to be configured at the same speed, so that each broken port can work according to the configured speed setting (10G/1G speed).

NOTE
To enable 1G Breakout Ports, you must perform a reload. Once 1G Breakout Ports is enabled, port density can be increased or decreased without performing a reload.

Consider the following when using this feature:

- All breakout ports work at same speed; however, all breakout ports can be configured with an individual speed.
- A new user configuration using the **speed-duplex 1000-full** command on a breakout port forces the speed configuration on the breakout port irrespective of the type of optics.

- Speed settings are changed dynamically and do not require a reboot.
- Each breakout port works according to its speed settings.
- 1G Breakout Ports is supported on ICX 7850 and ICX 7550 switches only. IG Breakout Ports is supported with two types of optics only. For details of these supported media types, refer to the Ruckus Ethernet Optics data sheet.
- Auto-negotiation must be disabled when using 1G Breakout Ports.
- The port must be configured in uplink mode before enabling breakout on ICX 7550-24F, ICX 7550-48F, ICX 7550-24ZP, and ICX 7550-48ZP models.
- 1G Breakout ports is limited to breakout ports and not applicable for ports configured as stacking ports.
- You can configure breakout ports in global configuration mode, and after the successful configuration and activation of breakout, the subports are available for configuration.

Configuring 1G Breakout Ports

The following example configures a breakout port and changes the breakout port speed to 1 Gbps. No reload is required.

```
device# configure terminal
device(config)# breakout ethernet 1/1/11
device(config)# exit
device# write memory
device# reload

device# configure terminal
device(config)# interface ethernet 1/1/1:2
device(config-if-e25000-1/2/1:2)# speed-duplex 1000-full
device(config-if-e25000-1/2/1:2)# gig-default neg-off
```

NOTE
The ICX 7550-24F, ICX 7550-48F, ICX 7550-24ZP, and ICX 7550-48ZP models require configuring slot 2 to 1-Gbps uplink mode before configuring 1G Breakout Ports.

Configuring the CLI Banner

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.

If you are using a Web client to view the message of the day, and the 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.

NOTE
When configuring from SmartZone, terminate each line, except the last line on the banner string with a delimiting character.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Set the message of the day (MOTD) banner on the user terminal using a delimiting character.

```
device(config)# banner motd c
Enter TEXT message, End with the character 'c'.
Welcome!!! c
```

   In this example, the delimiting character is "$" (dollar sign). The text in between the dollar signs is the content of the banner. The banner text can be up to 4,000 characters long, which can consist of multiple lines.

3. Configuring the requirement to press the Enter key after the banner message is displayed.

```
device(config)# banner motd require-enter-key
```

   Requiring to press the Enter key after the MOTD is displayed is disabled by default.

4. Set a privileged EXEC CLI level banner.

```
device(config)# banner exec
ASCII string   c banner text c, where 'c' is a delimiting character
<cr>
device(config)# banner exec $
Enter TEXT message, End with the character '$'.
TEST PRIVILEGE MODE $
```

   You can configure the RUCKUS device to display a message when a user enters the privileged EXEC CLI level.

The following example shows how to configure CLI banner with "$" (dollar sign) as the delimiting character, requires pressing the Enter key.

```
device# configure terminal
device(config)# banner motd $
Enter TEXT message, End with the character '$'
Welcome!!! $
device(config)# banner motd require-enter-key
device(config)# banner exec
ASCII string   c banner text c, where 'c' is a delimiting character
<cr>
device(config)# banner exec $
Enter TEXT message, End with the character '$'.
TEST PRIVILEGE MODE $
```

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.

To remove the banner, enter the **no banner incoming** command.

Cut-through switching

A device that operates in cut-through switching mode 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. Table 25 provides the latency details.

NOTE
The cut-through mode is supported for ICX 7850 devices.

TABLE 24 Default Behavior on Devices that Support Cut-through Switching

Supported Device	Default Mode
ICX 7750	Cut-through switching mode
ICX 7850	Store-and-forward mode

On devices that support cut-through switching, the default switching method for packet forwarding can be changed using the [**no**]**store-and-forward** command. In the store-and-forward mode, the data packets are not forwarded until the device receives the whole frame and checks its integrity. However, there are many factors to consider when selecting which switching method is best for your environment. In some cases it is desirable to change from the default method and configure a device to store-and-forward. You must save the configuration and reload for the change to take effect.

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.

- 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 is 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.
- ICX 7850-48C devices do not support cut-through switching on either 1G or 10G ports. Furthermore, when cut-through is enabled, while 1G and 10G ports remain in store-and-forward mode (the default), flow control is disabled on these ports in both directions.
- 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.

TABLE 25 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
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

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.

Multi-Process Memory Leak Detection

Memory leak detection provides a snapshot of allocated memory when dynamic memory allocation or deallocation happens. Memory leak detection assumes great significance as memory leaks impact the performance of the system. In current implementation, memory leak detection and debugging is available for FastIron (FI) processes and a few other processes that support this feature. You can collect the memory leak snapshot

on running process by enabling memory leak detection using the **debug mem-leak** command and see the collected memory leak information based on size, reference count, and resource using the **show memory mem-leak** 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.

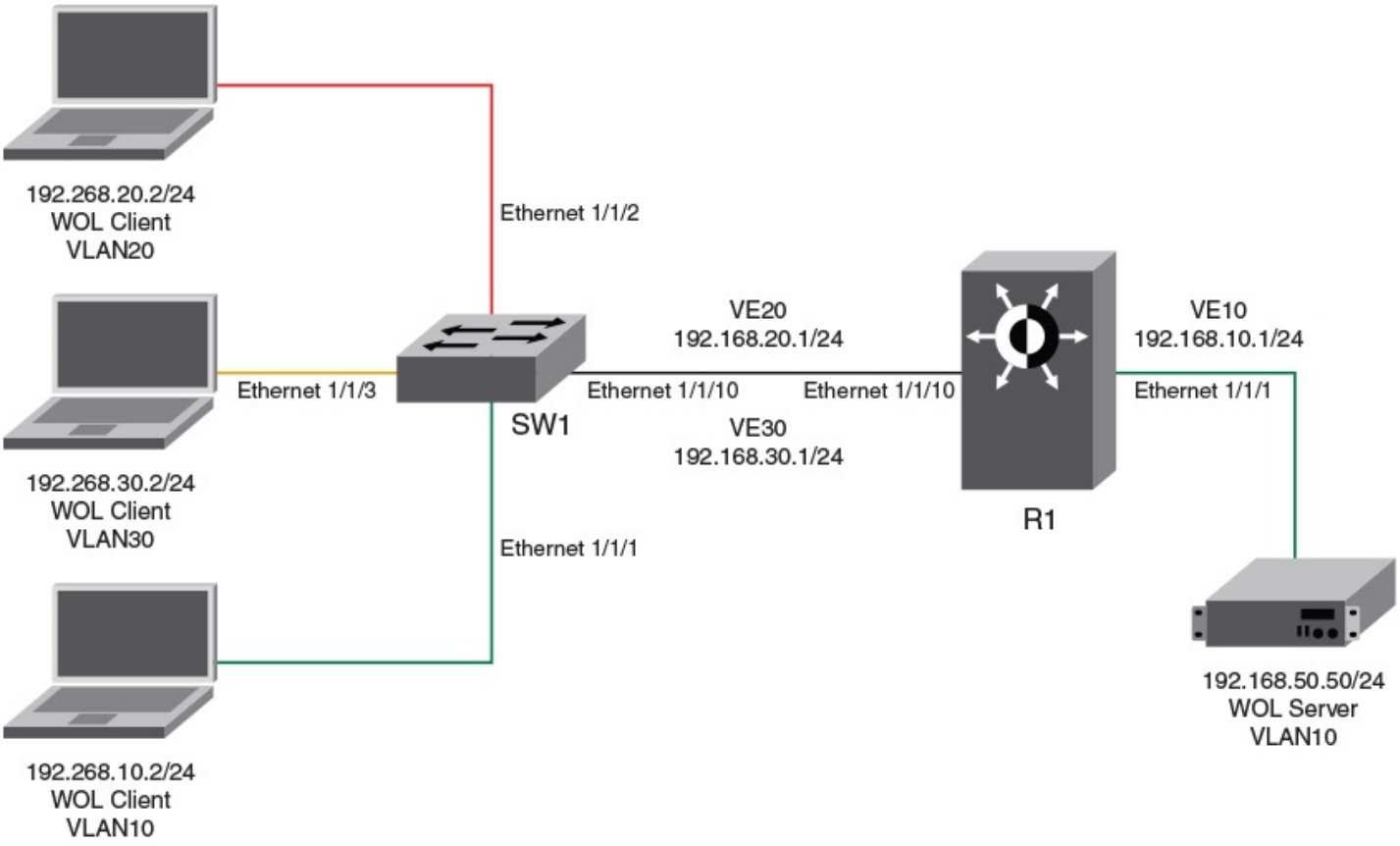
You must also configure a helper address on the VLAN of the WOL server to join the subnet of the desired clients using the **ip helper-address** command. You must specify the broadcast address of each client network as this is the only way to send a packet to a PC that is shut down. Because the PC is 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 R1 (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)# 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)# 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)# interface ve 30
device(config-vlan-30)# exit
device(config)# ip forward-protocol udp echo
device(config)# interface ve 10
device(config-vif-10)# ip address 192.168.10.1 255.255.255.0
device(config-vif-10)# ip helper-address 1 192.168.20.255
device(config-vif-10)# ip helper-address 2 192.168.30.255
device(config-vif-10)# 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 (SW1) 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
```

Secure Wipe

Data sanitization is the process of irreversibly erasing or wiping existing data stored on a memory device. It is essential for any organization to safeguard its sensitive data stored on a memory device from being retrieved by a third party. Secure wipe can be used for data sanitization and it provides the ability to wipe disk space according to DoD 5220.22-M standards, and afterwards reinstalls the ICX device. The process involves overwriting the previously stored data on hard disk or solid state disk drive storage areas with specific binary patterns repeatedly through a specific number of passes, followed by verification at the end of the final pass.

NOTE
Secure wipe is supported on the ICX 7550, ICX 7650, and ICX 7850 (router) devices only.

There are three different types of secure wipes:

- Single Pass: Overwrites all addressable locations with a random bit pattern.
- 3-Pass (DoD 5220.22-M [E]): Overwrites the previously stored data on hard disk or solid state disk drive storage areas with specific binary patterns repeatedly through three passes followed by verification.
  - Pass 1: Overwrites all addressable locations with binary zeroes.
  - Pass 2: Overwrites all addressable locations with binary ones (the complement of the previous pass).
  - Pass 3: Overwrites all addressable locations with a random bit pattern.
  - Verifies the final overwrite pass.
- 7-Pass (DoD 5220.22-M [ECE]): Overwrites the previously stored data on hard disk or solid state disk drive storage areas with specific binary patterns repeatedly through seven passes followed by verification.
  - Pass 1: Overwrites all addressable locations with binary zeroes.
  - Pass 2: Overwrites all addressable locations with binary ones (the complement of the previous pass).
  - Pass 3: Overwrites all addressable locations with a random bit pattern.
  - Pass 4: Overwrites all addressable locations with binary zeroes.
  - Pass 5: Overwrites all addressable locations with binary zeroes.
  - Pass 6: Overwrites all addressable locations with binary ones (the complement of the previous pass).
  - Pass 7: Overwrites all addressable locations with a random bit pattern.
  - Verifies the final overwrite pass.

You can securely erase the flash memory contents permanently and reinstall the ICX device using the **securewipe** command. Secure wipe erases only the flash memory and does not erase EEPROM. Before the **securewipe** command begins overwriting, a warning message displays for you to consider the implications before proceeding with the process. Because secure wipe occurs during bootup, the ICX device will reboot an extra time after secure wipe to install packages and boot up from the installed FastIron image. Except for TPM keys, all the files, including configurations, licenses, and any other keys are lost after a secure wipe.

Secure Wipe Configuration Notes and Considerations

- Only a user with Super User level privileges can perform secure wipe.
- SSH and Telnet sessions cannot be used to perform secure wipe because prints are displayed only on the console.
- Secure wipe is not supported in a stacking environment. To perform secure wipe, you must disable the stack by removing the stack configuration.
- Powering down or power cycling the device during secure wipe may cause the device to fail and it will fail to reboot.
- Powering down or power cycling the device during secure wipe may cause a failure to connect to the cloud because of the loss of the TPM keys.
- If both the primary unified forwarding image (UFI) and the secondary UFI do not exist, secure wipe will be aborted.
- If the UFI in flash memory is from a release prior to FastIron 09.0.10, secure wipe will be aborted.
- If FIPS is enabled, it will be disabled forcibly and automatically during secure wipe.
- Secure wipe is limited to the addressable range of memory.

Starting Secure Wipe

Complete the following steps to run secure wipe and reinstall the device.

1. Enter the **securewipe** command from the console.

   A warning message is displayed indicating the implications of the action.

```
device#securewipe 7pass
************************************************************
* SECUREWIPE Alert *
************************************************************
* Please pay attention to the details listed below *
* 1. U-Boot params will be erased *
* 2. All flash partitions will be erased and loose all files *
* 3. FIPS will be disabled and related keys will be erased *
* 4. License and config files will be erased *
* 5. Only FI image, U-Boot and TPM keys will be restored. *
* 6. All warm memory contents will be erased *
* 7. Device may fail to boot and/or fail to connect cloud if *
* power cycled or power down during secure wipe process *
* 8. Performing secure wipe frequently may reduce the flash *
* life cycle *
************************************************************
************************************************************
* I have read the alert and SECUREWIPE can be performed now. *
* Please enter 'y' to confirm, 'n' to exit : *
************************************************************
(enter 'y' or 'n'): y
Current booted partition: Primary, UFI used for secure wipe: Primary
Prerequisite check success,securewipe is processing....
*****************************************
PLEASE WAIT SYSTEM WILL GO FOR RESTART....
*****************************************
```

2. Enter **y** to proceed with the secure wipe process.

   After overwriting the flash memory content, the FastIron device will reboot an extra time to install packages and boot up from the installed FastIron image.
3. Verify the package installation (UFI bundle), the primary and secondary flash memory, and the version number.

Configuration File Management

Loading and Saving Configuration Files

For easy configuration management, all RUCKUS devices support both the download and upload of configuration files between the devices and a TFTP server on the network.

You can upload either the startup configuration file or the running configuration file to the TFTP server for backup and use in booting the system:

- Startup configuration file - This file contains the configuration information that is currently saved in flash. To display this file, enter the **show configuration** command at any CLI prompt.
- Running configuration file - This file contains the configuration active in the system RAM but not yet saved to flash. These changes could represent a short-term requirement or general configuration change. To display this file, enter the **show running-config** or **write terminal** command at any CLI prompt.

Each device can have one startup configuration file and one running configuration file. The startup configuration file is shared by both flash modules. The running configuration file resides in DRAM.

When you load the startup-config file, the CLI parses the file three times.

1. During the first pass, the parser searches for **system-max** commands. A **system-max** command changes the size of statically configured memory.
2. During the second pass, the parser implements the **system-max** commands if present and also implements trunk configuration commands (**trunk** command) if present.
3. During the third pass, the parser implements the remaining commands.

After you make configuration changes to the active system, you can save those changes by writing them to flash memory. When you write configuration changes to flash memory, you replace the startup configuration with the running configuration. The following example saves configuration changes to the active system to flash memory.

```
device# write memory
```

NOTE

To return the unit to the default startup configuration, use the **delete startup-config** command. Refer to the *RUCKUS FastIron Command Reference* for more information.

The following example displays how to back out of the changes you have made to the running configuration and return to the startup configuration.

```
device# reload
```

Logging Changes to the Startup-config File

You can configure a RUCKUS device to generate a Syslog message when the startup-configuration file is changed. The trap is enabled by default.

The following task configures a device to generate a Syslog message when the start-up configuration file is changed. Syslog messages are generated by default when the start-up configuration file is changed. Use this task if this functionality has been disabled.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Use the **logging enable config-changed** command to enable syslog messages when the startup-config file is changed.

```
device(config)# logging enable config-changed
```

When this feature is enabled the following syslog messages appear when the startup-config file is changed:

- The following Syslog message is generated when the startup-config file is changed.

```
startup-config was changed
```

- If the startup-config file was modified by a valid user, the following Syslog message is generated.

```
startup-config was changed by
username
```

Copying a Configuration File To or From a TFTP Server

You can upload a copy of the running configuration file from a Layer 2 or Layer 3 switch to a Trivial File Transfer Protocol (TFTP) server. The following task copies the startup-config or running-config file to or from a TFTP server.

NOTE
You can name the configuration file when you copy it to a TFTP server. However, when you copy a configuration file from the server to a RUCKUS device, the file is always copied as "startup-config" or "running-config", depending on which type of file you saved to the server.

NOTE
You should use a script or the **copy running-config tftp** command for extensive configuratiosn. You should not use the copy and paste for configurations with more than 2000 characters into.

The following example uploads a copy of the startup configuration file from the Layer 2 Switch or Layer 3 Switch to a TFTP server.

```
device# copy startup-config tftp 10.2.2.2 file4
```

The following example uploads a copy of the running configuration file from the Layer 2 Switch or Layer 3 Switch to a TFTP server.

```
device# copy running-config tftp 10.1.1.1 copyrun
Parameter Validation Successful
....File Upload Complete
```

The following example downloads a copy of the startup configuration file from a TFTP server to a Layer 2 Switch or Layer 3 Switch.

```
device# copy tftp startup-config 10.4.4.4 configfile
Parameter Validation Successful
Startup Config Download started
....Startup Config Download Done
Startup Config Write Done
Startup Config Download Complete
```

Maximum File Sizes for Startup-config File and Running-config File

Each RUCKUS device has a maximum allowable size for the running-config and the startup-config file. If you use TFTP to load additional information into a device running-config or startup-config file, it is possible to exceed the maximum allowable size. If this occurs, you will not be able to save the configuration changes.

The maximum size for the running-config and the startup-config file is 640K each.

To determine the size of a running-config or startup-config file, copy it to a TFTP server, then use the directory services on the server to list the size of the copied file.

Dynamic Configuration Loading

You can load dynamic configuration commands (commands that do not require a reload to take effect) from a file on a TFTP server into the running-config on a RUCKUS device. You can make configuration changes off-line, then load the changes directly into the device running-config, without reloading the software.

Dynamic Configuration Usage Considerations

- Use this feature only to load configuration information that does not require a software reload to take effect. For example, you cannot use this feature to change statically configured memory using a **system-max** command or to enter trunk group configuration information into the running configuration.
- Do not use this feature if you have deleted a trunk group but have not yet placed the changes into effect by saving the configuration and then reloading. When you delete a trunk group, the command to configure the trunk group is removed from the device running configuration, but the trunk group remains active. To finish deleting a trunk group, save the configuration to the startup-config file, then reload the software. After you reload the software, you can then load the configuration from the file.
- Do not load port configuration information for member ports in a trunk group. Since all ports in a trunk group use the port configuration settings of the LAG virtual interface in the group, the software cannot implement the changes to the member port.

Preparing the Configuration File

A configuration file that you create must follow the same syntax rules as the startup-config file the device creates.

- The configuration file is a script containing CLI configuration commands. The CLI reacts to each command entered from the file in the same way the CLI reacts to the command if you enter it. For example, if the command results in an error message or a change to the CLI configuration mode, the software responds by displaying the message or changing the CLI mode.
- The software retains the running-config that is currently on the device, and changes the running-config only by adding new commands from the configuration file. If the running config already contains a command that is also in the configuration file you are loading, the CLI rejects the new command as a duplicate and displays an error message. For example, if the running-config already contains a a command that configures ACL 1, the software rejects ACL 1 in the configuration file, and displays a message that ACL 1 is already configured.
- The file can contain global configuration commands or configuration commands for interfaces, routing protocols, and so on. You cannot enter User EXEC or privileged EXEC commands.
- The default CLI configuration mode in a configuration file is the global configuration model. Thus, the first command in the file must be a global configuration command or " ! ". The ! (exclamation point) character means "return to the global configuration mode".

  NOTE
  You can enter text following " ! " as a comment. However, the " !" is not a comment marker. It returns the CLI to the global configuration mode.

NOTE
If you copy-and-paste a configuration into a management session, the CLI ignores the " ! " instead of changing the CLI to the global configuration mode. As a result, you might get different results if you copy-and-paste a configuration instead of loading the configuration using TFTP.

- Make sure you enter each command in the correct CLI mode. Since some commands have identical forms at both the global configuration mode and individual configuration modes, if the CLI response to the configuration file results in the CLI entering a configuration mode you did not intend, then you can get unexpected results.

For example, if a trunk group is active on the device, and the configuration file contains a command to disable STP on one of the secondary ports in the trunk group, the CLI rejects the commands to enter the interface configuration mode for the port and moves on to the next command in the file you are loading. If the next command is a spanning-tree command with syntax that is valid in global confiiguration mode as well as interface configuration mode, then the software applies the command globally. Here is an example.

The configuration file contains these commands.

```
interface ethernet 1/1/2
no spanning-tree
```

The CLI responds like this.

```
device(config)# interface ethernet 1/1/2
Error - cannot configure secondary ports of a trunk
device(config)# no spanning-tree
device(config)#
```

- If the file contains commands that must be entered in a specific order, the commands must appear in the file in the required order. For example, if you want to use the file to replace an IP address on an interface, you must first remove the old address using "no" in front of the **ip address** command, then add the new address. Otherwise, the CLI displays an error message and does not implement the command. Here is an example.

The configuration file contains these commands.

```
interface ethernet 1/1/2
ip address 10.10.10.10/24
```

The running-config already has a command to add an address to port 1/1/2, so the CLI responds like this.

```
device(config)# interface ethernet 1/1/2
device(config-if-e1000-11)# ip add 10.10.10.10/24
Error: can only assign one primary ip address per subnet
device(config-if-e1000-1/1/2)#
```

To successfully replace the address, enter commands into the file as follows.

```
interface ethernet 1/1/2
no ip address 10.20.20.20/24
ip address 10.10.10.10/24
```

This time, the CLI accepts the command, and no error message is displayed.

```
device(config)# interface ethernet 1/1/2
device(config-if-e1000-1/1/2)# no ip add 10.20.20.20/24
device(config-if-e1000-1/1/2)# ip add 10.10.10.10/24
device(config-if-e1000-1/1/2)#
```

NOTE
Always use the **end** command at the end of the file. The **end** command must appear on the last line of the file, by itself.

Loading the Configuration Information into the Running-config

You can load a file from a TFTP server. The following example loads a file from a TFTP server.

```
device# copy tftp running-config 2001:db8::12:13 runningfile
```

NOTE
In the current FastIron release, the **copy tftp running-config** command merges only the ACL and MAC ACL configuration from the configuration file on the TFTP server to the running configuration on the device.

Refer to the *RUCKUS FastIron Command Reference* for more information.

Loading and Saving Configuration Files with IPv6

For IPv6, you can load and save configuration files. You can:

- Copy a file from a specified source to an IPv6 TFTP server
- Copy a file from an IPv6 TFTP server to a specified destination

Copying a File to an IPv6 TFTP Server

You can copy a file from the following sources to an IPv6 TFTP server:

- Flash memory
- Running configuration
- Startup configuration

The following example copies the secondary boot image named test.img from flash memory to a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3.

```
device# copy flash tftp 2001:DB8:e0ff:7837::3 test.img secondary
Parameter Validation Successful
.................................File Upload Complete
```

The following example copies the running configuration to a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3 and names the file on the TFTP server newrun.cfg.

```
device# copy running-config tftp 2001:DB8:e0ff:7837::3 newrun.cfg
Parameter Validation Successful
....File Upload Complete
```

Copying a File From an IPv6 TFTP Server

You can copy a file from an IPv6 TFTP server to the following destinations:

- Flash memory
- Running configuration
- Startup configuration

The following example copies a boot image named test.img from an IPv6 TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3 to the secondary storage location in the device flash memory.

```
device# copy tftp flash 2001:DB8:e0ff:7837::3 test.img secondary
Parameter Validation Successful
Image Download started
........................Image Download Done
```

```
Image Validation Started
Image Write Done
Image Download Complete
```

The following example copies the newrun.cfg file from the IPv6 TFTP server and overwrites the running configuration file with the contents of newrun.cfg.

```
device# copy tftp running-config 2001:DB8:e0ff:7837::3 newrun.cfg overwrite
Parameter Validation Successful
Running Config Download started
....Running Config Download Done
Running Config Download Complete
device# reload
```

Copying a Primary or Secondary Boot Image from Flash Memory to an IPv6 TFTP Server

You can copy the primary or secondary boot image from a device flash memory to an IPv6 TFTP server. The following example copies the primary boot image named primary.img from flash memory to a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3.

```
device# copy tftp flash 2001:DB8:e0ff:7837::3 primary  primary.img
Parameter Validation Successful
....File Download Done
File Write Done
File Download Complete
```

Copying the Running or Startup Configuration to an IPv6 TFTP Server

You can copy a device running or startup configuration to an IPv6 TFTP server. The following example copies a device running configuration to a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3 and names the destination file bakrun.cfg.

```
device# copy running-config tftp 2001:DB8:e0ff:7837::3 bakrun.cfg
Parameter Validation Successful
....File Upload Complete
```

IPv6 TFTP Server File Upload

You can upload the following files from an IPv6 TFTP server:

- Primary boot image.
- Secondary boot image.
- Running configuration.
- Startup configuration.

The following example uploads the primary boot image named primary.img from a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3 to the device primary storage location in flash memory.

```
device# copy tftp flash 2001:DB8:e0ff:7837::3 primary.img primary
Parameter Validation Successful
....File Download Done
File Write Done
File Download Complete
```

The following example uploads the running-configuration file from a TFTP server with the IPv6 address of 2001:DB8:e0ff:7837::3 and saves it to the filename newrun.cfg on the ICX device.

```
device# copy tftp running-config 2001:DB8:e0ff:7837::3 newrun.cfg
Parameter Validation Successful
Running Config Download started
```

```
....Running Config Download Done
Running Config Download Complete
```

Refer to the *RUCKUS FastIron Command Reference* for more information.

Using SNMP to Save and Load Configuration Information

You can use a third-party SNMP management application such as HP OpenView to save and load a configuration on a RUCKUS device. Use the following task to save and load configuration information using HP OpenView.

NOTE
The syntax shown in this section assumes that you have installed HP OpenView in the `/usr` directory.

1. Configure a read-write community string on the device, if one is not already configured. To configure a read-write community string, enter the following command in global configuration mode.

   ```
   device(config)# snmp-server community community_string rw
   ```

2. Enter the **no snmp-server pw-check** command to disable password checking for SNMP set requests. .

   ```
   device(config)# no snmp-server pw-check
   ```

   If a third-party SNMP management application does not add a password to the password field when it sends SNMP set requests to a device, by default the device rejects the request.

3. From the command prompt in the UNIX shell, enter the following command.

   ```
   unix-shell> /usr/OV/bin/snmpset - rw-community-string device-ip-addr c
   1.3.6.1.4.1.1991.1.1.2.1.5.0 a tftp-ip-addr 1.3.6.1.4.1.1991.1.1.2.1.8.0 s
   config-file-name 1.3.6.1.4.1.1991.1.1.2.1.9.0 integer command-integer
   ```

   Where

   rw-community-string is a read-write community string configured on the RUCKUS device.

   fdry-ip-addr is the IP address of the RUCKUS device.

   tftp-ip-addr is the TFTP server IP address.

   config-file-name is the configuration file name.

   command-integer is one of the following:

   - **20** — Upload the startup-config file from the flash memory of the device to the TFTP server.
   - **21** — Download a startup-config file from a TFTP server to the flash memory of the RUCKUS device.
   - **22** — Upload the running-config from the flash memory of the RUCKUS device to the TFTP server.
   - **23** — Download a configuration file from a TFTP server into the running-config of the RUCKUS device.

     NOTE
     Option **23** adds configuration information to the running-config on the device, and does not replace commands. If you want to replace configuration information in the device, use "no" forms of the configuration commands to remove the configuration information, then use configuration commands to create the configuration information you want. Follow the guidelines in Dynamic Configuration Loading on page 93.

Erasing Image and Configuration Files

Software images or configuration files stored in the system flash can be erased.

The following example erases the image stored in the primary flash of the system.

```
device# erase flash primary
```

The following example erases the image stored in the secondary flash of the system.

```
device# erase flash secondary
```

The following example erases the configuration stored in the startup configuration file. However, the running configuration will remain intact until system reboot.

```
device# erase startup-config
```

Refer to the *RUCKUS FastIron Command Reference* for more information.

Configuration Archive and Replace

Configuration Archives

Beginning with FastIron release 09.0.00, ICX switches and routers can manage multiple configuration files in flash, providing the flexibility to save multiple configuration files and to change the system configuration when needed.

An archive is a text file to change the system configuration with the same syntax as a startup-config.txt file. You can create, copy, delete, rename, and compare archives. Archives are saved in a designated folder in the flash memory. Archive naming convention requires archive names to be prefixed with a pre-defined string 'ICX7K_ARCHIVE'. This feature is supported on all RUCKUS ICX 7000 series devices.

For more information about Configuration, Archive, and Replace commands refer to the *RUCKUS FastIron Command Reference*

Creating a Configuration Archive

To copy an existing archive to another one, the destination archive name must comply with the archive naming convention. In case the source file does not exist in the archive repository, the full path must be used. As per the archive naming convention, the archive names must be prefixed with a pre-defined string 'ICX7K_ARCHIVE_'. An archive can be created from the running configuration. Archives can be created in the following ways:

1. Enter the following command to copy an archive to another archive.

   ```
   cfg-archive management copy ICX7K_ARCHIVE_22 to ICX7K_ARCHIVE_25
   ```

2. From the system running configuration: Copy the running configuration to an archive ICX7K_ARCHIVE_03, using the following command.

   ```
   device# cfg-archive management copy-running-config ICX7K_ARCHIVE_03
   ```

3. Create an archive from the startup configuration saved in startup-config.txt using the below command.

   ```
   device# cfg-archive management copy /fast_iron/startup-config.txt to ICX7K_ARCHIVE_02
   ```

Performing a Reload Using a Configuration Archive

Reloads the system with a specific configuration archive file.

Enter the following command to reload the system with an existing archive in the repository.

```
device# cfg-archive management reload-with-archive pri ICX7K_ARCHIVE_01
```

Managing Configuration Archive Files

All CLI commands in this procedure are available in executive mode. After reloading the system, enter the enable command to change from user mode to executive mode.

1. Enter the following command to change the archive size.

   ```
   device(config)# cfg-archive revert-option archive-size 90
   ```

   User configurable value that determines the number of archives the system can maintain. Valid values range from 5 through 100. The default maximum value for archive size is 100.
2. Enter the following command to show the contextual differences between two archives.

   ```
   device# cfg-archive management compare-archives
   ```

   The archive comparison is a contextual comparison instead of a line-by-line comparison. The comparison output is prefixed with '+' or '-'. There are three files involved while comparing two archive files: a baseline file, a compare file, and an ignore file.
3. Enter the following command to compare an archive with the running configuration.

   ```
   device# cfg-archive management compare-running-config
   ```

   This provides a comparison between running configuration and an existing archive. Shows the contextual difference between the system running configuration and a designated archive.
4. Enter the following command to delete a designated archive or all archives.

   ```
   device# cfg-archive management delete
   ```

   Before deleting an archive, you are prompted to confirm. Use cfg-archive management list to verify the deletion.
5. Enter the following command to list all of the archive names.

   ```
   device# cfg-archive management list
   ```

   For multiple configuration files, the files will be shown in the order of their time of modification.
6. Enter the following command to rename a designated archive to a new archive name.

   ```
   device# cfg-archive management rename
   ```

   The archive names in source and destination must comply with the archive naming convention to rename an existing archive.
7. Enter the following command to show the content of a designated archive.

   ```
   device# cfg-archive management show-archive-content
   ```

8. Enter the following command to cancel the comparison aborted by Ctrl+C .

   ```
   device# cfg-archive management cancel-comparison
   ```

9. Enter the following command to compare a designated archive with the startup-configuration.

   ```
   device# cfg-archive management compare-startup-config 10
   ```

10. Enter the following command to copy an archive to another.

```
device# cfg-archive management copy
```

11. Enter the following command to copy the running configuration to an archive.

```
device# cfg-archive management copy-running-config
```

12. Enter the following command to delete the unsaved running configuration before last reload.

```
device# cfg-archive management delete-unsaved-cfg
```

13. Enter the following command to reload with an archive.

```
device# cfg-archive management reload-with-archive
```

14. Enter the following command to rename a designated archive to a new archive name.

```
device# cfg-archive management rename
```

15. Enter the following command to shows the set of current default values used in auto revert feature.

```
device# cfg-archive management show-current-config
```

16. Enter the following command to show the unsaved running configuration before last reload, which was not saved in non-volatile memory.

```
device# cfg-archive management show-unsaved-cfg
```

Configuration Archive Auto-Revert

Configuration archive auto-revert provides the capability to revert or roll back to a previous configuration if the changed running configuration is not saved to the non-volatile memory within a predefined time. This prevents the system from entering an unknown state by reminding the system administrator that the running configuration has changed and these configurations have not been saved. If the **write memory** command is not used after the reminder is issued, the system can reload automatically using the golden archive that has been previously configured.

When an ICX system runs from non-volatile configurations without any changes, it is assumed that the system is running under a supervised state or is in a stable state. The time interval between changing any running configuration and saving it into the non-volatile memory is known as an un-supervised or unstable state. Changes to the configuration are saved using the **write memory** command and the system transits from an unsupervised state to a supervised state. Configuration archive auto-revert steps in when the system runs over a period of time in un-supervised state so that the last snapshot of the system is saved before the system is reloaded.

When an auto-revert time expiry occurs, an informational message is displayed in any newly connected session through the console, Telnet, or SSH.

```
!!! ICX7850-48F Router might be reloaded due to cfg-archive auto-revert-timer expiry,
Please check SYSLOG for further details !!!
```

Verifying Configuration Archives

You can display the current running configuration for configuration archives, and compare a configuration archive with the startup configuration. You can also display the unsaved running configuration before the last system reload, and delete an unsaved configuration after a system reload. Using the following commands is optional and they can be entered in any order.

1. Display the current running configuration for configuration archives.

```
device# cfg-archive management show-current-config

Revert option timer : 5 minute(s) 0 second(s)
Confirm wait timer : 30 minute(s) 0 second(s)
Confirm mode : Auto
Boot Partition : Primary
Auto revert : Enable
Golden archive : Auto mode
```

2. Compare a configuration archive with the startup configuration.

```
device# cfg-archive management compare-startup-config 10
```

3. Display the unsaved running configuration before the last system reload.

```
device# cfg-archive management show-unsaved-cfg
```

4. Delete the unsaved running configuration.

```
device# cfg-archive management delete-unsaved-cfg

About to delete the unsaved running configuration before reload. Are you sure you want to delete?
(enter 'y' or 'n'): y
```

Enabling Configuration Archive Auto-Revert

Configuration archive auto-revert provides the capability to revert or roll back to a previous configuration if the changed running configuration is not saved to the flash using the **write memory** command within a predefined time. The following task enables configuration archive auto-revert. The following commands are supported in configuration mode also.

Use the following command to enable configuration archive auto-revert.

```
device# cfg-archive revert enable
```

The following example disables configuration archive auto-revert.

```
device# cfg-archive revert disable
```

The following example immediately reverts the running configuration if it has been changed.

```
device# cfg-archive revert now
```

The following example shows the state transition, state name, and elapsed time in the current state.

```
device# cfg-archive revert status

Current state : START_STATE
Elapsed time : 19 second(s)
```

Enabling Configuration Archive Auto-Revert Options

The following task configures various options for configuration archive auto-revert. Using these commands is optional and they can be entered in any order. If any of the following commands is not entered, the default is applied after configuration archive auto-revert is enabled.

1. Configure a specified golden archive to be used used when reloading the system instead of the startup configuration.

```
device(config)# cfg-archive revert-option archive 10
```

2. Display the configured automatic revert timer.

```
device(config)# cfg-archive revert-option auto-revert-timer

Revert option timer : 1 minute(s) 0 second(s)
```

3. Set the automatic revert timer interval to ten minutes.

```
device(config)# cfg-archive revert-option auto-revert-timer 10
```

4. Display the configured partition that is used when using configuration archive auto-revert.

```
device(config)# cfg-archive revert-option boot-partition
Boot Partition : Primary
```

5. Specify that the secondary partition be used when auto-reverting.

```
device(config)# cfg-archive revert-option boot-partition sec
```

6. Display the configured confirm wait timer.

```
device(config)# cfg-archive revert-option confirm-wait-timer

Confirm wait timer : 1 minute(s) 0 second(s)
```

7. Set the confirm wait timer to ten minutes.

```
device(config)# cfg-archive revert-option confirm-wait-timer 10

New Confirm wait timer : 10 minute(s) 0 second(s)
```

8. Specify that a reload is automatically initiated after the configured wait time expires.

```
device(config)# cfg-archive revert-option confirm-wait-type auto
```

9. Specify that the golden archive is updated with the latest running configuration.

```
device(config)#device# cfg-archive revert-option update-archive-content
```

Network Time Protocol Version 4 (NTPv4)

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.

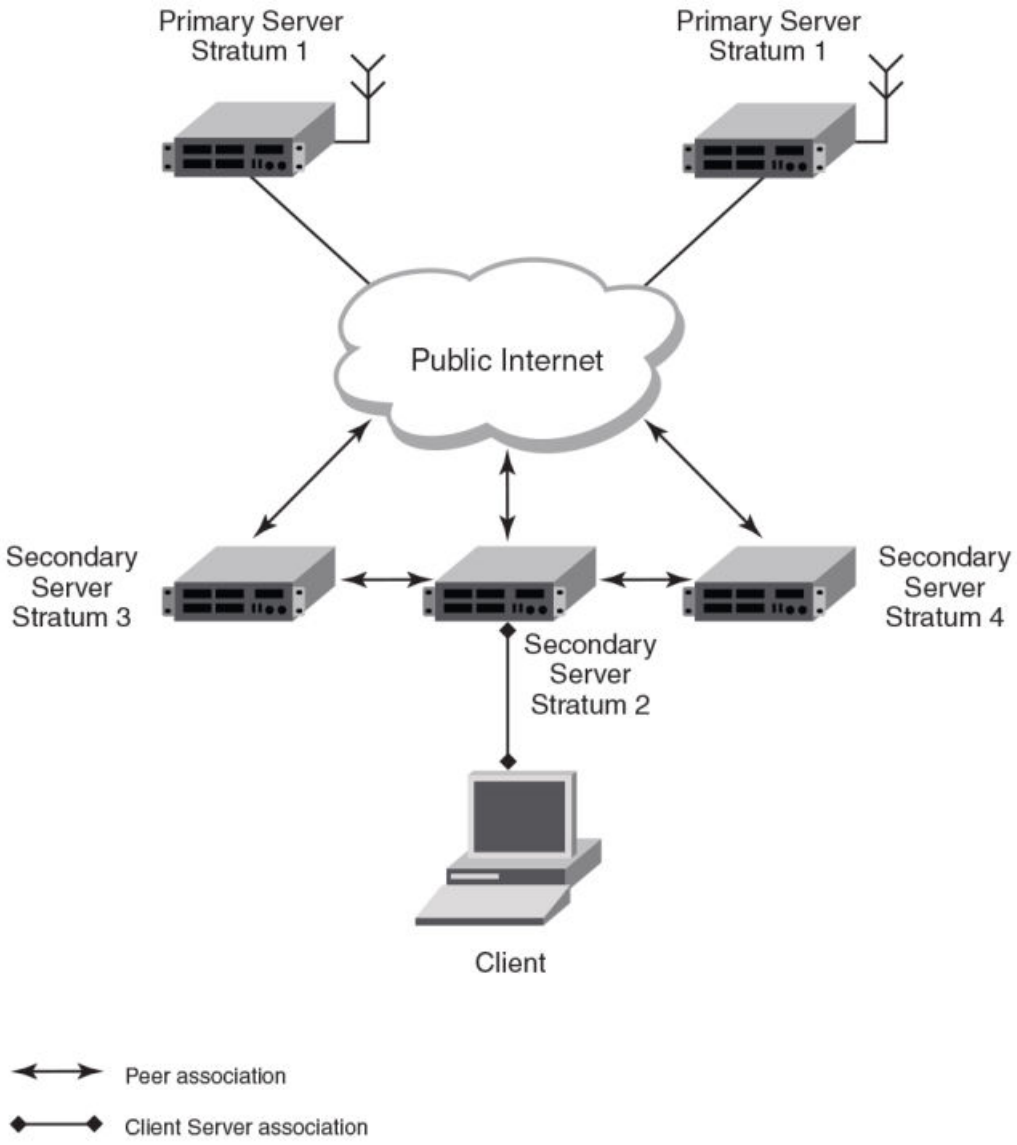
NTPv4 obsoletes NTPv3 (RFC1305) and SNTP (RFC4330). SNTP is a subset of NTPv4. RFC 5905 describes NTPv4.

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.

NTP can be configured to provide cryptographic authentication of messages with the clients and peers, and with its upstream time server. A symmetric key scheme is supported for authentication. The scheme uses an MD5 keyed hash algorithm.

The authentication can be enabled using the **authenticate** command. The symmetric key and key string set 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 or peer is configured without authentication keys, the NTP request is not sent to the configured server or peer.

NOTE
The same set or subset of key ID and key string must be installed on all NTP devices.

NTP and a Configured VLAN

Take note of the following considerations when configuring a VLAN:

- NTP time servers must be reachable through the interfaces that belong to the configured VLAN. Otherwise, NTP packets are not transmitted. This applies to both the unicast and the broadcast server and client.
- NTP broadcast packets are sent only on the interface that belongs to the configured VLAN.
- The received unicast or broadcast NTP packets are dropped if the interface on which the packets have 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 1,000 seconds of the Coordinated Universal Time (UTC).

Enabling NTP

To enable NTP, use the **ntp** command in global configuration mode. This command enables the NTP client mode 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 NTP configuration configured statistically as well as learned associations from NTP neighbors.

Disabling NTP

To disable the NTP server and client modes, 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 **serve** keyword disables NTP server mode. If the **serve** keyword is specified, NTP does not serve the time to downstream devices. In contrast, if the **serve** keyword is not specified, both NTP client and NTP server modes are disabled.

> **NOTE**
> The **no disable** command enables both the client and the 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 authentication, use the **no** form of the command.

By default, authentication is disabled.

```
device(config-ntp)# 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 the command.

By default, authentication keys are not configured.

```
device(config-ntp)# authentication-key key-id 1 md5 moof
```

The key string is the value of the MD5 or SHA1 key. The maximum length of the key string is 16 characters. Up to 32 authentication keys can be defined.

> **NOTE**
> If Joint Interoperability Test Command (JITC) mode is enabled, only the **SHA1** option is available.

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 **management source-interface protocol ntp** command to configure a specific interface from which the IP source address will be taken. To remove the specified source IP address, use the **no** form of the command.

```
device(config)# management source-interface ethernet 1/3/1 protocol ntp
```

The specified interface will be used for the source IP address for all packets sent to all destinations.

> **NOTE**
> If the source-interface is not configured, then the lowest IP address in the outgoing interface will be used in the NTP packets. The source IP address of a tunnel interface is not supported.

Enabling or Disabling 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 the command.

```
device(config-ntp)# access-control vlan 100
```

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.

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 of eight NTP servers can be configured. To remove the NTP server configuration, use the **no** form of the command.

By default, no servers are configured.

```
device(config-ntp)# server 1.2.3.4 key 1234
device(config-ntp)# server 1:2::3:4 key 1234
```

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 the command. The master command is not effective if NTP is enabled in client mode only.

```
device(config-ntp)# master stratum 5
```

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 eight NTP peers can be configured. To disable this capability, use the **no** form of the command.

```
device(config-ntp)# peer 1.2.3.4 key 1234
device(config-ntp)# peer 1:2::3:4 key 1234
```

The **peer** command is not effective if the NTP is enabled in client mode only.

NOTE
The **peer** command will fail if the peer is a member of a symmetric passive association.

NOTE
When the NTP server or peer is configured, the **master** command is not configured; upon configuring the **clock set** command, the system clock is not synchronized. When the **master** command is configured, and upon 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 must disable NTP, configure the peers, and enable NTP using the **no disable** command.

Configuring NTP on an Interface

The broadcast server or client is configured on selected interfaces.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enable NTP configuration mode.

```
device(config)# ntp
```

3. Enter the **ntp-interface** command and specify the port number to configure the NTP interface.

```
device(config-ntp)# ntp-interface ethernet 1/2/13
```

NOTE
The **ntp-interface** command changes the command mode and will not be included in the show run command output unless a configuration exists within the interface.

4. Exit to NTP configuration mode.

```
device(config-ntp-if-e1000-1/2/13)# exit
```

5. Enter the management port.

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

6. Exit from the management mode.

```
device(config-ntp-mgmt-1)# exit
```

7. Specify the virtual port number.

```
device(config-ntp)# ntp-interface ve 100
```

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 clients can be enabled on a maximum of 16 Ethernet interfaces. If the interface is operationally down or NTP is disabled, the NTP broadcast server packets are not received. To disable this capability, use the **no** form of the command.

```
device(config-ntp-mgmt-1)# broadcast client
```

Configuring the Broadcast Destination

To configure the options for broadcasting Network Time Protocol (NTP) traffic, use the **broadcast destination** command. The NTP broadcast server can be enabled on a maximum of 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, the NTP broadcast server packets are not sent. By default, the broadcast mode is not enabled.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter management interface mode.

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

3. Enter the IPv4 subnet address of the device to send NTP broadcast messages.

```
device(config-if-mgmt-1)# ip address 10.20.99.173/24
```

4. Enable NTP configuration mode.

```
device(config-if-mgmt-1)#ntp
device(config-ntp)# ntp-interface m1
```

5. Enter the mangement interface.

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

6. Define the authentication key to send the NTP broadcast traffic. By default, no authentication key is configured.

```
device(config-ntp-mgmt-1)# broadcast destination 10.20.99.0 key 2
```

The default NTP version number 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 26 NTP status command output descriptions

Field	Description
synchronized	Indicates that the system clock is synchronized to the NTP server or peer.
stratum	Indicates the stratum number that this system is operating. Range 2..15.
reference clock	The IPv4 address or first 32 bits of the MD5 hash of the IPv6 address of the peer to which the 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 the path to the 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 mode	Status of the master mode.
master stratum	Stratum number that will be used by this device when the master is enabled and no upstream time servers are accessible.
panic mode	Status of the panic mode.

Displaying NTP Association Information

Use the **show ntp associations** command to display detailed association information for 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 27 show ntp associations Command Output

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 a 'falsticker' 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 the 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 the peer, in milliseconds.
offset	Relative time difference between a peer clock and a local clock, in milliseconds.
disp	Dispersion.

Displaying NTP Association Details

Use the **show ntp associations detail** command to display association information for all NTP servers and peers.

```
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 detailed NTP server and peer 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
```

The following table provides descriptions of the **show ntp associations detail** command output.

TABLE 28 show ntp associations detail Command Output

Field	Description
server	Indicates that the server is statically configured.
symmetric active peer	Indicates that the peer is statically configured.
symmetric passive peer	Indicates that the 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 a falsticker by the selection algorithm.
outlier	This peer is dropped as an outlier by the clustering algorithm.
stratum	The stratum number
ref ID	The IPv4 address or hash of the IPv6 address of the upstream time server to which the peer is synchronized.
time	The last time stamp that the peer received from its master.
our mode	This system's mode relative to the 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	The poll interval of peer to this system.
root delay	The delay along the path to root (the final stratum 1 time source).
root disp	Dispersion of the path to root.
reach peer	The peer reachability (bit string in octal).
delay	Round-trip delay to the peer.
offset	Offset of the peer clock relative to this clock.
dispersion	Dispersion of the peer clock.
precision	Precision of the peer clock.
version	NTP version number of the peer.
org time	The originate time stamp of the last packet.
rcv time	The receive time stamp of the last packet.
xmt time	The transmit time stamp of the last packet.
filter delay	The round-trip delay, in milliseconds, of the last 8 samples.

TABLE 28 show ntp associations detail Command Output (continued)

Field	Description
filter offset	The clock offset, in milliseconds, of the last 8 samples.
filter error	Approximate error of the last 8 samples.

NTP Client Mode Configuration Example

The following example configures 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 Example

The following example configures 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 Example

The following example configures 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 Example

The following example configures the RUCKUS device in loose authentication mode. This configuration 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 Example

The following example enters the NTP interface context.

```
device(config)# interface 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 Example

The following example configures 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

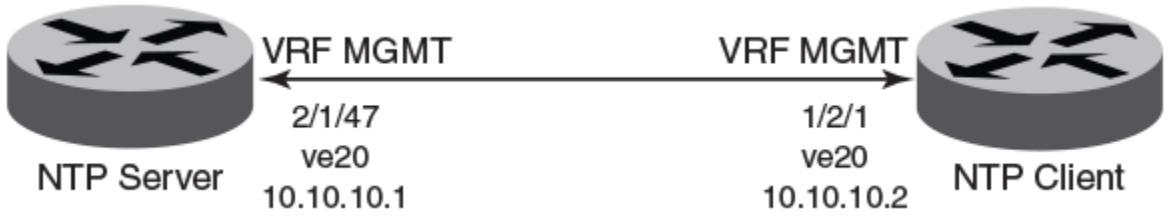
Network Time Protocol (NTP) traffic can be segregated from network traffic using the management VRF.

Virtual Routing and Forwarding (VRF) 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 the management VRF, the NTP traffic is routed through the 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, which isolates NTP traffic from the network data traffic.

The following figures 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

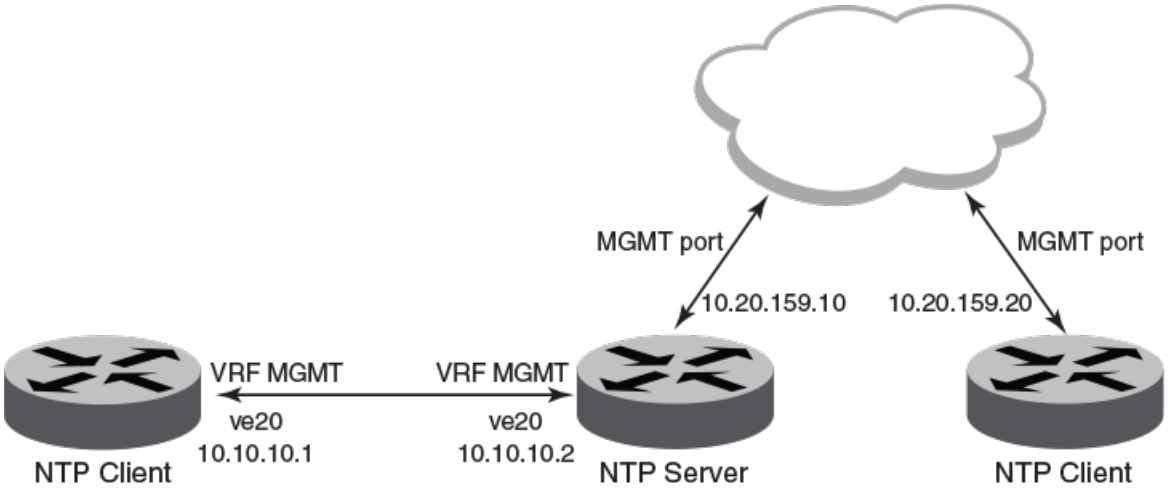


In this scenario, NTP over Management VRF is implemented on both an NTP server and an NTP client device using Virtual Ethernet (VE) interfaces.

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

Be aware of the following limitations before implementing NTP over Management VRF.

- The communication channel between the NTP client and the server is through the In-Band 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.
- The management VRF for NTP broadcast clients is supported only on one interface, using the **management source-interface protocol ntp** command, because the outgoing port is determined by the routing table.
- The management VRF for peers is supported only on “symmetric active” (not "symmetric passive") NTP association modes because the management VRF is related to the NTP **management source-interface protocol ntp** command.

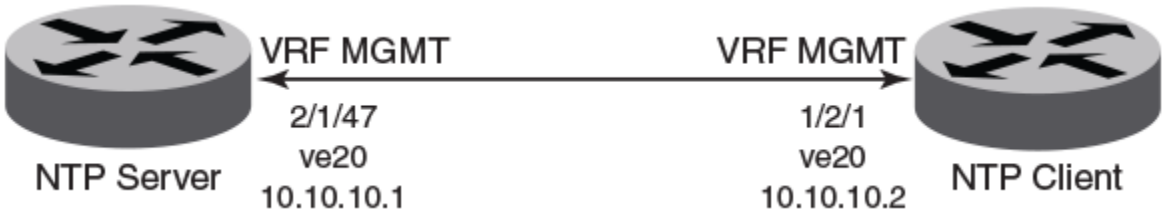
Configuring NTP over Management VRF on an NTP Server

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.

NTP over Management VRF allows NTP traffic to be isolated from network traffic. In the following figure, an NTP server is configured to run NTP over Management VRF with just one client and running over Virtual Ethernet (VE) interfaces.

After configuring the NTP server, configure the NTP client devices.



1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure a port-based VLAN and enter VLAN configuration mode.

```
device(config)# vlan 20 by port
```

3. Add an untagged port to the VLAN.

```
device(config-vlan-20)# untagged ethernet 2/1/47
```

4. Create a virtual routing interface.

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

5. Exit to global configuration mode.

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

6. Configure the VRF named management as a global management VRF.

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

7. Enter virtual interface mode for interface ve 20.

```
device(config)# interface ve 20
```

8. Configure the VRF named management 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. Enable the Network Time Protocol (NTP) client and server mode.

```
device(config)# ntp
```

12. Configure 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
    vlan 20 by port
  untagged ethernet 2/1/47
  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
```

Configuring NTP over Management VRF on an NTP Client

To implement NTP over Management VRF, a 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.

NTP over Management VRF allows NTP traffic to be isolated from network traffic. In the following figure, an NTP client is configured to run NTP over Management VRF and communicate with an NTP server device. Be sure to use the 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 20 by port
   ```

3. Add an untagged port to the VLAN.

   ```
   device(config-vlan-20)# untagged ethernet 1/2/1
   ```

4. Create a virtual routing interface.

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

5. Exit to global configuration mode.

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

6. Configure the VRF named management as a global management VRF.

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

7. Enter 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)# end
```

11. Identify the source interface for the NTP server.

```
device# configure terminal
device(config)# management source-interface ve 20 protocol ntp
```

12. Enable the Network Time Protocol (NTP) client and server mode.

```
device(config)# ntp
```

13. Identify 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
   vlan 20 by port
  untagged ethernet 1/2/1
  interface ve 20
  exit
 management-vrf mgmt
 interface ve 20
  vrf forwarding mgmt
  ip address 10.10.10.2 255.255.255.0
management source-interface ve 20 protocol ntp
 ntp
  server 10.10.10.1
```

Configuration Example for NTP over Management VRF Using IPv6

NTP over Management VRF 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
 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
 interface ethernet 2/1/47
 vrf forwarding mgmt_ipv6
 ipv6 address 10:10::10:1/64
 exit
management-vrf mgmt_ipv6
management source-interface ethernet 2/1/47 protocol ntp
ntp
 server 10:10::10:2
```

Precision Time Protocol

Precision Time Protocol Overview

Precision Time Protocol (PTP) is a two-way time transfer protocol that was introduced in the IEEE-1588-2002 standard, which was revised by a new version called PTPv2 that is addressed by IEEE-1588v2-2008.

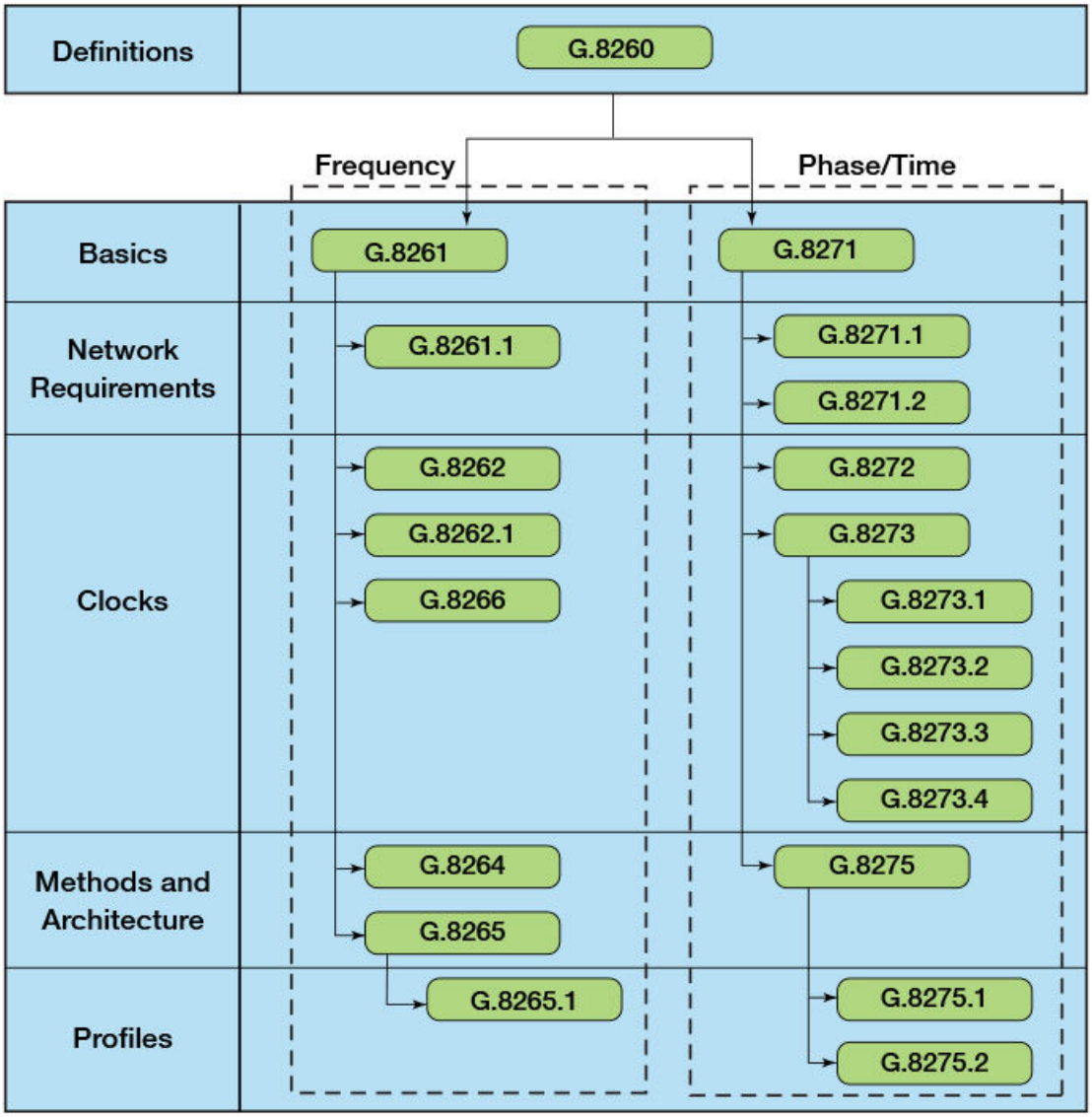
In Ethernet networks, the switches forward Ethernet frames to the connected devices and some of the frames are subjected to store-and-forward conditions. This causes the switches to delay in sending those packets and to lose synchronization. PTP has been developed to ensure clock synchronization in a packet-based network like an Ethernet network and to correct the latency and time delays. Unlike Network Time Protocol (NTP), the PTP clock devices will stamp the precise time that the synchronization messages spend in each device.

The following figure provides a summary of the standards within the ITU-T SG15/Q13 (Telecommunication Standardization Sector of the International Telecommunications Union) that are related to frequency and phase or time delivery using PTP. These standards can be divided into two major groups:

- Solution for frequency synchronization
- Solution for time or phase synchronization

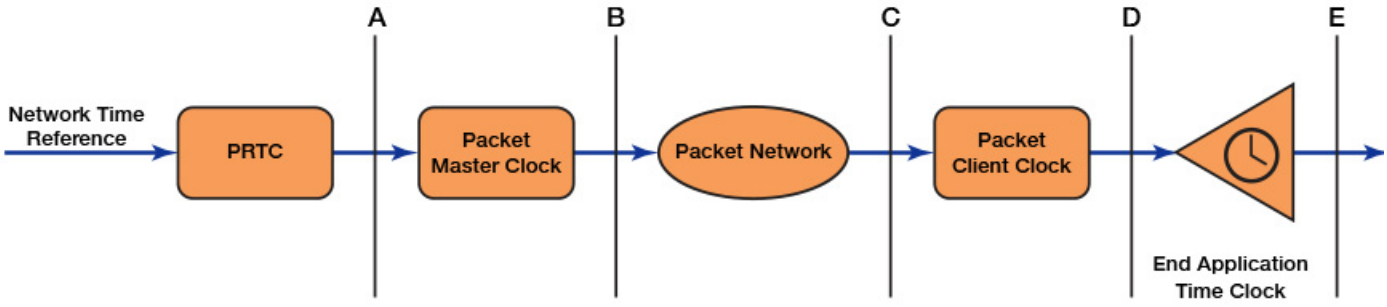
The G.8260 model (for timing and synchronization in packet networks) is applicable to both the groups.

FIGURE 6 Summary of Standards Studied Within Q13 Related to PTP



The following figure defines the network reference model provided in ITU-T G.8271. This is used to define time and phase synchronization performance objectives. The following model defines reference points for the timing measurements with respect to a common time reference such as GPS time.

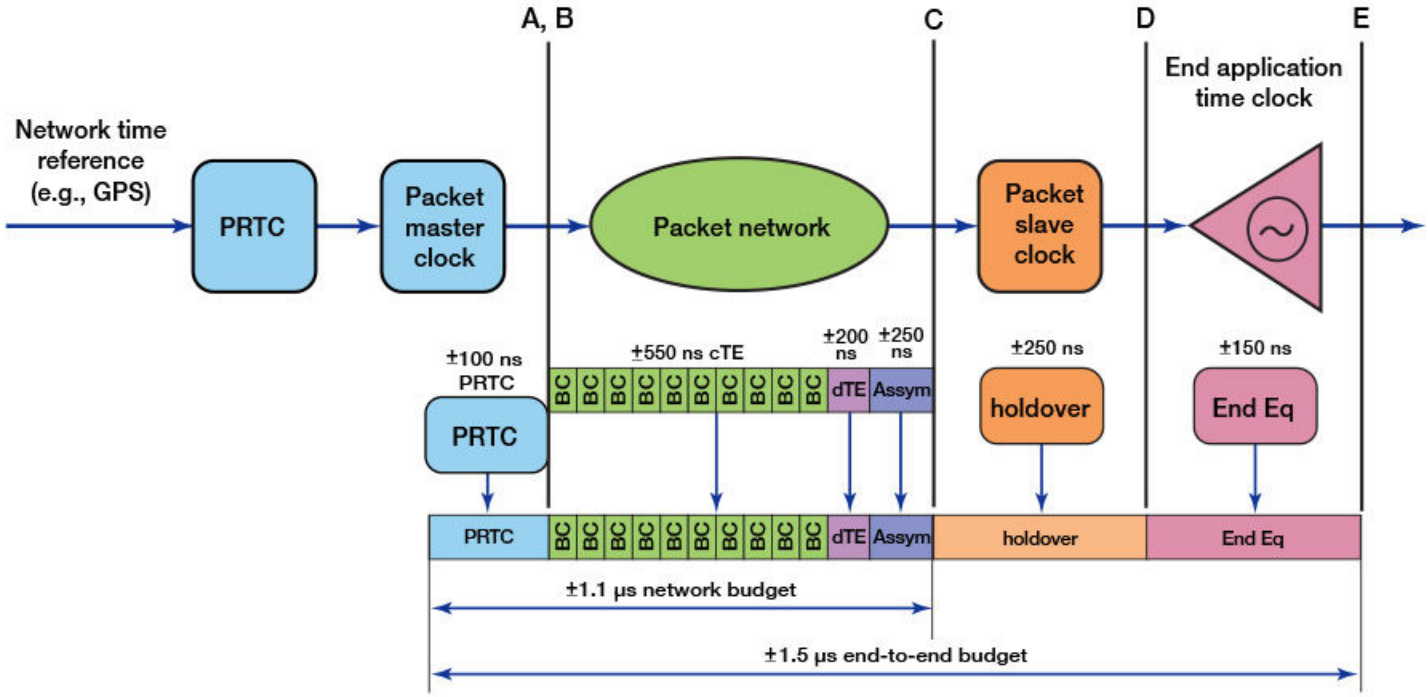
FIGURE 7 Network Reference Model



1. Primary Reference Time Clock output(A)
2. Packet Master Clock output(B)
3. Packet Client Clock input(C)
4. Packet Client Clock output(D)
5. End Application output(E)

The following figure is an example that shows the end-to-end time error network budget for an LTE-TDD application.

FIGURE 8 Time Error Network Budget



1. Primary Reference Time Clock output(A)
2. Packet Master Clock output(B)
3. Packet Client Clock input(C)
4. Packet Client Clock output(D)
5. End Application output(E)

PTP Clock Types

- Grand-master clock: A domain is a group of clocks that synchronize to each other using PTP. The Grand-master clock is the primary time source for clock synchronization using PTP within a domain.

- Master clock: The source of the clock.
- Slave clock: The slave or client clock synchronizes with the master clock.
- Ordinary clock: A clock that has a single PTP port in a domain.
- Boundary clock: A clock that has multiple PTP ports in a domain.
- Transparent clock: A clock that measures the PTP event message transit time and provides this information to clocks receiving this PTP event message.
- End-to-end transparent clock: A transparent clock that measures PTP event message transit time. This information supports the end-to-end delay measurement mechanism between client clocks and the master clock.
- Peer-to-peer transparent clock: A transparent clock that measures PTP event message transit time as well as adjusts the delay. The time difference between client clocks and the master clock is adjusted using the peer-to-peer delay measurement mechanism in the peer-to-peer transparent clock.
- One-step clock: A clock that provides time information using a single event message.
- Two-step clock: A clock that provides time information using multiple event messages.
- Holdover: A clock previously synchronized or syntonized to another clock. The frequency is corrected using the data acquired while it had been synchronized or syntonized to the other clock.
- Synchronized clocks: Two clocks are synchronized if they have the same origin of timescale.
- Syntonized clocks: Two clocks are syntonized if the duration of the seconds is same on both the clocks.

PTP Event Messages

The following event messages are sent during the synchronization when using the End-to-End delay mechanism. PTP devices require precise measurement of time delay between the source and the receiver by using the event messages. Then, the PTP devices adjust the time to ensure clock synchronization.

- SYNC: Used by the master to send a sync message to the slave.
- DELAY REQUEST: Used by the master and slave to measure the time delay between them. The slave sends a delay request message to the master and stamps the time.
- PEER DELAY REQUEST: The master receives the delay request message and stamps the receiving time. This is used in Peer-to-Peer delay mechanism only.
- PEER_DELAY_RESPONSE: The master sends this time delay to the slave. This is used in a Peer-to-Peer delay mechanism.

Timestamping Modes

There are two types of timestamping modes.

One-step: In this timestamp method, the time is recorded in real time as the message starts transmitting out the physical interface. The message is then edited while transmitting to carry the captured timestamp.

> **NOTE**
> The ICX devices that support PTP can only support one-step timestamping mode

Two-step: In this method, the timestamp is recorded in real time as the message starts transmitting out the physical interface, but the message is unable to be edited while the packet is transmitting, and therefore cannot carry the captured timestamp.

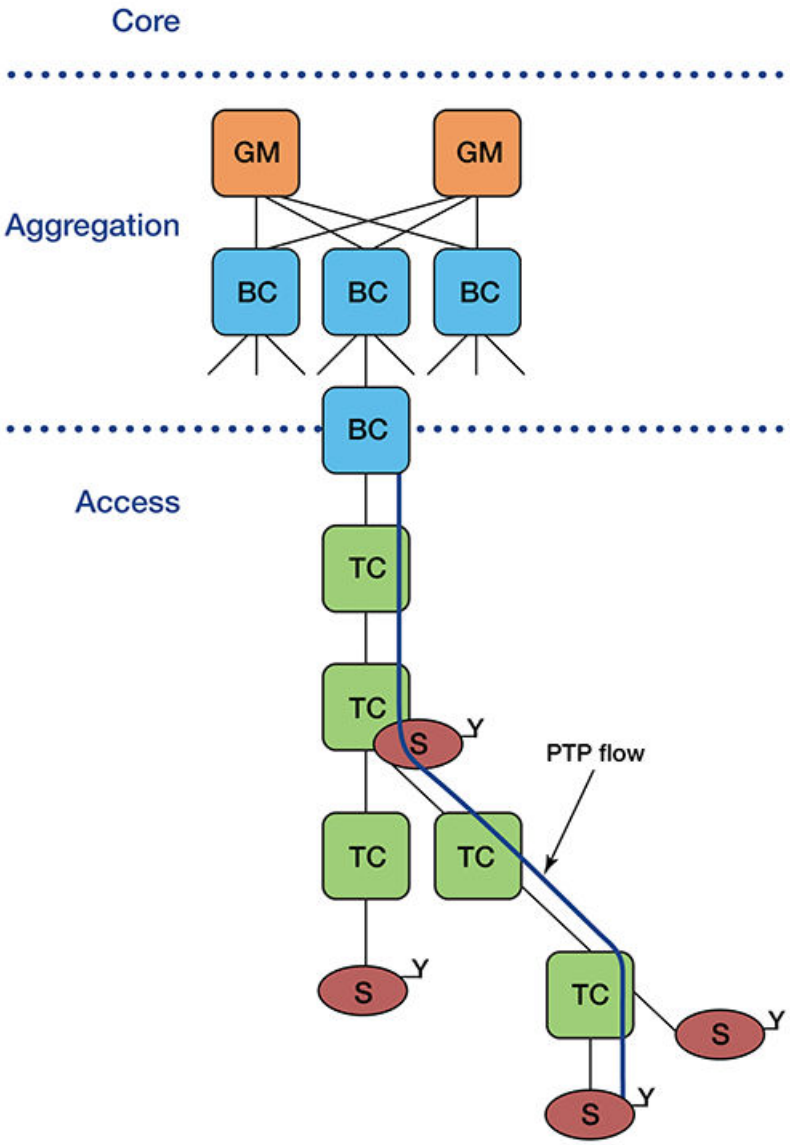
Transparent Clock

IEEE-1588v2-2008 defines a Transparent Clock (TC) as a device that measures the time taken for a PTP event message to transit the device, and provides this information to clocks receiving this PTP event message.

Refer to the *RUCKUS FastIron Features and Standards Support Matrix* for more information about the supported devices.

The following figure shows a typical clock distribution topology in the network.

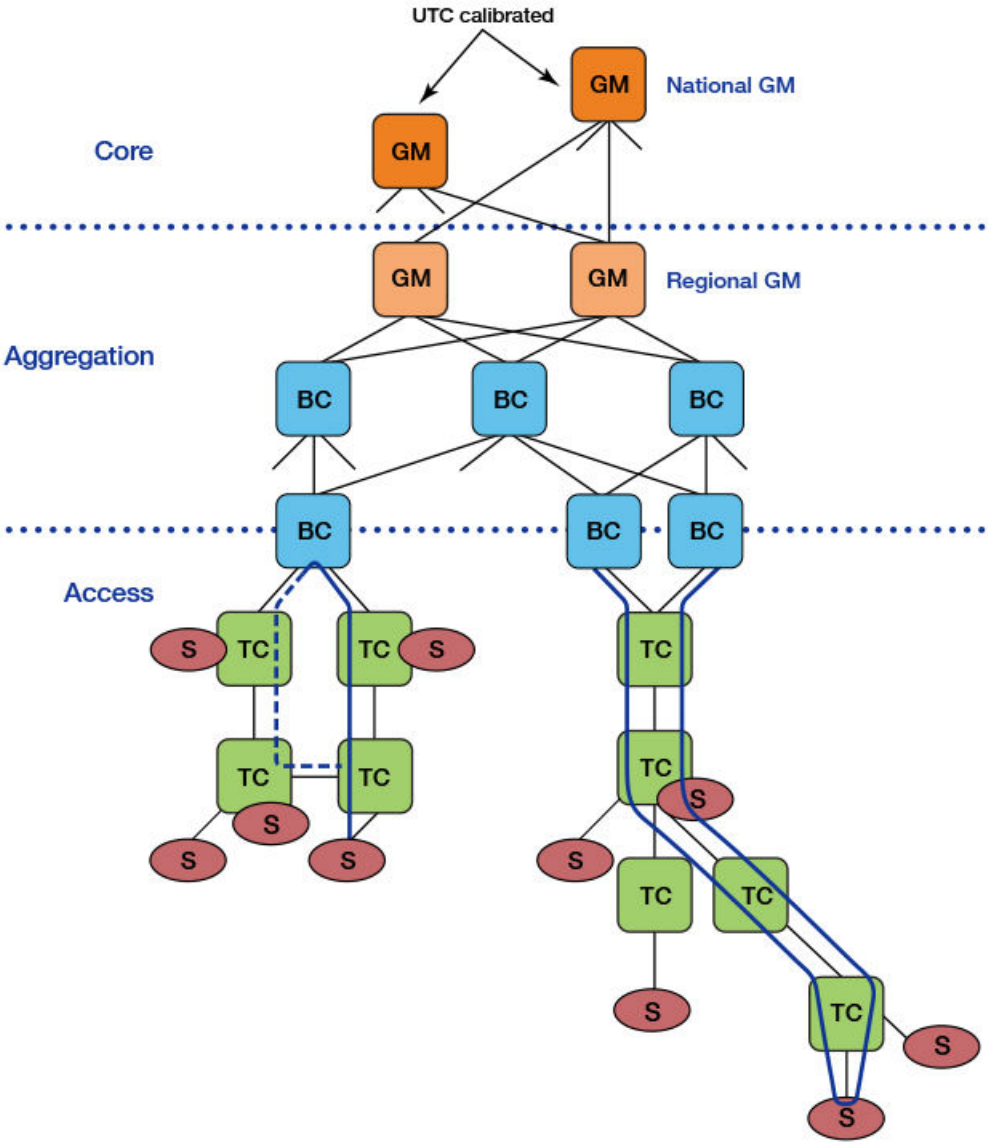
FIGURE 9 Typical Clock Distribution Topology



1. GM- Grandmaster clock-regional
2. BC- Boundary Clock
3. TC- Transparent Clock
4. S- Slave Clock
5. Y - End Device

The following figure shows a clock topology with redundant clock sources in the network.

FIGURE 10 Topology with Redundant Clock Sources

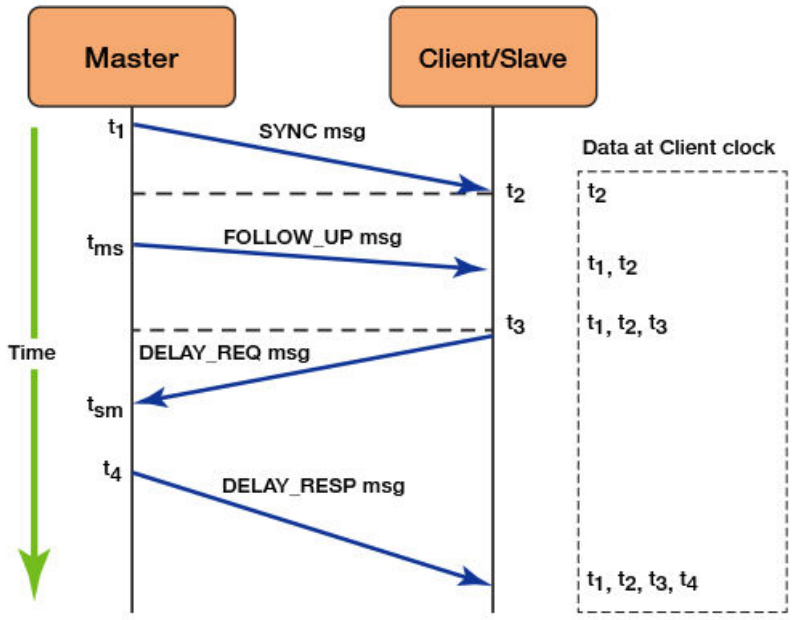


1. GM- Grandmaster Clock
2. BC- Boundary Clock
3. TC- Transparent Clock
4. S- Slave Clock

End-To-End Delay Mechanism

The following figure shows an ideal End-to-End delay mechanism.

FIGURE 11 End-to-End Delay Mechanism



1. The master clock sends a SYNC message to the slave device. As the SYNC message leaves the physical interface of the master clock, it captures a timestamp (t1).
2. The slave clock receives the SYNC message and the clock captures the time (t2) when the SYNC message arrives at its physical port. Due to the propagation delay in the wire, there will be a slight time difference between the slave timestamp clock and the master clock.
3. A delay request message is then sent to the master clock to the slave clock to calculate the time difference between them. The slave clock running timestamp captures the time (t3) as soon as the message starts transmitting out the physical interface of the slave.
4. The master clock receives the delay request and uses the master clock running timestamp to capture the time (t4) when the message starts receiving on its physical interface.
5. The master clock sends the slave clock a delay response message containing the captured t4 value. The slave clock receives the delay response message with the t4 value and adjusts itself to synchronize with the master clock.

IEEE-1588v2 Message Format

The following figure shows the common message format according to IEEE-1588v2-2008.

TABLE 29 Message Format

Bits								Octets	Offset
7	6	5	4	3	2	1	0		
transportSpecific				messageType				1	0
reserved				versionPTP				1	1
messageLength								2	2
domainNumber								1	4
reserved								1	5
flagField								2	6

TABLE 29 Message Format (continued)

Bits								Octets	Offset
7	6	5	4	3	2	1	0		
correctionField								8	8
reserved								4	16
sourcePortIdentity								10	20
sequenceId								2	30
controlField								1	32
logMessageInterval								1	33

The End-to-End Transparent Clock Overcomes Clock Errors

When the PTP event message flows continuously through a network, it experiences packet delay and latency. The PTP-TC-enabled devices can overcome this delay by adjusting the correctionField in the PTP message to compensate for the residence time within the network. The PTP-TC is implemented as part of the Packet Processor. The ICX software enables the timestamping capability on a given port based on the user input or configuration. The implementation of the end-to-end transparent clock requires the residennce time of the device, which is the time it takes the event message from ingress port to egress port, and adding the calculated residence time to the correctionField of the event message. The end-to-end transparent clock uses the SYNC, DELAY_REQ, and DELAY_RESP event messages.

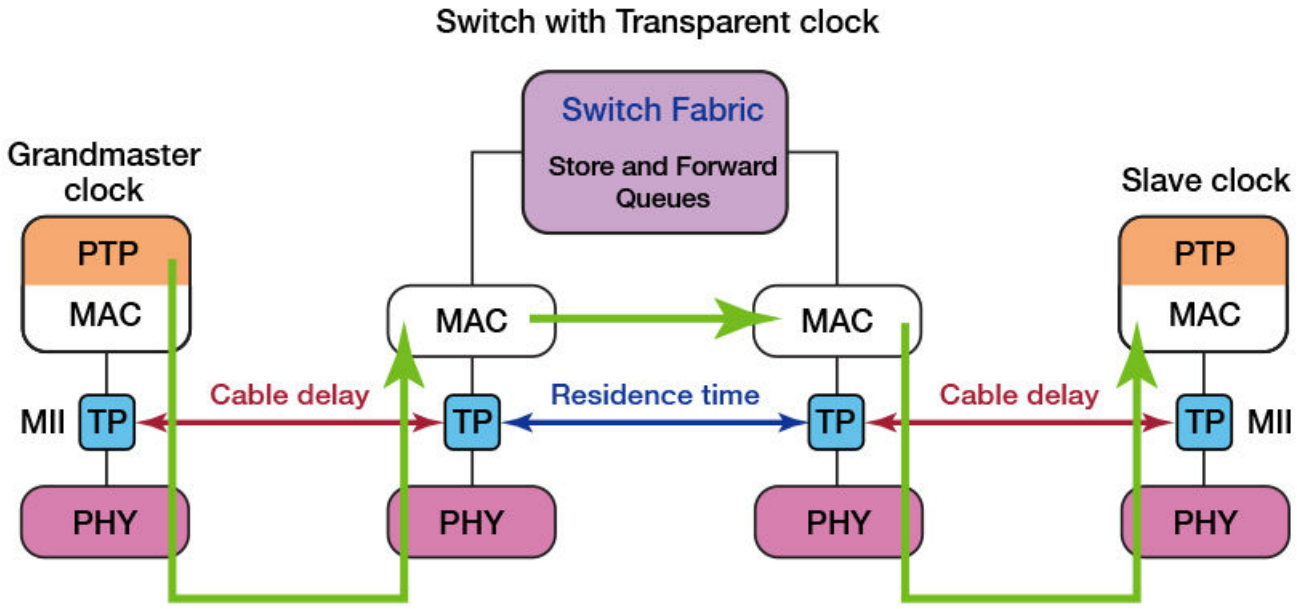
Residence time: A transparent clock generates an ingress timestamp when a PTP event message reaches the ingress port, and generates an egress timestamp when the PTP event message leaves the egress port. The residence time for each PTP event message can be computed for each egress port. The residence time is equal to the egress timestamp minus the ingress timestamp.

NOTE
The egress timestamp has a different value on each egress port of the transparent clock.

One-step transparent clocks: The residence time can be added to the correctionField of the Sync event message by the egress port during the transmission of the Sync message. The egress port can make any required corrections to the fields in the Sync message.

NOTE
The data type of the correctionField allows the residence time to be expressed to a fraction of a nanosecond, if this accuracy is supported by the transparent clock.

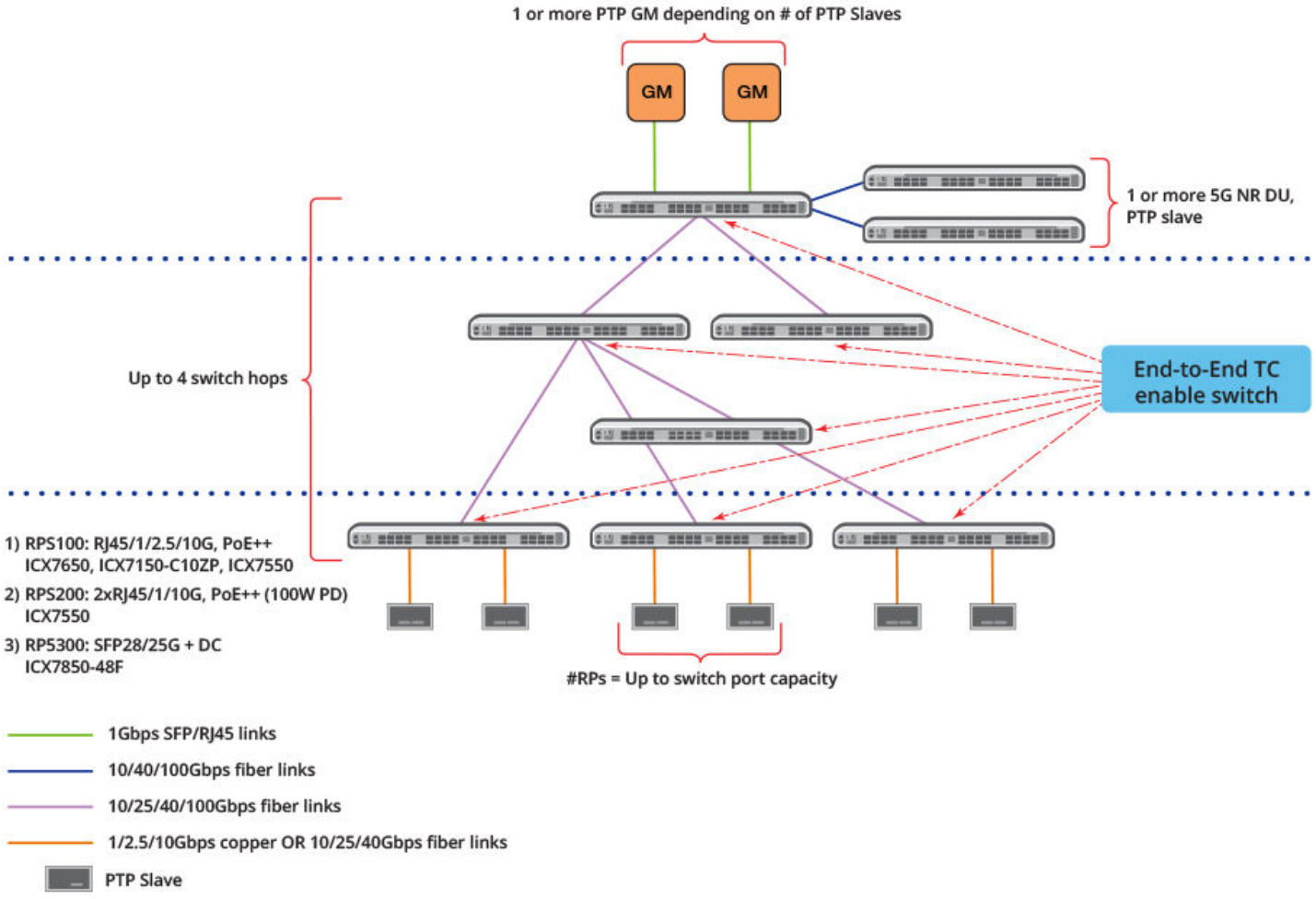
FIGURE 12 End-to-End Transparent Clock Recovery Mechanism



1. TP- Timestamp Point
2. MII - MAC Interface

The following topology shows the use case of PTP-TC using the ICX devices supporting PTP.

FIGURE 13 Network Topology with Transparent Clock Using ICX 7850 Units



PTP packet prioritization and the end-to-end transparent clock is supported by the RUCKUS devices listed in the following table in both standalone and stacking topology.

TABLE 30 PTP-TC-Supported RUCKUS Devices by FastIron Release

Supported Platforms	FastIron Release			
	FastIron 08.0.95	FastIron 08.0.95c	FastIron 09.0.00	FastIron 09.0.10a
ICX7150-24 (non-PoE)	Yes	Yes	Yes	Yes
ICX7150-24P	No	Yes	Yes	Yes
ICX7150-48PF	No	Yes	Yes	Yes
ICX7150-48ZP	No	No	No	Yes
ICX7150-C12P	Yes	Yes	Yes	Yes
ICX7150-C10ZP	No	Yes	Yes	Yes
ICX7550-24ZP, ICX7550-24F	No	No	Yes	Yes
ICX7650-48ZP, ICX7650-48F	No	No	Yes	Yes
ICX7850-32Q	Yes	Yes	Yes	Yes
ICX7850-48F	Yes	Yes	Yes	Yes

TABLE 30 PTP-TC-Supported RUCKUS Devices by FastIron Release (continued)

Supported Platforms	FastIron Release			
	FastIron 08.0.95	FastIron 08.0.95c	FastIron 09.0.00	FastIron 09.0.10a
ICX7850-48FS	No	Yes	Yes	Yes

FastIron 08.0.95 allows updates to the correctionField on PTP event messages for the following types of PTP packets:

- Ethernet frame with EtherType of 0x88F7.
- Support PTP messages with MAC addresses as specified in the following table.

TABLE 31 Message Type and MAC Address

Message Type	MAC Address
All except peer delay	01-1B-19-00-00-00
Peer delay messages	01-80-C2-00-00-0E

FastIron 08.0.95 supports timestamping of PTP messages on ingress and egress ports, provided the PTP-TC is enabled on the participating ports.

NOTE
The supported RUCKUS ICX devices do not participate in generation or consumption of any PTP messages. The packets are generated between master and slave or client clock devices.

FastIron 08.0.95 supports the end-to-end PTP-TC mode of operation for standalone and stacking topologies. The software treats the stacking as a chain of PTP-TC devices connected back to back, and each device updates the correctionField to eliminate the residence time within the switch.

FastIron 08.0.95 automatically assigns the highest priority to the PTP messages that are untagged, or if they are not part of the IEEE 802.1Q encapsulated frame. The messages encapsulated as part of the IEEE 802.1Q frame follow the IEEE 802.1p priority carried in the Ethernet frame.

Enabling Transparent Clock Mode for PTP

The PTP-TC configuration is disabled by default on all interfaces. The PTP-TC can be enabled globally. All the ports are configured for timestamping after the transparent clock is configured globally. Enable each port individually if you want to enable or disable timestamping on an individual port or range of ports.

The following task shows how PTP can be enabled on individual ports or multiple ports.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Specify the the individual port to be enabled in PTP.

```
device(config)# interface ethernet 1/1/5
```

3. Enable the transparent clock mode for PTP using the following command.

```
device(config-if-e25000-1/1/5)# ptp-clock transparent pkt-type ethernet option e2e step-type onestep
PTP Feature Enabled on port 1/1/5
```

The following example enables the transparent clock mode for PTP on a range of ports.

```
device(config-if-e25000-1/1/5)# interface ethernet 1/1/10 to 1/1/15
device(config-mif-1/1/10-1/1/15)# ptp-clock transparent pkt-type ethernet option e2e step-type onestep
PTP Feature Enabled on port 1/1/10
PTP Feature Enabled on port 1/1/11
PTP Feature Enabled on port 1/1/12
PTP Feature Enabled on port 1/1/13
PTP Feature Enabled on port 1/1/14
PTP Feature Enabled on port 1/1/15
```

The following example enables the PTP transparent clock mode globally.

```
device# configure terminal
device(config)# ptp-clock transparent pkt-type ethernet option e2e step-type onestep
PTP Feature Enabled
device(config)# show ptp-clock
Clock           : Transparent
Clock ID           : 00e0.5200.0100
PTP Enabled Ports     : e 1/1/1 to 1/1/48 e 1/2/1 e 1/2/2 e 1/2/3 e 1/2/4
                        e 1/2/5 e 1/2/6 e 1/2/7 e 1/2/8
Packet Type        : Ethernet
Option          : End-to-End
Primary Domain        : 0
Step Type          : One-step
```

Displaying Transparent Clock Information for PTP

After enabling PTP-TC, you can view the clock information.

You can view the following PTP clock information:

- Clock type
- Clock ID
- Number of ports
- Packet type
- Transparent clock option
- Primary domain
- Step type

Enter the following command to display the PTP transparent clock information.

```
device# show ptp-clock
Clock           : Transparent
Clock ID           : 00e0.5200.0100
PTP Enabled Ports     : e 1/1/5 e 1/1/10 to 1/1/15
Packet Type        : Ethernet
Option          : End-to-End
Primary Domain        : 0
Step Type          : One-step
```

Enter the following command to display the PTP transparent clock information in a stack unit.

```
device# show ptp-clock unit-id 1
Clock              : Transparent
Clock ID           : 00e0.5200.0100
PTP Enabled Ports : e 1/1/5 e 1/1/10 to 1/1/15
Packet Type        : Ethernet
Option             : End-to-End
Primary Domain     : 0
Step Type          : One-step
```

Disabling Transparent Clock Mode for PTP

The PTP transparent clock mode can be disabled globally or on specified interfaces.

The following task shows you how to disable the transparent clock mode on a specified interface.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter interface configuration mode.

```
device(config)# interface ethernet 1/1/5
```

3. Disable PTP on the Ethernet interface 1/1/5 using the **no** form of the command.

```
device(config-if-e25000-1/1/5)# no ptp-clock transparent pkt-type ethernet option e2e step-type
onestep
PTP Feature Disabled on port 1/1/5
device(config)# show ptp-clock
Clock             : Transparent
Clock ID          : 00e0.5200.0100
PTP Enabled Ports : e 1/1/1 to 1/1/4 e 1/1/6 to 1/1/48 e 1/2/1 e 1/2/2
                    e 1/2/3 e 1/2/4 e 1/2/5 e 1/2/6 e 1/2/7 e 1/2/8
Packet Type       : Ethernet
Option            : End-to-End
Primary Domain    : 0
Step Type         : One-step
```

The following example disables the PTP transparent clock mode globally.

```
device# configure terminal
device(config)# no ptp-clock transparent pkt-type ethernet option e2e step-type onestep
PTP Feature Disabled
```

Cisco Discovery Protocol

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

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 ICX7450-48 Switch

Device ID: ICX7450-48 Switch
configured as tag-type8100
Entry address(es):
IP address: 11.1.1.1
Platform: ICX7450-48 Switch,  Capabilities: Switch
Interface: ethernet1/1/41
Port ID (outgoing port): ethernet2/1/31 is dual-mode with default traffic vlan 66 in following
VLAN(s):
22 33 66 78 111
Holdtime : 142 seconds
Ruckus Wireless, Inc. ICX7450-48, IronWare Version 09.0.00_b53T211
Compiled on Jan 12 2021 at 17:23:54 labeled as SPS09000_b53
```

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

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.

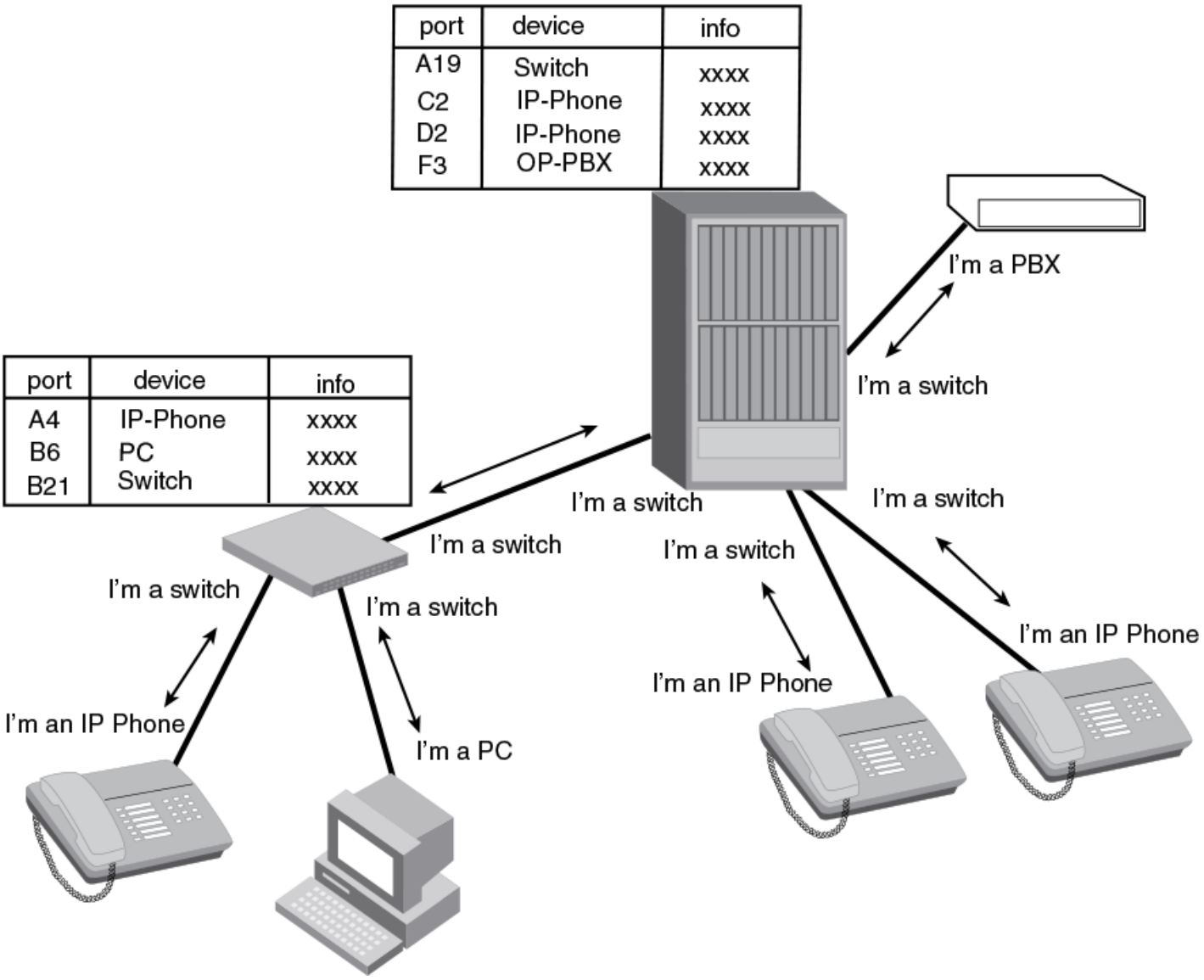
LLDP overview

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 14 LLDP connectivity



Benefits of LLDP

LLDP provides the following benefits:

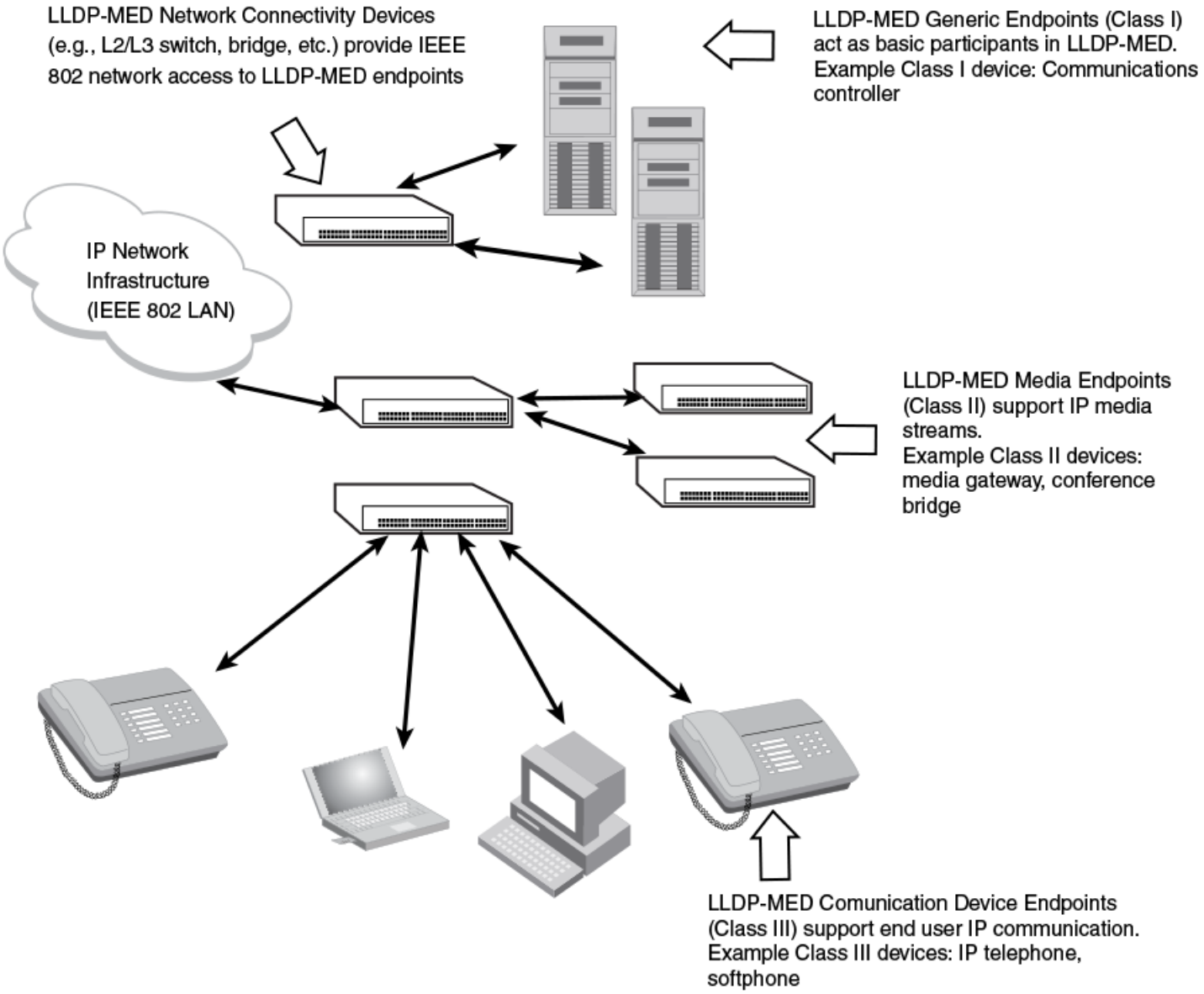
- Network Management:
  - Simplifies the use of and enhances the ability of network management tools in multi-vendor environments
  - Enables discovery of accurate physical network topologies such as which devices are neighbors and through which ports they connect
  - Enables discovery of stations in 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 15 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

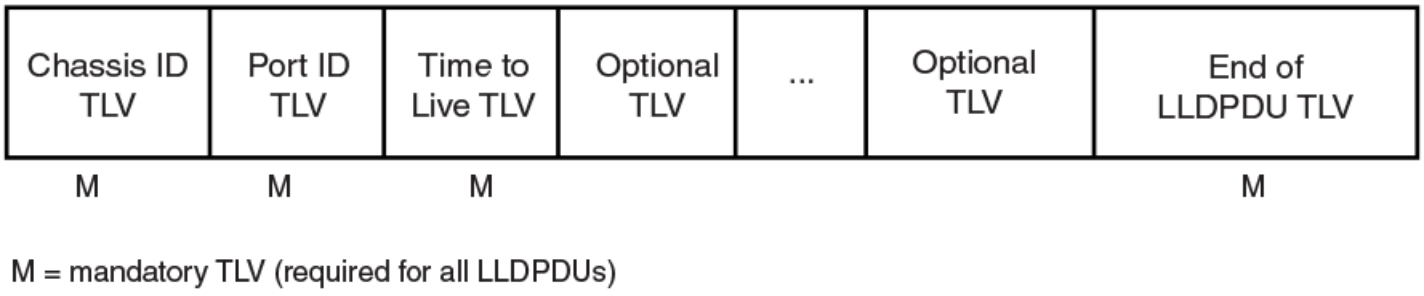
contain basic formatting errors, are assumed to be valid and are assigned a temporary identification index and stored for future possible alter retrieval by network management. All validated TLVs are stored in the neighbor database.

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 16 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 32 Chassis ID subtypes

ID subtype	Description
0	Reserved

TABLE 32 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 33 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

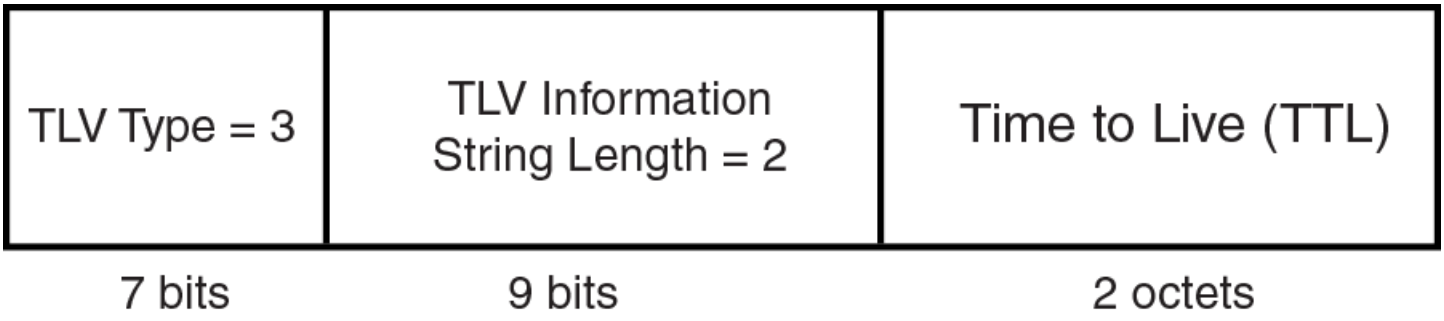
RUCKUS devices use port ID subtype 3, the permanent MAC address associated with the port. Other third party devices may use a port ID subtype other than 3. The port ID appears similar to the following on the remote device, and in the CLI display output on the RUCKUS device (show lldp local-info).

```
Port ID (MAC address):  0000.0033.e2d3
```

The LLDPDU format is shown in LLDP packets on page 152.

The Port ID TLV format is shown below.

FIGURE 17 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
```

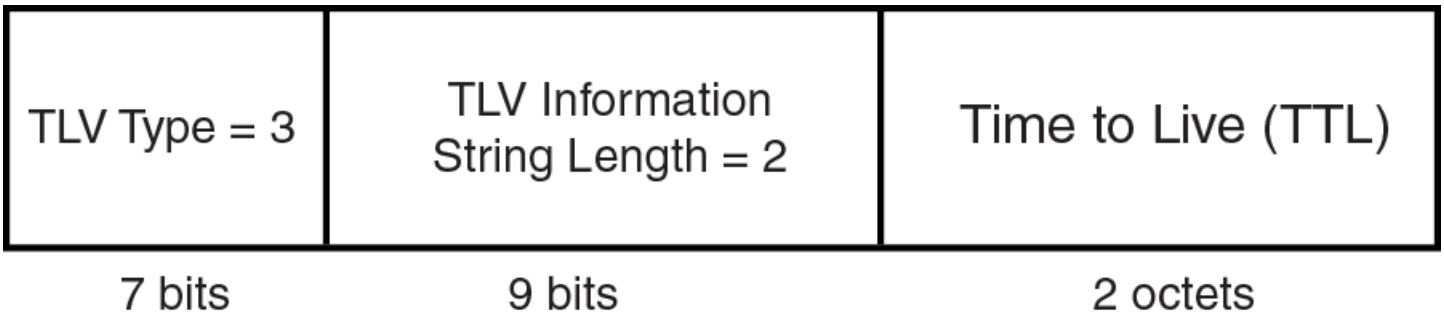
If the TTL field has a value other than zero, the receiving LLDP agent is notified to completely replace all information associated with the LLDP agent/port with the information in the received LLDPDU.

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 152.

The TTL TLV format is shown below.

FIGURE 18 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.

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 169.

LLDP Configuration

This section describes how to configure LLDP.

The following table lists the LLDP global-level tasks and the default behavior or value for each task.

TABLE 34 LLDP Global Configuration Tasks and Default Behaviors or Values

Global Task	Default Behavior or value when LLDP is enabled
Enabling LLDP on a global basis	Default
Specifying the maximum number of LLDP neighbors per device	Automatically set to 2048 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 automatically advertises 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.
- 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.

Managing LLDP on a Global Basis

LLDP is enabled by default on individual ports.

You can enable support for tagged LLDP packets, change the maximum number of LLDP neighbors per device and per port.

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

   ```
   device# configure terminal
   ```

2. (Optional) Enable support for tagged LLDP packets.

   ```
   device(config)# lldp tagged-packets process
   ```

   By default, RUCKUS devices do not accept tagged LLDP packets from other vendor devices.

   When enabled, the device accepts incoming LLDP tagged packets if the VLAN tag matches with a configured VLAN on the port, the default VLAN for a tagged port, and the configured untagged VLAN for a dual-mode port.

3. (Optional) Specify the maximum number of LLDP neighbors per device.

   ```
   device(config)# lldp max-total-neighbors 26
   ```

   This example changes the maximum number of LLDP neighbors for the entire device to 26.

4. (Optional) Specify the maximum number of LLDP neighbors per port .

   ```
   device(config)# lldp max-neighbors-per-port 6
   ```

   This example changes the maximum number of LLDP neighbors per port to 6.

This following example enables support for tagged LLDP packets and change the maximum number of LLDP neighbors per device and per port.

```
device# configure terminal
device(config)# lldp tagged-packets process
device(config)# lldp max-total-neighbors 26
device(config)# lldp max-neighbors-per-port 69
```

Enabling Support for Tagged LLDP packets

By default, RUCKUS devices do not accept tagged LLDP packets from other vendor devices. To enable support, use the **lldp tagged-packets process** command in global configuration mode.

When enabled, the device accepts incoming LLDP tagged packets if the VLAN tag matches any of the following configurations:

- A configured VLAN on the port
- The default VLAN for a tagged port
- The configured untagged VLAN for a dual-mode port

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

   ```
   device# configure terminal
   ```

2. Enter the **lldp tagged-packets process** to enable support for tagged LLDP packets.

   ```
   device(config)#lldp tagged-packets process
   ```

The following task enables the support for tagged LLDP packets

```
device# configure terminal
device(config)#lldp tagged-packets process
```

Disabling LLDP 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.

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

```
device# configure terminal
```

2. Enter the below commands to stop the ports to transmit and receive LLDP packets.

```
device(config)#no lldp enable ports e 1/2/4 e 1/2/5
```

The following task stops the ports to transmit and receive LLDP packets.

```
device# configure terminal
device(config)#no lldp enable ports e 1/2/4 e 1/2/5
```

Re-enabling LLDP receive and transmit mode

After disable the receipt and transmission of LLDP packets on individual ports, it can be re-enabled again.

To re-enable LLDP on a port after it has been disabled, enter the following command.

```
device(config)#lldp enable ports e 1/2/4


device(mode)# command executable
Command output
```

Enabling LLDP receive only mode

LLDP receive mode only mode can be configured for individual ports.

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. Regardless of whether both transmit and receive mode are enabled, or transmit mode only is enable, you have to disable transmit mode before enabling receive mode only.

1. Enter global configuration mode.

```
device# configure terminal
```

2. As per the current enabled mode, follow any one of the below steps.
   - If LLDP transmit and receive modes are enabled globally, disable LLDP transmit on the required ports to automatically enable receive only mode on those ports.

```
device(config)# no lldp enable transmit ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

   - If LLDP transmit only mode is enabled, then first disable the transmit only mode and then enable the receive only mode.

```
device(config)# no lldp enable transmit ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
device(config)# lldp enable receive ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

   - If either LLDP transmit and receive modes are enabled globally or transmit only mode is enabled, disable LLDP on the required ports and enable receive only mode on those ports.

```
device(config)# no lldp enable ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
device(config)# lldp enable receive ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

Enabling transmit only mode

LLDP transmit mode only mode can be configured for individual ports.

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. Regardless of whether both transmit and receive mode are enabled, or receive mode only is enable, you have to disable receive mode before enabling transmit mode only.

1. Enter global configuration mode.

```
device# configure terminal
```

2. As per the current enabled mode, follow any one of the below steps.
   - If LLDP transmit and receive modes are enabled globally, disable LLDP receive on the required ports to automatically enable transmit only mode on those ports.

```
device(config)# no lldp enable receive ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

   - If LLDP transmit only mode is enabled, then first disable the receive only mode and then enable the transmit only mode.

```
device(config)# no lldp enable receive ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
device(config)# lldp enable transmit ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

   - If either LLDP transmit and receive modes are enabled globally or receive only mode is enabled, disable LLDP on the required ports and enable transmit only mode on those ports.

```
device(config)# no lldp enable ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
device(config)# lldp enable transmit ports ethernet 1/2/7 ethernet 1/2/8 ethernet 1/2/9
```

LLDP port's operating mode change

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.

Configuring the LLDP parameters (Optional)

The following steps are optional and non sequential.

1. Enter global configuration mode.

```
device# configure terminal
```

2. (Optional) Specify the maximum number of LLDP neighbors per device

```
device(config)#lldp max-total-neighbors 26
```

   The above example changes the maximum number of LLDP neighbors for the entire device to 26.

3. (Optional) Specify the maximum number of LLDP neighbors per port

```
device(config)#lldp max-neighbors-per-port 6
```

   The above example changes the maximum number of LLDP neighbors per port to six.

4. (Optional) Enable LLDP SNMP notifications and Syslog messages

```
device(config)#lldp enable snmp notifications ports e 1/4/2 to 1/4/6
```

   The above example enables SNMP notifications and corresponding Syslog messages on ports 1/4/2 through 1/4/6.

5. (Optional) Specify the minimum time between SNMP traps and Syslog messages

```
device(config)#lldp snmp-notification-interval 60
```

   When the above example is applied, the LLDP agent will send no more than one SNMP notification and Syslog message every 60 seconds.

6. (Optional) Change the minimum time between LLDP transmissions

   NOTE
   The LLDP transmit delay timer must not be greater than one quarter of the LLDP transmission interval (CLI command lldp transmit-interval).

```
device(config)#lldp transmit-delay 7
```

   The above example causes the LLDP agent to wait a minimum of seven seconds after transmitting an LLDP frame and before sending another LLDP frame.

7. (Optional) Change the interval between regular LLDP transmissions

```
device(config)#lldp transmit-interval 40
```

   The above example causes the LLDP agent to transmit LLDP frames every 40 seconds.

8. (Optional) Change the holdtime multiplier for transmit TTL

```
device(config)#lldp transmit-hold 6
```

   The above example changes the holdtime multiplier to 6.

9. (Optional) Change the minimum time between port reinitializations

```
device(config)#lldp reinit-delay 5
```

   The above example causes the device to wait five seconds after LLDP is disabled, before attempting to honor a request to reenable it.

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.

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

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.

Advertising IP management address

The following steps shows to advertise the IP management address.

1. Enter global configuration mode.

```
device# configure terminal
```

2. To advertise management address, follow any one of the choices.
   - 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
```

   - 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
```

The following task advertises the IP management address

```
device# configure terminal
device(config)# lldp advertise management-address ipv4 10.157.2.1 ports e 1/1/4
```

Port parameters

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.

Disabling advertisement of the port description

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.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter the following command to disable the advertisement of the port description.

```
device(config)#no lldp advertise port-description ports e 1/2/4 to 1/2/12
```

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.

Disabling the advertise system capabilities

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.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter the following command to disable the lldp advertise system capabilities.

```
device# 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
```

The following task disables the lldp advertise system capabilities

```
device# configure terminal
device# no lldp advertise system-capabilities ports e 1/2/4 to 1/2/12
```

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.

Advertising the system description

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter the following command to advertise the system description.

```
device(config)# lldp advertise system-description ports e 1/2/4 to 1/2/12
```

The following task advertises the system description

```
device# configure terminal
device(config)# lldp advertise system-description ports e 1/2/4 to 1/2/12
```

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

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
```

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
```

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"
```

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
```

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.

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"
```

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"
```

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
```

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
```

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
```

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
```

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 173.

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)
```

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 35 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.

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
```

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.

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
```

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, use the **lldp med location-id civic-address** command in 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"
```

This example describes the following location elements:

- Country=USA
- State=California
- City=San Jose
- Street address=120 Holger Way
- Post code=95134
- Floor=5
- Cube number=551
- Type of location=Office
- Name at civic address=John Doe

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
```

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 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
```

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 166. 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 36 802.3af 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)
```

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
```

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.
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
```

NOTE

You can reset LLDP statistics using the CLI command **clear LLDP statistics** . Refer to Resetting LLDP statistics on page 181.

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.
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~
```

The following table describes the information displayed by the **show lldp neighbors** command.

Field	Description
Lcl Port	The local LLDP port number.

Field	Description
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.
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.

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.

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         : "ICX7450SP-ADV Router"
       + Port description    : "GigabitEthernet20"
       + System capabilities : bridge
         Enabled capabilities: bridge
       + 802.3 MAC/PHY          : auto-negotiation enabled
         Operational MAU type   : 100BaseTX-FD
       + 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 175).

```
device#clear lldp statistics
```

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
```

Power over Ethernet

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), 802.3at (PoE+) and 802.3bt.

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 the 802.3af and 802.3at specifications. The 802.3af specification defines 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(APs). Except where noted, this document uses the term PoE to refer to PoE and PoE+.

The 802.3bt specification further expands the standards to support even more power to end devices such as wireless APs (802.11ac), Internet of Things (IoT), computers (Thin Clients), smart buildings (LED lighting), pan-tilt-zoom (PTZ) cameras with lens movement or built-in heaters, hospital equipment (nurse call), business (POS terminals), information kiosks, Small Cell (low-powered radio-access nodes, and televisions.

For a list of the FastIron devices and modules that support IEEE 802.3af, IEEE 802.3at, IEEE 802.3bt, 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 an uninterruptible power supply near IP Powered Devices(PDs). 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

The following PoE 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 802.3at, 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.

IEEE 802.3bt Features

PoE on RUCKUS ICX 7550 devices is IEEE 802.3bt standard compliant. The IEEE 802.3bt standard has increased the amount of power that can be transmitted over the Ethernet cable by using all four wire pairs of the cable.

IEEE 802.3bt is backward compatible with 802.3af and 802.3at.

The IEEE 802.3bt standard contains a number of the following features:

- Type 3 and Type 4 PSE or PD: PoE++ is the latest PoE that supports the 802.3bt standard. The IEEE 802.3bt standard introduced two new types. The Type 3 supports 60W power for the PSE over two or four twisted pairs in a copper cable to supply 51W for the PD. Type 4 supports up to 90W for the PSE and 71.3W for the PD over four twisted pairs.
- Classes: The new standard also introduced additional classes from Class 5 to Class 8. 802.3bt-compliant switches can deliver up to 60W on each port under Type 3 and up to 90W under Type 4.
- PoE over 4-pair twisted cables: The IEEE 802.3bt standard increases the maximum PoE power by utilizing all four pairs in a 4-pair twisted cable such as Cat5 or Cat6 Ethernet cables. Type 3 utilizes both 2-pair and 4-pair twisted cables. Type 4 uses only 4-pair cables. The current 802.3at- and 802.3af-compliant switches uses only two out of the four twisted pairs provided in a network cable.
- Short Maintain Power Signature (MPS): The minimum amount of current that the PD must draw from the PSE, so that the PD does not get disconnected from the PSE, is called the Maintain Power Signature. The minimum standby power has been reduced from the current standard of 200mW to 20mW. This low standby power level enables the IoT applications to be powered with PoE.
- Autoclass: Autoclass allows the PSE to measure the actual power consumption of the connected PD during power-on. Based on this reference power measurement, the PSE can power multiple PDs on the unit. For example, a PSE can allocate an additional bulb using the leftover power if it knows that the connected PD consumes less power than its class power.
- 802.3bt proposes the PD to support Autoclass, in which case, there will not be any cable loss calculation at the ICX 7550. The power reserved for the PD is based on Autoclass information. If Autoclass is not supported, cable loss is calculated based on the real cable length. ICX 7550 devices are capable of cable length detection. When an LLDP request for power comes from a PD, the ICX 7550 calculates will calculate cable loss for the requested power considering that the cable length is already detected.
- Power Demotion: Power Demotion allows the PSE to supply lower power to the PD when the PD demands excess power from a PSE and the PSE cannot meet this power demand. The PD can operate using this limited available power. If a PD ignores this power demotion and tries to operate at its higher power, the PD makes the PSE unavailable.
- Mandatory Classification: This is a hardware-based classification where Type 2 PSEs are not required to support full hardware classification. They can use LLDP to provide full power to PDs. But, it is mandatory for Type 3 and Type 4 PSEs (ICX 7550) to fully support hardware classification.
- Connection Check: The IEEE 802.3bt standard defines two topologies: single-signature PD and dual-signature PD. Connection check determines if the connected PD is a single-signature PD or a dual-signature PD. This is applicable only for Type 3 and Type 4 PSEs that use twisted 4-pair Ethernet cables.

  A dual-signature PD, can support two different loads with different power classes. For example, in a CCTV camera built with a dual-signature PD, one pair of the cable can be connected to the camera and the other pair can be connected to the heater.

  NOTE
  Only RUCKUS ICX 7550 devices support IEEE 802.3bt specifications.

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 method, 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 method, 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, 802.3at and 802.3bt standards. Refer to the *RUCKUS FastIron Features and Standards Support Matrix* for more information.

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 specifications.

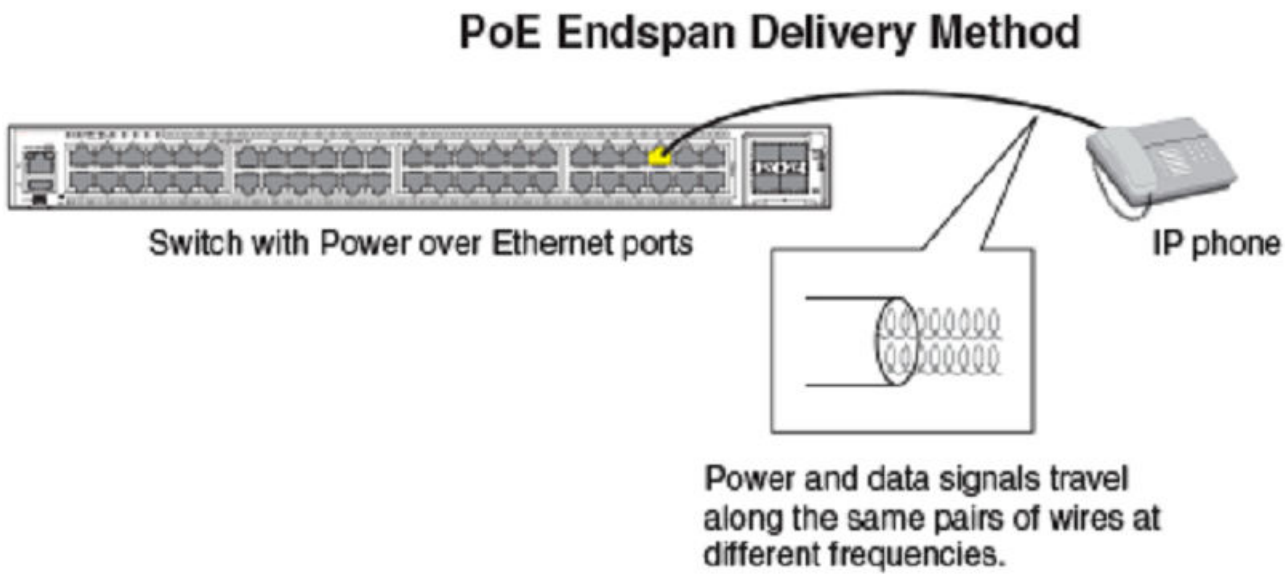
PoE Endspan Method

The PoE Endspan method uses the Ethernet switch ports on power-sourcing equipment, such as a RUCKUS FastIron PoE switch, which has embedded PoE technology to deliver power over the network.

With the Endspan method, 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. 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 illustrated in the following figure.

FIGURE 19 PoE Endspan Method

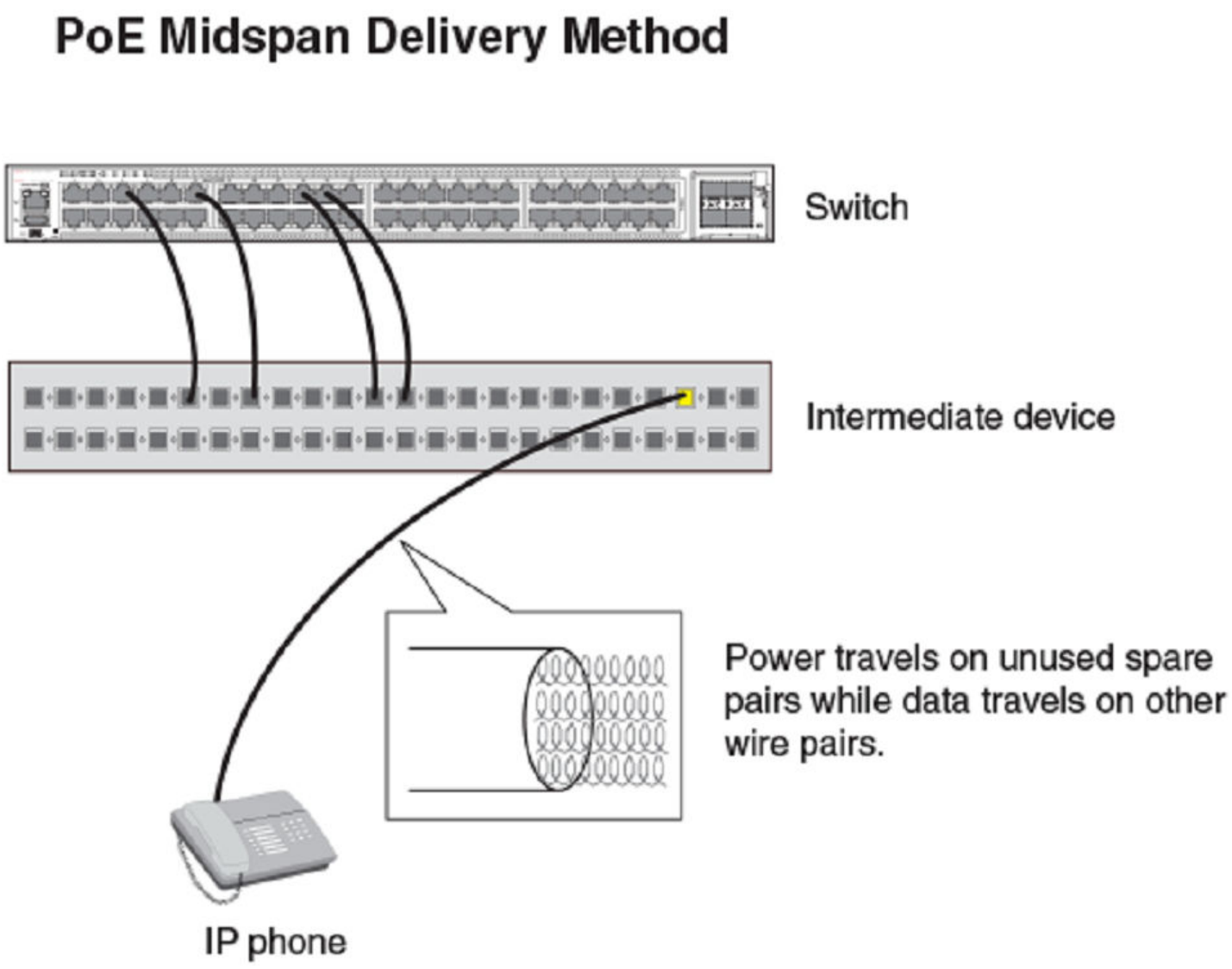


PoE Midspan Method

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.

FIGURE 20 PoE Midspan Method



Perpetual PoE and Fast Boot PoE

Perpetual PoE and fast boot PoE are two new enhancements that can be configured on ICX 7550 switches to allow brief or no power downtime. These enhancements provide high availability to the PD devices by powering them even when a software process is not running on the switch. You must configure perpetual PoE or fast boot PoE on a per-port basis. When configured, the PDs will not lose power while reloading and will have a brief power-down time when power-cycled. By default, perpetual PoE and fast boot PoE are disabled in FastIron 08.0.95.

Perpetual PoE provides uninterrupted power to the connected PDs even when the PSE switch is rebooting or reloading.

Fast boot PoE provides power to the powered devices as soon as the PSE switch is turned on without waiting for the system to boot up.

Use the **inline power poe-ha** command to enable the perpetual PoE and fast boot PoE. Perpetual PoE allows the PoE to remain active and to remember the last PoE settings within 2 seconds after receiving the power, assuming the PD remains the same. If a change of the PD occurs, disable or enable the **inline power** command to re-check the PD type or class.

Configuring Perpetual PoE

Complete the following steps to configure perpetual PoE and fast boot PoE on a per-port basis.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Specify the interface to be configured in interface configuration mode.

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

3. Configure perpetual PoE using the **inline power poe-ha** command.

   NOTE
   Configure the **inline power poe-ha** command before connecting the PD. If the ports are configured before the PDs are connected, power is supplied to the PDs even while the unit is reloading.

```
device(config-if-e1000-1/1/1)# inline power poe-ha
```

   In the PoE restart process, perpetual PoE will be always on irrespective of the configuration. In a system reload case, if the configuration is not saved to the startup configuration, perpetual PoE comes on only with the next reload or power cycle.

PoE Refactoring

Beginning with FastIron 08.0.95, PoE is considered a separate process similar to DHCP and not a part of the FastIron process.

PoE functionality on some ports will not be available when the device fails during operation. Beginning with FastIron 08.0.95, if the PoE process fails, the system attempts five times to bring up the PoE process. If the process fails to come up after five retries, the PoE process will be considered unavailable. In such scenarios, you should contact the RUCKUS support team.

A syslog message is generated when the PoE process fails.

```
SYSLOG: Application poed failed recovery and functionality provided by it will not be available
until failure reason is remedied (may require manual intervention)
```

Enter the **hmon status** command to display the basic information on clients.

```
device# hmon status
---------------------
Health Monitor Status:
---------------------
Hmon's Stack Role is : Standalone
Number of Clients    : 5

Client Names (ID) :
      nginx (4)
      uwsgi (5)
      PySzAgtSrv.py (6)
      dhcpd (3)
      poed (7)
```

Use the **hmon client configuration all-clients** command to display the registered attributes information

```
device# hmon client configuration all-clients
-----------------------------------
Health Monitor Client Configuration:
-----------------------------------

Configuration attributes for client ID 4:
Process Name                  : nginx
Startup Script                : nginx-service.sh
Stackrole mask                : 0x3
Starts on bootup              : No
Process restartable           : Yes
Criticality of the process    : Non-Critical
Process restart count limit   : 5
Heart-Beat monitoring reqd.   : No
Functionality monitoring reqd.: Yes
Func. monitoring interval     : 10 Secs
Func. fail count limit        : 2

Configuration attributes for client ID 5:
Process Name                  : uwsgi
Startup Script                : uwsgi-service.sh
Stackrole mask                : 0x3
Starts on bootup              : No
Process restartable           : Yes
Criticality of the process    : Non-Critical
Process restart count limit   : 5
Heart-Beat monitoring reqd.   : No
Functionality monitoring reqd.: Yes
Func. monitoring interval     : 10 Secs
Func. fail count limit        : 2

Configuration attributes for client ID 6:
Process Name                  : PySzAgtSrv.py
Startup Script                : pySzagent-service.sh
Stackrole mask                : 0x3
Starts on bootup              : No
Process restartable           : Yes
Criticality of the process    : Non-Critical
Process restart count limit   : 5
Heart-Beat monitoring reqd.   : No
Functionality monitoring reqd.: Yes
Func. monitoring interval     : 10 Secs
Func. fail count limit        : 2

Configuration attributes for client ID 3:
Process Name                  : dhcpd
Startup Script                : dhcpd-script.sh
Stackrole mask                : 0x3
Starts on bootup              : No
Process restartable           : Yes
Criticality of the process    : Non-Critical
Process restart count limit   : 5
Heart-Beat monitoring reqd.   : No
Functionality monitoring reqd.: Yes
Func. monitoring interval     : 10 Secs
Func. fail count limit        : 2

Configuration attributes for client ID 7:
Process Name                  : poed
Startup Script                : poed.sh
Stackrole mask                : 0xffffffff
Starts on bootup              : Yes
Process restartable           : Yes
Criticality of the process    : Non-Critical
Process restart count limit   : 5
Heart-Beat monitoring reqd.   : No
Functionality monitoring reqd.: Yes
```

Use the **hmon client status all-clients** command to display the operational status information of the PoE.

```
device# hmon client status all-clients
-----------------------------
Health Monitor Client Status:
-----------------------------

Status for client ID 4:
Process Name              : nginx
Valid                     : Yes
Admin. State              : Disabled, HA Disabled
Oper. State               : Down

Status for client ID 5:
Process Name              : uwsgi
Valid                     : Yes
Admin. State              : Disabled, HA Disabled
Oper. State               : Down

Status for client ID 6:
Process Name              : PySzAgtSrv.py
Valid                     : Yes
Admin. State              : Disabled, HA Disabled
Oper. State               : Down

Status for client ID 3:
Process Name              : dhcpd
Valid                     : Yes
Admin. State              : Disabled, HA Disabled
Oper. State               : Down

Status for client ID 7:
Process Name              : poed
Valid                     : Yes
Admin. State              : Enabled, Started, HA Enabled
Oper. State               : Up
```

To display the statistics including the failure and restart counts, use the **hmon client statistics all-clients** command.

```
device# hmon client statistics all-clients
---------------------------------
Health Monitor Client Statistics:
---------------------------------

Statistics for client ID 4:
Process Name                           : nginx
Most recent PID                        : Not Available
Func. Monitor fail counts              : 0
Total number of admin stops            : 0
Total number of disallowed admin stops   : 0
Total number of admin starts           : 0
Total number of disallowed admin starts  : 0
Total number of admin restarts         : 0
Total number of restarts for recovery    : 0
Code from latest func. fail recovery     : 0x0
Status from latest Func. Monitor check   : Not Invoked

Statistics for client ID 5:
Process Name                           : uwsgi
Most recent PID                        : Not Available
Func. Monitor fail counts              : 0
Total number of admin stops            : 0
Total number of disallowed admin stops   : 0
Total number of admin starts           : 0
Total number of disallowed admin starts  : 0
Total number of admin restarts         : 0
Total number of restarts for recovery    : 0
Code from latest func. fail recovery     : 0x0
Status from latest Func. Monitor check   : Not Invoked

Statistics for client ID 6:
```

```
Process Name                            : PySzAgtSrv.py
Most recent PID                         : Not Available
Func. Monitor fail counts               : 0
Total number of admin stops             : 0
Total number of disallowed admin stops  : 0
Total number of admin starts            : 0
Total number of disallowed admin starts : 0
Total number of admin restarts          : 0
Total number of restarts for recovery   : 0
Code from latest func. fail recovery    : 0x0
Status from latest Func. Monitor check  : Not Invoked

Statistics for client ID 3:
Process Name                            : dhcpd
Most recent PID                         : Not Available
Func. Monitor fail counts               : 0
Total number of admin stops             : 0
Total number of disallowed admin stops  : 0
Total number of admin starts            : 0
Total number of disallowed admin starts : 0
Total number of admin restarts          : 0
Total number of restarts for recovery   : 0
Code from latest func. fail recovery    : 0x0
Status from latest Func. Monitor check  : Not Invoked

Statistics for client ID 7:
Process Name                            : poed
Most recent PID                         : Not Available
Func. Monitor fail counts               : 0
Total number of admin stops             : 0
Total number of disallowed admin stops  : 0
Total number of admin starts            : 0
Total number of disallowed admin starts : 0
Total number of admin restarts          : 0
Total number of restarts for recovery   : 0
Code from latest func. fail recovery    : 0x0
Status from latest Func. Monitor check  : Not Invoked
```

PoE Autodiscovery

PoE autodiscovery is a detection mechanism that identifies whether an installed device is 802.3af-, 802.3at-, or 802.3bt-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. PoE autodiscovery 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-, 802.3at-, or 802.3bt-compatible device is plugged into a 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

According to the IEEE 802.3at standard, 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.

In the IEEE 802.3af standard, the maximum power output of a port is limited to 15.4W. But some power will get lost on the Ethernet cable and therefore, the minimum power available at the PD is 13W per port.

The IEEE 802.3at standard is backward compatible with IEEE 802.3af. This standard provides up to 30W of power on each port of the power equipment. The minimum output power on each port at the PD after the cable loss is 25.5W.

The new IEEE 802.3bt standard introduced two more types of powering standards, Type 3 and Type 4, and four new classes, from Class 5 to Class 8. Type 3 can carry up to 60W for each PoE port and Type 4 can provide maximum power output of 90W per PoE port. IEEE 802.3bt is backward compatible with 802.3af and 802.3at.

The following table shows the different power classes and their respective power consumption needs.

TABLE 37 Power Classes for PDs

Class	Power (watts) from Power-Sourcing Device				
	IEEE 802.3af (Standard PoE)	IEEE 802.3af (PoE+)	IEEE 802.3bt	PoE++/LT PoE	Power over HDBaseT (PoH)
0	15.4	15.4	15.4	15.4	15.4
1	4	4	4	4	4
2	7	7	7	7	7
3	15.4	15.4	15.4	15.4	15.4
4	N/A	30	30	30	Default is 60. If PoE overdrive is enabled, up to 95W is supported.
5	N/A	N/A	45	45	N/A
6	N/A	N/A	60 (65 if overdrive is enabled).	60	N/A
7	N/A	N/A	75	75	N/A
8	N/A	N/A	90	90	N/A

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 30W. In releases prior to FastIron 08.0.70, the default power reservation of 30W places the ports in the denied state when the available power is less than 30W. The port remains in the 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, or 3 power, the ports are enabled and, if the PD is detected in these classes, the PD is powered up. 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 38 Power Requirement for Ports and PD Detection

Available System Power	Power Reservation for PD Detection
Class 8 Power	90W
> Class 7 Power (between 75W and 90W)	75W
> Class 6 Power (between 60W and 75W)	60W
> Class 5 Power (between 45W and 60W)	45W
> Class 4 Power (between 30W and 45W)	30W
> Class 3 Power (between 15.4W and 30W)	15.4W
> Class 2 Power (between 7W and 15.4W)	7W
> Class 1 Power (between 4W and 7W)	4W
< Class 1 Power (between 0W and 4W)	Ports will be in disabled state (power-denied state)

The Power Supply Units (PSUs) on ICX 7550 devices are the RPS22 (PoE) and the RPS21 (non-PoE). The capacity of the RPS22 varies with the AC input voltage and the number of PSUs. The RPS21 PSU (non-PoE) is not compatible with PoE models.

The PSU AC input (110-240V) remains the same while configuring perpetual PoE and fast boot PoE. Moving the PSU AC input from 240V to 110V reduces the power supply capacity. If perpetual PoE or fast boot PoE is applied on all ports, and the connected PDs are already using more than the capacity of the PSU with 110V, then there is a possibility of PSU shutdown.

TABLE 39 ICX 7550 Models Using AC < 180V

Model	PSU Count	Maximum 12V Output Power (W)	Maximum PoE Output Power (W)
ICX 7550-24P	1	154W	812W
	2	154W each	812W x 2
ICX 7550-48P	1	164W	812W
	2	164W each	812W x 2
ICX 7550-24ZP	1	197W	815W
	2	197W each	815W x 2
ICX 7550-48ZP	1	250W	763W
	2	250W each	763W x 2

TABLE 40 ICX 7550 Models Using AC > 180V

Model	PSU Count	Maximum 12V Output Power (W)	Maximum PoE Output Power (W)
ICX 7550-24P	1	154W	950W
	2	154W	950W x 2
ICX 7550-48P	1	164W	950W
	2	164W	950W x 2
ICX 7550-24ZP	1	197W	954W
	2	197W each	954W x 2
ICX 7550-48ZP	1	250W	929W
	2	250W each	929W x 2

Scaling numbers depend on the PSUs and power budget of the PDs.

TABLE 41 Maximum Ports Supported for ICX 7550

Model	VAC(V)	PSU	Max PoE output power draw (W)	Maximum Number of Ports Supported							
				802.3af/at/bt Class 3	802.3at/bt Class 4	PoE overdrive	802.3bt Class 5	802.3bt Class 6	802.3bt Class 7	802.3bt Class 8	802.3bt Class 9
				2-Pair	2-Pair	2-Pair	4-Pair	4-Pair	4-Pair	4-Pair	4-Pair
				15.4W	30W	45W	45W	60W	70W	90W	95W
ICX7550-24P	100-180	1	812	24	24	18	N/A	N/A	N/A	N/A	N/A
		2	1624	24	24	24	N/A	N/A	N/A	N/A	N/A
	181-240	1	950	24	24	21	N/A	N/A	N/A	N/A	N/A
		2	1900	24	24	24	N/A	N/A	N/A	N/A	N/A
ICX7550-48P	100-180	1	812	48	27	18	N/A	N/A	N/A	N/A	N/A
		2	1624	48	48	36	N/A	N/A	N/A	N/A	N/A
	181-240	1	950	48	31	21	N/A	N/A	N/A	N/A	N/A
		2	1900	48	48	42	N/A	N/A	N/A	N/A	N/A

TABLE 41 Maximum Ports Supported for ICX 7550 (continued)

Model	VAC(V)	PSU	Max PoE output power draw (W)	Maximum Number of Ports Supported							
				802.3af/at/bt Class 3	802.3at/bt Class 4	PoE overdrive	802.3bt Class 5	802.3bt Class 6	802.3bt Class 7	802.3bt Class 8	802.3bt Class 9
				2-Pair	2-Pair	2-Pair	4-Pair	4-Pair	4-Pair	4-Pair	4-Pair
				15.4W	30W	45W	45W	60W	70W	90W	95W
ICX7550-24ZP	100-180	1	815	24	24	18	18	13	10	9	8
		2	1630	24	24	24	24	24	21	18	17
	181-240	1	954	24	24	21	21	15	12	10	10
		2	1908	24	24	24	24	24	24	21	20
ICX7550-48ZP	100-180	1	753	48	25	16	16	12	10	8	8
		2	1526	48	48	33	33	25	20	16	16
	181-240	1	929	48	30	20	20	15	12	10	9
		2	1858	48	48	41	41	30	24	20	19

PoE Overdrive

POE overdrive is not part of the IEEE standard, but a RUCKUS proprietary enhancement. In releases prior to FastIron 08.0.61, a PD could negotiate only for a power lower than the limit defined by the power class of the PD through the LLDP-MED messages. Beginning with FastIron 08.0.61, PoE overdrive allows the Class 0 and Class 4 PD to negotiate for power greater than the 30W allocation (refer to Table 42 through Table 45 for PoE overdrive support details). The maximum power that can be processed based on LLDP-MED 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 disabled by default. When RUCKUS PDs negotiate for power greater than the 30W allocation on PoE+ ports that support overdrive through LLDP-MED messages, PoE overdrive is enabled automatically. When the port mode dynamically changes to overdrive mode, the power is cycled (off and on) on the port. To avoid PD reload, manually apply the **inline power overdrive** configuration on the port before connecting the PD. PoE overdrive is a per-port configuration and can be configured on a range of ports.

> **NOTE**
> PoE overdrive on PoE+ ports is available for RUCKUS PDs. Beginning with FastIron 08.0.92, PoE overdrive on PoE+ ports is available for the RUCKUS-tested third-party PDs. RUCKUS PDs use UPoE when connected to PoH ports.

If PoE overdrive is enabled on the ports dynamically (when overdrive-supported RUCKUS PDs are connected), it is disabled on the ports automatically when the PD is disconnected. This automatic overdrive configuration is not displayed in the running configuration.

By default, the initial power allocation is 60W on PoH ports and 30W on PoE+ ports. With the PoE overdrive configuration, the initial power allocation is 95W on PoH ports and 30W on PoE+ ports.

The ICX 7550 models are a mix of 2-pair and 4-pair ports that support the 802.3bt standard. Automatic overdrive is used for 2-pair ports and only RUCKUS-tested third-party PDs receive more than 30W. RUCKUS PDs that require more than 30W on 2-pair ports automatically get the power without any configuration, and there is no reload of the PD.

> **NOTE**
> Non-RUCKUS PDs cannot take more than 30W on 2-pair ports

For platforms other than the ICX 7550, the 2-pair ports require the **inline power overdrive** command to avoid the PD reload.

The ICX 7550 4-pair ports require the **inline power overdrive** command to supply more power to PoH and PoE++ PDs.

You must manually configure the **inline power power-limit** command on the port to support PoH and PoE++ PDs. The ICX 7550 devices supply more power to PoE++ PDs by configuring the **inline power overdrive** command. The PoE++ PD gets power and comes under Class 5 to Class 8 as it is

classified under the 802.3bt standard. The RUCKUS ICX 7550 power-supplying devices provide only 802.3bt standard power, irrespective of whether the connected PD is 802.3bt- or LT PoE++-compliant.

The PoE overdrive allocation varies depending on the hardware models as shown in the following table.

TABLE 42 PoE Overdrive Limit on Different Hardware Models

ICX Platforms	PoH Ports	Overdrive: Maximum Power Capability	PoE+ Ports	Overdrive: Maximum Power Capability
ICX 7450 (all PoE models)	1 to 8	By default, the value is 60, but with overdrive, it is 95W.	9 to 48	N/A
ICX 7650-48P	1 to 8		9 to 48	45W **NOTE** Only RUCKUS PDs can go up to 45W.
ICX 7150-48ZP	1 to 16		17 to 48	
ICX 7650-48ZP	25 to 48		1 to 24	
ICX7150-C10ZP	7 to 10		1 to 6	
ICX 7150-24P, ICX 7150-48P, ICX 7150-C12P, ICX 7150-C08, ICX 7250-24P, ICX 7250-48P	None		All PoE ports	N/A

TABLE 43 PoE Overdrive Limit for ICX 7550

Classes	Default Power Limit	Overdrive Power Limit
Class 5	45	45
Class 6	60	65
Class 7	75	90
Class 8	90	120

TABLE 44 Ports Supporting Overdrive Feature

ICX Platforms	2-pair 802.3bt Ports (Type 3)	4-pair 802.3bt Ports (Type 4)
ICX 7550-24P	1 to 24	None
ICX 7550-48P	1 to 48	None
ICX 7550-24ZP	None	1 to 24
ICX 7550-48ZP	None	1 to 48

TABLE 45 PDs Allowed for POE Overdrive on PoE+ Ports

Supported PDs	Minimum Software Release
RUCKUS R720 AP	SmartZone 3.5.1
RUCKUS R730 AP	SmartZone 3.6.2
RUCKUS-tested third-party PDs	FastIron 08.0.92

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
By default, PoH ports on RUCKUS devices allocate 60W for Class 4 PDs. If PoE overdrive is enabled, PoH ports allocate 95W for Class 4 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.

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

Auto Firmware Download

Beginning with FastIron 08.0.70, PoE firmware is bundled with the FastIron image, copied to the rootfs file of the ICX product, and 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 a difference between the versions, the firmware from the 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 occurs 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 cause a delay in availability of the PoE functionality.

Firmware Image File Types

Beginning with FastIron 08.0.61, a unified PoE firmware is used across the supported devices.

TABLE 46 PoE Firmware Files

Product	PoE Firmware File
ICX 7450, ICX 7250, ICX 7150, and ICX 7650	icx7xxx_poe_02.1.8.b004.fw
ICX 7550	icx7xxx_poe_01.51.0.b000.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. Because the **inline power** configuration is applied on all PoE-capable ports by default, the PD is powered up as soon as it is connected to the port. If the PoE power allocation must be disabled on bootup, use the **no inline power** command and the **write memory** command. Upon reboot, all the saved PoE configurations are applied and PoE is not enabled.

Decoupling and Coupling of PoE with Data Link operations

Although PoE and data link operations are functionally independent of each other, some data link 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 data link operational behavior on a PoE port does not affect the power state of the powered device (PD) that is connecting to the port.

From FastIron 08.0.70b onwards, you can override the default behavior of data link decoupling using the **inline power couple-datalink** command. This command links the behavior of PoE configuration with the **interface disable** or **interface enable** configuration. When the behaviors are linked, the **interface disable** command also removes the power on the port (disables power when the interface is disabled).

The following data link operations can affect the operational state of PoE on the PoE ports:

- Using the **interface disable** command on the power sourcing equipment (PSE) port interface.
- LAG operational changes can affect the PoE power state if data link coupling is enabled. That is, power on LAG ports is impacted when the LAG is undeployed, the **interface disable** command is issued on the LAG port, or an interface is deleted from the LAG.

In situations where data link operations tamper with PoE configurations and disable the power on the port, the interface must be enabled so as to get the power enabled. To reinstate the default setting of the data link decoupling, you must configure the **inline power** command on the interface.

> **NOTE**
> The **no 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 the default as **no inline power** will show a behavior change because all ports will get power. If you do not want PoE on a port, the PoE must be disabled after bootup. The **decouple-datalink** parameter of the **inline power** command in the PoE configuration will be ignored when upgrading to FastIron 08.0.70.

Downgrade impact: After a downgrade, all PDs are powered down and you must specifically enable inline power on the ports. There is no impact to the **decouple-datalink** configuration keyword of the **inline power** command.. However, the **inline power couple-datalink** command will not be recognized by the downgraded version.

ISSU Impact: If there is a change in firmware versions between FastIron images when the image upgrade is using in-service software upgrade (ISSU), there will be an increase in the time taken for the upgrade. Because there is a chance that a PD may take power from two units of the stack, ISSU must wait to reload a second unit until the firmware upgrade finishes on one unit. If the firmware upgrade is taking place on one unit, that unit will not deliver power to the PD. If another unit is reloaded at the same time, the PD loses power from both units. Only after the firmware upgrade is finished and power is stabilized on all ports can ISSU begin upgrading the image on the next unit. This consideration does not apply to PE ports, because all the PEs are reloaded together during an upgrade using ISSU.

Backward Compatibility

New PoE configuration files are not backward compatible with respect to the default **inline power** and **inline power couple-datalink** configurations. Other configurations of the **inline power power-limit** command are backward compatible.

Enabling Power over Ethernet

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 using the **write memory** command, all the saved PoE configurations are applied and PoE will not be enabled upon reboot. In such a scenario, PoE can be enabled as shown in the following example.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Specify the interface to be configured in interface configuration mode.

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

3. 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.

```
device(config-if-e1000-1/1/1)# inline power
```

NOTE
Do not configure inline power between two switches because it may cause unexpected behavior.

Once you have entered the commands to enable inline power, the console displays the following message after the PD is powered up.

```
device(config-if-e1000-1/1/1)# PoE Info: Power enabled on port 1/1/1.
```

Disabling Power over Ethernet

Complete the following steps to disable the inline power.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter the interface range.

```
device(config)# interface ethernet 1/1/1 to 1/1/48
```

3. Enter the **no inline power** command to disable the ports from receiving inline power.

```
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.
```

Support for PoE Legacy Power-Consuming Devices

RUCKUS PoE devices support most legacy power-consuming devices (devices not compliant with 802.3af or 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 the port level using the **legacy-inline-power** command where non-standard PDs are connected.

With global configuration enabled, if the **legacy-inline-power** command is configured at the interface level, it will be displayed in the interface level running the 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 the enabled 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.

The command **inline power non-pd-detection enable** can be used for the detection for non-powered endpoints or devices (non-PD). By default, non-PD detection is enabled and new devices that connect to the Power over Ethernet (PoE) ports are detected. When this feature is re-enabled after having been disabled, only new devices that connect to the PoE ports are detected. To ensure that all existing non-PDs are detected, you must save the configuration and reload the device or follow the below order of configuration:

1. Configure the LAG for multiport PDs.

2. Enable non-PD detection mode.

3. Configure inline power on interfaces.

When the no form of the command is used to disable non-PD detection, the existing non-PD state declarations on the ports are not cleared. The state declarations on the ports clear when they are disconnected from the non-PDs or when you save the configuration and reload the device. Either reload after disabling the mode or disable and then enable inline power on ports that are in a non-PD state. When a port has detected a non-PD, it generates the following syslog message:

```
PoE: Power disabled on port 1/1/21 because of detection of non-PD. PD detection will be disabled on port..
```

When a port loses a non-PD (cable disconnected, etc.), it generates the following syslog message:

```
PoE: Port 1/1/21 lost non-PD, so enabling PD detection.
```

The following example enables non-PD detection.

```
device# configure terminal
device(config)# inline power non-pd-detection enable
Warning: Enabling or disabling non-PD detection requires reload or
disable/enable of ports with existing non-PDs.
Warning: Enabling this configuration also has following limitation:
All ports of a multi-port PD must be connected to one unit only so
that a LAG configured does not span more than a single unit.
device(config)# write memory
device(config)# exit
device# reload
```

The PoE port flap might occur when multiple links on multiple PoE ports go down and at the same time if one of the PSU is removed and added back. To avoid this, disable the Non-PD detection logic on non-legacy ports using the command **no inline power non-pd-detection enable**. The Non-PD detection logic is not enabled on legacy disabled ports. On legacy enabled ports, if the link is already up before the port is powered, the port would be set to Non-PD state. Later, if legacy is disabled on ports, the port would continue to stay in Non-PD state until you enable **inline-power** configuration.

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 cdp run** 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(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 cables. This is compliant with the IEEE 802.3af, 802.3at, and 802.3bt specifications for delivering inline power. Devices that are configured to receive less PoE power (for example, 4 watts of power), experience of power, experience a lower rate of power loss through the cables.

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

Review the following considerations when setting power levels:

- 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 Setting the Power Class for a PoE Power-Consuming Device on page 201. 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 the PDs are not supporting LLDP power negotiations and not using PoH devices in any of the PoH ports of any ICX platforms, 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 PoH ports because Class 4 encompasses 30W through 95W. However, Class 4 on units that do not support PoH or High Power remains 30W.
- FastIron devices pre-allocate power as per the configured maximum power for a physically operational PoE- or PoE+-configured port.

Configuring Power Levels

Complete the following steps to configure the maximum power level for a power-consuming device.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Specify the interface and enter the interface configuration mode.

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

3. Enter the following command to 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).

```
device(config-if-e1000-1/1/1)# inline power power-limit 14000
```

For information about resetting the maximum power level, refer to Resetting PoE Parameters on page 203.

Setting the Power Class for a PoE Power-Consuming Device

A power class specifies the maximum amount of power that a RUCKUS 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 47 Power Classes for PDs

Class	Usage	Power (watts) from Power-Sourcing Device			
		IEEE 802.3af (Standard PoE)	IEEE 802.3at (PoE+)	IEEE 802.3bt	Power over HDBaseT (PoH)
0	default	15.4	15.4	15.4	15.4
1	optional	4	4	4	4
2	optional	7	7	7	7
3	optional	15.4	15.4	15.4	15.4
4	optional	15.4	30	30	95
5	optional	N/A	N/A	45	N/A
6	optional	N/A	N/A	60	N/A
7	optional	N/A	N/A	75	N/A
8	optional	N/A	N/A	90	N/A

Refer to Considerations for setting power levels on page 200 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 cables. 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 watts), experience a lower rate of power loss through the cables.
- The RUCKUS 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

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         14400      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 4.

For information about resetting the power class, refer to Resetting PoE Parameters on page 203.

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 receives 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.

Power is removed from the ports according to the port power-down priority order. Power is removed from the port in the following scenarios:

- During power budget recovery when a PSU is removed
- When a high priority port is powered causing a low priority port to lose power.
- When fanless mode is enabled causing power budget reduction and hence budget recovery.

When power is removed, higher-numbered non-powered ports are considered first for shutdown followed by higher-numbered powered ports of the same user priority. This mechanism helps to keep the already powered ports alive as much as possible.

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
```

NOTE

By default, the port priority value is 3.

You must specify both the inline power priority and the maximum power level (**power-limit** parameter), 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

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 (because 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 mode 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

Complete 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 configuration also enables inline power on the PoE ports.

1. Configure a LAG.

   ```
   device(config)# lag "mylag" static id 5
   ```

   This command configures 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 enters 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 configures 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 configures 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 configures inline power on port 1/1/4, specifying a power value of 12,000 mW.

Fanless Mode Support on the 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 an 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 bootup or reboot and will be turned off after the bootup.

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. To display the inline power debug information, use the **show inline power debug-info** command.

The following example displays **show inline power** command output for a PoE device.

> **NOTE**
> IEEE 802.3bt is backward compatible with 802.3af and 802.3at. The **show inline power** command cannot differentiate whether the connected PD is supported by 802.3af, 802.3at, or 802.3bt. Therefore, the PD Type is listed as 2P-IEEE (2-pair), 4P-IEEE (4-pair), or Non-Std.

```
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          6300       7000  802.3af  Class 2     3  n/a
1/1/2  On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/3  On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/4  On      On          6500       7000  802.3af  Class 2     3  n/a
1/1/5  On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/6  On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/7  On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/8  On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/9  On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/10 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/11 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/12 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/13 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/14 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/15 On      On          5900       7000  802.3af  Class 2     3  n/a
1/1/16 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/17 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/18 On      On          6500       7000  802.3af  Class 2     3  n/a
1/1/19 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/20 On      On          6500       7000  802.3af  Class 2     3  n/a
1/1/21 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/22 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/23 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/24 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/25 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/26 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/27 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/28 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/29 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/30 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/31 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/32 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/33 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/34 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/35 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/36 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/37 On      On          6200       7000  802.3af  Class 2     3  n/a
```

```
1/1/38 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/39 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/40 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/41 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/42 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/43 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/44 On      On          6400       7000  802.3af  Class 2     3  n/a
1/1/45 On      On          6200       7000  802.3af  Class 2     3  n/a
1/1/46 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/47 On      On          6300       7000  802.3af  Class 2     3  n/a
1/1/48 On      On          6300       7000  802.3af  Class 2     3  n/a
--------------------------------------------------------------------------------
Total                   259600     336000
```

The following example displays **show inline power debug-info** command output.

```
device# sh inline power debug-info 1/1/9

  Port    Admin     Oper    ---Power(mWatts)---  PD Type   PD Class     Pri  Fault/
         State     State   Consumed  Allocated                           Error
--------------------------------------------------------------------------------
  1/1/9    On     On          7900      28850  2P-IEEE  Class 4        3  n/a
 Last 5 HW port status:
    1:0x0C RHIGH                                  2:0x0C RHIGH
    3:0x0C RHIGH                                  4:0x1A User OFF
    5:0x01 af/at PD Detected

Max Power Capability for 2pair PD :30000 mWatts
Highest Power Requested by PD Through LLDP/CDP :28850 mWatts
```

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 example displays **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         28200      30000  802.3at  Class 4     3  n/a
 1/1/2 On      On         28900      30000  802.3at  Class 4     3  n/a
 1/1/3 On      On         28100      30000  802.3at  Class 4     3  n/a
 1/1/4 On      On         28100      30000  802.3at  Class 4     3  n/a
 1/1/5 On      On         28400      30000  802.3at  Class 4     3  n/a
 1/1/6 On      On         28100      30000  802.3at  Class 4     3  n/a
 1/1/7 On      On         28400      30000  802.3at  Class 4     3  n/a
 1/1/8 On      On         28300      30000  802.3at  Class 4     3  n/a
 1/1/9 On      On         28100      30000  802.3at  Class 4     3  n/a
1/1/10 On      On         28100      30000  802.3at  Class 4     3  n/a
1/1/11 On      On         28100      30000  802.3at  Class 4     3  n/a
1/1/12 On      On         28100      30000  802.3at  Class 4     3  n/a
```

```
1/1/13 On      On         28200      30000  802.3at  Class 4     3  n/a
1/1/14 On      On         28200      30000  802.3at  Class 4     3  n/a
1/1/15 On      On         26000      30000  802.3at  Class 4     3  n/a
1/1/16 On      On         28300      30000  802.3at  Class 4     3  n/a
1/1/17 On      On         28500      30000  802.3at  Class 4     3  n/a
1/1/18 On      On         28600      30000  802.3at  Class 4     3  n/a
1/1/19 On      On         28600      30000  802.3at  Class 4     3  n/a
1/1/20 On      On         28600      30000  802.3at  Class 4     3  n/a
1/1/21 On      On         28600      30000  802.3at  Class 4     3  n/a
1/1/22 On      On         28600      30000  802.3at  Class 4     3  n/a
1/1/23 On      On         28400      30000  802.3at  Class 4     3  n/a
1/1/24 On      On         28600      30000  802.3at  Class 4     3  n/a
--------------------------------------------------------------------------------
Total                    678200     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        679.300 W   720.0   W
```

The following example displays **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

Consider some of the following scenarios that impact PoE functionality and the actions required to overcome the 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:
  - When a PSE port is configured with 10M and connected to PDs with 10-Mbps uplink port speed.
  - 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 the **no inline power** command followed by the **inline power** command.

  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 high power-consuming PDs are connected in consecutive ports and the ambient temperature is high, the device gets heated up. 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 voltage applied from an external source is detected from a PoE port, new PDs cannot get powered on this unit. In such scenarios, 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 due to power being injected on another port of this unit. In such scenarios, 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** configuration at the interface configuration level. 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 runn int eth 1/1/1
interface ethernet 1/1/1
 legacy-inline-power
!
```

SNMP

SNMP Overview

Simple Network Management Protocol (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:

- Using the **management access** command to restrict SNMP access
- Restricting SNMP access to a specific MAC or IP address
- Restricting SNMP access to a specific VLAN
- Disabling SNMP access

Restricting SNMP access using management access controls, VLANs, or a specific MAC or IP address constitutes 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.

NOTE
For more information on using access controls to restrict SNMP access, refer to the Remote Access to the Switch on page 227. The protection offered by software-based access controls is effective only after the SNMP requests reach the host and does not prevent potential SNMP attacks such as Denial of Service (DoS) attacks.

Disabling SNMP

SNMP is enabled by default.

To disable SNMP, enter the **no snmp server** command in global configuration mode.

```
device(config)# no snmp server

device(config)# show snmp server
Status: Disabled
```

```
Contact:
Location:
```

To re-enable SNMP, enter the **snmp server** command in global configuration mode.

```
device(config)# snmp server

device(config)# show snmp server
Status: Enabled

Contact:
Location:
```

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 (get) and password (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, and log in using the user name "set" and the read-write community string you configured as the password.

You can configure as many additional read-only and read-write community strings as you need. The number of community 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 clear text in the Web Management Interface.

Encryption is enabled by default. You can disable encryption for individual strings or trap receivers if desired.

Adding an SNMP Community String

A community string is encrypted by default. You can assign an SNMP community string and indicate whether the string is encrypted.

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.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Add an encrypted community string and save the configuration.

   ```
   device(config)# snmp-server community private
   device(config)# write memory
   ```

   In the example, you must enter the community string "private" to gain SNMP access.

3. Configure the access privileges for the community string from one of the following options:
   - Read-only (ro) access
   - Read-write (rw) access

   ```
   device(config)# snmp-server community private ro

   device(config)# snmp-server community private rw
   ```

4. Set the encryption option for the community string from one of following options:
   - 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 files. 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.

   ```
   device(config)# snmp-server community 0 private rw
   device(config)# write memory
   ```

   In the example, the community string "private" is added in the clear, which means that the string is displayed in the clear.
5. (Optional) Associate a view to the members of the community string.

   ```
   device(config)# snmp-server community private ro view sysview
   ```

   The view that you want must exist before you can associate it to a community string. In the example, the "sysview" view is associated to the community string "private" and the community string has read-only access to "sysview". If no view is specified, access to the full MIB is granted.

   NOTE
   To make configuration changes, including changes involving SNMP community strings, you must first configure a read-write community string using the CLI. As an alternative, you must configure another authentication method and log in to the CLI using a valid password for that method.

The following example shows how to configure an SNMP community string.

```
device# configure terminal
device(config)# snmp-server community private
device(config)# snmp-server community private ro
device(config)# snmp-server community 0 private ro
device(config)# write memory
device(config)# snmp-s community myread ro view sysview
```

Displaying the SNMP Community Strings

To display the configured community strings, enter the at any CLI level.

```
device# configure terminal
device(config)# enable password-display
device(config)# exit
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
```

NOTE

If display of the strings is encrypted, the strings are not displayed. Encryption is enabled by default.

Suppress SNMP Authentication Failure Timer

Beginning with FastIron release 09.0.00, a new CLI is introduced to avoid the flooding of SNMP authentication failure logging. A timer starts when an SNMP authentication fails. This timer keeps track of all the authentication attempts from the same IPv4 or IPv6 address. A syslog entry then gets generated after a configurable suppress time interval. If there are no matches within the configured time interval, the timer restarts with the next IPv4 or IPv6 address match.

The following syslog message is generated for an SNMP authentication failure.

SYSLOG: <14> Jul 2 08:52:49 SNMP: Auth. failure, intruder IP: 2::1, 1 event(s).

SYSLOG: <14> Jul 2 08:53:50 SNMP: Auth. failure, intruder IP: 10.198.136.154, 5 event(s).

The **snmp-server log-suppress-timer <value>** command is used to configure the suppress-timer. The suppress timer can be configured between 1 to 5 minutes and the default value is five minutes.

When the SNMP log suppress timer is configured, the following syslog message is displayed when the snmp authentication failure happens from the intruder ip.

SYSLOG: <14> Jul 2 08:49:09 SNMP: Auth. failure, intruder IP: 10.198.136.154, 1 event(s).

SYSLOG: <14> Jul 2 08:49:09 SNMP: Auth. Failure, intruder IP: 10.198.136.154, suppression started for threshold timer of <configured time> minutes.

User-based Security Model

SNMP version 3 (SNMPv3) (RFC 2570 through 2575) introduces a User-based Security model (USM) (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 SNMPv3, the User-based Security Model 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

SNMPv3 also supports the View-based Access Control Mechanism (VACM) (RFC 2575) to control access at the PDU level. It defines mechanisms for determining whether access to a managed object in a local MIB by a remote principal should be allowed. For more information, refer to SNMPv3 Configuration Examples on page 226.

Configuring Your NMS

Complete the following steps to use the SNMPv3 features.

1. Make sure that your Network Management System (NMS) supports SNMPv3.
2. Configure your NMS agent with the necessary users.
3. Configure the SNMPv3 features in RUCKUS devices.

Configuring SNMPv3 on RUCKUS Devices

You can create SNMPv3 groups and configure the SNMPv3 users.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Change the default engine ID using the **snmp-server engineid local** command.

   ```
   device(config)# snmp-server engineid local 800007c70300e05290ab60
   ```

   A default engine ID is generated during system startup. Use the **show snmp engineid** command to view the default engine ID.

3. Define an SNMP group using the **snmp-server group** command.

   ```
   device(config)# snmp-server group admin v3 auth read all write all
   ```

   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. The default view is "all", providing access to the entire MIB; however, it must be specified when creating the SNMP group. For more information, refer to "SNMPv3 Configuration Examples".

   In the example, an SNMPv3 group named "admin" is created with read and write access.

4. Define an SNMP user using the **snmp-server user** command.

   ```
   device(config)# snmp-server user bob admin v3 access 2 auth md5 bobmd5 priv des bobdes
   ```

   In the example, an SNMPv3 user named "bob" is configured to be associated with the SNMPv3 group "admin". Here "2" specifies the access list associated with the user with MD5 type of authentication to access SNMP and DES encryption to encrypt the privacy password.

   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, the ACL groups must be configured before configuring user accounts.

The following example shows how to configure SNMPv3 on RUCKUS devices. The SNMP group and SNMP user are configured.

```
device# configure terminal
device(config)# snmp-server engineid local 800007c70300e05290ab60
device(config)# snmp-server group admin v3 auth read all write all
device(config)# snmp-server user bob admin v3 access 2 auth md5 bobmd5 priv des bobdes
```

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.

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.

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*.

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 may 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.

Configuring SNMP Parameters

You can configure SNMP parameters by specifying the SNMP trap receiver and source.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Add the SNMP trap receiver and configure the software to encrypt display of the community string.

```
device(config)# snmp-server host 10.2.2.2 0 mypublic port 200
device(config)# write memory
```

In the example, trap receiver 10.2.2.2 is added and the configuration is saved.

NOTE
To add a trap receiver and configure the software to encrypt display of the community string in the CLI and the Web Management Interface, you can use the following commands:

```
device(config)# snmp-server host 10.2.2.2 0 FastIron-12
device(config)# write memory
```

3. Specify an interface as the SNMP trap source.

```
device(config)# management source-interface ethernet 1/1/1 protocol snmp
device(config)# management source-interface loopback 10.0.1.1 protocol snmp
```

   An Ethernet interface is configured as the SNMP trap source in the first example. A loopback interface is configured as the SNMP trap source in the second example.

4. Set the SNMP trap holddown time.

```
device(config)# snmp-server enable traps holddown-time 30
```

   By default, a RUCKUS device uses a one-minute holddown time to wait for the Layer 2 convergence (STP) and Layer 3 convergence (OSPF) to occur before starting to send SNMP traps. You can change the holddown time to a value from one second through ten minutes.

The following example shows how to configure SNMP parameters.

```
device# configure terminal
device(config)# snmp-server host 10.2.2.2 0 mypublic port 200
device(config)# write memory
device(config)# management source-interface ethernet 1/1/1 protcol snmp
device(config)# snmp-server enable traps holddown-time 30
```

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 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 command.

```
device(config)# no snmp-server enable traps link-down
```

SNMP ifIndex

On RUCKUS ICX 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.

Defining SNMP Views

All MIB objects are automatically excluded from any view unless they are explicitly included.

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.

1. Enter the global configuration mode.

   ```
   device# configure terminal
   ```

2. Add an SNMP view and configure the access level using the **included** or **excluded** keywords.

   ```
   device(config)# snmp-server view Maynes system included
   device(config)# snmp-server view Maynes system.2 excluded
   device(config)# write memory
   ```

   In the example, "Maynes system" is included in the SNMP view and "Maynes system.2" is excluded from the SNMP view. You can also exclude views that are within the scope of inclusion.

The following example shows how to configure an SNMP view.

```
device# configure terminal
device(config)# snmp-server view Maynes system included
device(config)# snmp-server view Maynes system.2 excluded
device(config)# write memory
```

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.

Configuring SNMP Version 3 Trap Notifications

You can configure SNMP views to receive SNMP trap notifications and the UDP port to receive SNMP traps.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Define an SNMP group and specify the view for trap notification.

```
device(config)# snmp-server group admin v3 auth read all write all
notify all
```

3. Define the UDP port for SNMPv3 traps.

```
device(config)# snmp-server host 192.168.4.11 version v3 auth security-name port 1/1/4
```

   In the example, the UDP port 1/1/4 on the host 192.168.4.11 receives the traps and only authenticated packets are allowed to access the specified view with password authentication.

The following example shows how to configure SNMPv3 traps.

```
device# configure terminal
device(config)# snmp-server group admin v3 auth read all write all
notify all
device(config)# snmp-server host 192.168.4.11 version v3 auth security-name port 1/1/4
```

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 48 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-address** 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)
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 IPv6 SNMP Parameters

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.

You can restrict SNMP access so that the RUCKUS device can be accessed only by the IPv6 host address that you specify.

The following example shows how to configure an IPv6 host as an SNMP trap receiver and to restrict SNMP access to an IPv6 host address.

```
device# configure terminal
device(config)# snmp-server host ipv6 2001:DB8:89::13 mypublic port 200
device(config)# write memory
device(config)# management source-interface ethernet 1/2/1 protocol snmp
device(config)# snmp-server enable traps holddown-time 40
```

The following RUCKUS ICX devices support IPv6 for SNMPv3: ICX 7150, ICX 7250, ICX 7450, ICX 7550, ICX 7650, and ICX 7850.

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

You can display SNMP-related information using the various **show** commands.

> **NOTE**
> When the SNMP server is disabled, the **show snmp** commands display the following message: "SNMP is disabled. Please enable snmp to run **show snmp** commands."

The following example displays the engine ID of a management module.

```
device# show snmp engineid

Local SNMP Engine ID: 800007c70300e05290ab60
Engine Boots: 3
Engine time: 5
```

The following example displays the definition of an SNMP group.

```
device# show snmp group
groupname = exceptifgrp
security model = v3
security level = authNoPriv
ACL id = 0
IPv6 ACL name: ipv6acl
readview = exceptif
writeview =
none
```

The following example displays the definition of an SNMP user account.

```
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
```

Interpreting Varbinds in Report Packets

If an SNMPv3 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.

TABLE 49 Varbinds Supported by an SNMP Agent

Varbind Object Identifier	Description
1. 3. 6. 1. 6. 3. 11. 2. 1. 3. 0	Unknown packet data unit.
1. 3. 6. 1. 6. 3. 12. 1. 5. 0	The value of the varbind shows the engine ID that must be used in the **snmp-server engineid** command.
1. 3. 6. 1. 6. 3. 15. 1. 1. 1. 0	Unsupported security level.

TABLE 49 Varbinds Supported by an SNMP Agent (continued)

Varbind Object Identifier	Description
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 is the correct authoritative engine ID 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.

SNMPv3 Configuration Examples

The following examples present samples of SNMPv3 configurations.

SNMP Group, SNMP User, and SNMP Trap Receiver Configuration

The following example shows how to configure an SNMP group, an SNMP, and an SNMP trap receiver.

```
device(config)# snmp-server group admingrp v3 priv read all write all notify all
device(config)# snmp-server user adminuser admingrp v3 auth md5
auth password
 priv
privacy password
device(config)# snmp-server host
dest-ip
 version v3 privacy adminuser
```

SNMP Configuration with Various Parameters

The following example shows how to configure SNMP with various parameters.

```
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
```

Remote Access to the Switch

Remote Access Overview

By default, management access is disabled and must be specifically enabled.

RUCKUS ICX devices support the following remote access methods:

- RESTCONF
- SSH
- SNMP
- Telnet
- Web

Any combination of methods can be enabled. By default, once a management access protocol is enabled, protocol access is unrestricted.

NOTE
Access control lists (ACLs) can no longer be applied to any of the management protocols. Instead, use the **management access** command to define and apply access control to incoming traffic from these protocols.

The following sections explain how to enable and configure management access for the methods available.

NOTE
For information on configuring access through local user accounts, refer to "Managing User Accounts" in the *RUCKUS FastIron Security Configuration Guide*.

Configuring Remote Access Using Telnet

Telnet can be used to remotely access the CLI of an ICX switch. You can configure connection parameters such as idle timeouts and Telnet access restrictions based on IP and MAC addresses to secure access to the device.

Telnet support is disabled by default. The following Telnet configuration options are also disabled by default:

- Restriction of Telnet access: Telnet access to the device can be restricted based on the source IP address or MAC address or a combination of IP addresses and MAC addresses.
- Configuration of the number of login attempts before a user is locked out.
- CLI timeout: The number of minutes a Telnet session (or an SSH session) can remain idle before it is timed out. An idle Telnet session is still sending TCP ACKs in response to keepalive messages from the device but is not being used to send data. When the **cli timeout** command is configured with a value of 0, no timeout occurs, and the session remains up.

NOTE
RUCKUS ICX switches support fiveinbound Telnet sessions and five outbound Telnet sessions.

There is no Telnet-specific username and password. AAA authentication is used to secure Telnet access to the device.

Perform the following steps to enable Telnet, configure Telnet session parameters, and restrict Telnet access to a device.

1. Enter global configuration mode.

```
device# configure terminal
```

2. If Telnet is disabled, enable Telnet.

```
device(config)# telnet server enable
```

3. Configure the CLI idle time.

```
device(config)# cli timeout 120
```

The timeout for an inactive CLI session is set to 120 minutes. After 120 minutes of inactivity, the session is disconnected.

4. Restrict Telnet access to the device based on the source IP address or MAC address.

```
device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow telnet
device(config)# management access mac 00:00:00:0f:e9:a0 allow telnet
```

Telnet Configuration and Restriction of Telnet Access

The following example enables Telnet and sets the idle timeout and number of login retries. It also permits Telnet access to three specific IP addresses and denies Telnet (and other protocol) access to MAC address CC:4E:24:D0:8B:81.

```
device# configure terminal
device(config)# telnet server
device(config)# cli timeout 120
device(config)# management access scr-ip 11.10.10.1/32 deny all
device(config)# management access mac CC:4E:24:D0:8B:81 deny all
device(config)# management access src-ip 10.10.10.0 255.255.255.0 src-ip 1.1.1.1 255.255.255.255 mac CC:4E:
24:D0:8B:81 allow telnet ssh
```

Disabling Telnet

The following example shows how to disable Telnet support.

```
device# configure terminal
device(config)# no telnet server enable
```

Displaying the Telnet Connections and Status

The following **show telnet** command output displays the Telnet connections and status.

```
device# show telnet
Telnet server status: Enabled
Telnet connections:
device#
```

Remote Access Using SSH

Remote access to RUCKUS ICX devices can be enabled for SSH. Further configuration options for SSH users are available.

You can allow and restrict access to management functions from SSH. The following remote access methods are supported:

- Allowing SSH access only from specific IPv4 or IPv6 addresses.
- Allowing SSH access only from specific MAC addresses.
- Allowing remote access only to clients connected to a specific VLAN.

By default, there are no restrictions on access for SSH.

NOTE
RUCKUS ICX switches support five inbound SSH sessions and five outbound SSH sessions.

Configuring SSH

To allow SSHv2 access to a RUCKUS ICX device, you must generate a crypto key. Refer to the **crypto key generate** command in the *RUCKUS FastIron Command Reference* and to "Managing User Accounts" in the *RUCKUS FastIron Security Configuration Guide*.

Complete the following task to configure access control for SSH and allow SSH packets from a specified IPv4 address.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter the **management access** command, using the **src-ip** keyword and specifying an IP address, and the **allow** and **ssh** keywords.

```
device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow ssh
```

A source IPv4 address and subnet mask are specified. The allow action is applied to SSH packets.

The following example allows access to SSH packets (as well as Telnet) from a specified IPv4 address and network mask.

```
device# configure terminal
device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow telnet ssh
```

The following example denies management access permissions to SSH packets from a specified IPv4 address and network mask.

```
device(config)# management access src-ip 10.10.10.1 255.255.255.255 deny ssh
```

Remote Access Using SNMP

For detailed information on configuring and using Simple Network Management Protocol (SNMP), refer to SNMP on page 213.

Configuring Remote Access for SNMP

To enable SNMP and configure remote access using SNMP, perform the following steps.

NOTE
For additional information on controlling management access, refer to Restricting Remote Access Using IP Addresses or MAC Addresses on page 232.

1. Enter global configuration mode.

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

2. If necessary, enable SNMP access.

```
device(config)# snmp-server
```

3. Enter the **management access** command with appropriate parameters to configure SNMP remote access. On the same line, define the IPv4, IPv6, or MAC source address or a set of source addresses, an **allow** or **deny** action, and the protocol or protocols to which the **allow** or **deny** action applies when traffic is received from the specified address or set of addresses.
4. (Optional) Configure additional **management access** command lines if needed.

The following example enables SNMP and configures a MAC address as an allowed source address for SNMP traffic.

```
device# configure terminal
device(config)# snmp-server
device(config)# management access mac CC:4E:24:D0:8B:81 allow snmp
```

The following example drops SNMP traffic received from the specified set of IPv4 addresses.

```
device(config)# management access src-ip 10.10.10.0 255.255.255.0 deny snmp
```

Remote Web Management Access

RUCKUS ICX devices can be accessed and managed remotely through the 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. Web management access is allowed through HTTP or HTTPS. Web management access over HTTPS is enabled by default. You can also regulate access to management functions from the web management interface based on the IPv4 address, IPv6 address, and MAC address of the client.

NOTE
Web management HTTP configuration in pre-09.0.00 image will be disabled on upgrade to FastIron release 09.0.00, and web management access over HTTPS will be enabled by default.

Configuring Web Access

Perform the following steps to enable web access over HTTP, configure web session parameters, and restrict web access to a device.

1. Enter global configuration mode.

```
device# configure terminal
```

2. (Optional) Enable web management for HTTP access.

   ```
   device(config)# web-management http
   ```

   For TPM-enabled devices, TPM certificates are available by default to establish encrypted communication between the server and client. You can also import a digital certificate issued by a third-party using the **copy tftp flash 192.168.9.210 certfile certificate-data-file** command. ICX devices that are not TPM-capable, for example, legacy devices deployed to the field, may use an auto-generated non-TPM certificate. Non-TPM certificates are stored on the device in flash memory.

   Once a valid certificate is present, it remains available, unless the user erases the startup configuration or uses a command to zeroize (clear) the certificate.

   When no certificate is present, the RUCKUS ICX device is unable to use applications that require a certificate.

   When more than one certificate is stored in the RUCKUS ICX device, the device selects the certificate for use based on the following order of priority:

   a. User-imported (SSL) certificate
   b. TPM certificate
   c. Non-TPM (auto-generated legacy) certificate

   For more information on SSL certificates, refer to the *RUCKUS FastIron Security Configuration Guide*.

3. Restrict web access to the device based on the source IP address, IPv6 address, MAC address, or a combination of addresses of the clients.

   By default, there are no web access restrictions. You can control web access by allowing or denying HTTP and HTTPS traffic from the specified IP address or MAC address.

   ```
   device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow web

   device(config)# management access mac 0000.000f.e9a0 deny web
   ```

4. Configure the wait time interval after getting disconnected from the application.

   ```
   device(config)# connection-receive-timeout 3
   ```

5. Configure the duration for which the web session can remain idle before it is disconnected.

   ```
   device(config)# session-timeout 300
   ```

6. Configure the port number for the web service.

   ```
   device(config)# tcp-port 80
   ```

7. View the web login details.

   ```
   device# show web
   HTTP server status: Enabled
   HTTPS server status: Enabled

   Web session management:
   User    Privilege     IP address     Timeout(secs) CONNECTION
   admin   READ-WRITE    172.26.78.58    300           HTTP
   admin   READ-WRITE    10.198.138.97   300           HTTPS
   ```

Web Access Configuration

The following example enables web management for HTTP access. It also permits web access to a specific IP address and denies access to a MAC address.

```
device# configure terminal
device(config)# web-management http
device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow web
device(config)# management access mac 0000.000f.e9a0 deny web
```

Disable Web Access

The following example disables web access.

```
device# configure terminal
device(config)# no web-management
```

Remote Access Using RESTCONF

RESTCONF can be used to manage RUCKUS ICX devices. Refer to the *RUCKUS FastIron RESTCONF Programmers Guide* for more information.

Restricting Remote Access Using IP Addresses or MAC Addresses

You can specify which management protocols are allowed access to the switch using specific IP addresses or MAC addresses.

The following management protocols can be allowed or denied access to an ICX switch based on IPv4, IPv6, or MAC source addresses:

- SNMP
- SSH
- Telnet
- Web (HTTP)

You can use the **management access** command to restrict access for one or more protocols to a specified source address or set of source addresses. As an option, you can also specify that matching traffic generate a syslog entry.

Perform the following steps to configure address-based access control for management protocols.

1. Enter global configuration mode.

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

2. Enter the **management access** command followed by the keyword for the type of source address:
   - Enter **src-ip** for an IPv4 source address.
   - Enter **src-ip6** for an IPv6 source address.
   - Enter **mac** for a source MAC address.

3. Following the source address keyword, enter the source address.

   NOTE
   You can enter a series of source addresses of the same or different types on the same command line.

   NOTE
   Use a subnet mask for an IPv4 address in the format A.B.C.D xxxx.xxxx.xxxx (for example, **src-ip** 10.10.10.1 255.255.255.255, or 10.10.10.1/32).

4. On the same line, specify whether to **allow** or **deny** traffic for the source address or addresses, and designate the management protocol or protocols to which the action applies.

   NOTE
   You can apply the same action to more than one protocol.

   - **snmp**: Apply the action to SNMP packets.
   - **ssh**: Apply the action to SSH packets.
   - **telnet**: Apply the action to Telnet packets.
   - **web**: Apply the action to HTTP packets.
   - **all**: Apply the action to all the management protocols in this list.

5. (Optional) On the same line, enter the keyword **log** to generate a syslog entry for traffic that matches the management access statement.
6. (Optional) Enter the **show management access** command to display the management access controls applied to the ICX switch.

```
device# show management access
src-ip 10.10.10.0/255.255.255.0 src-ip 1.1.1.1/255.255.255.255 mac CC:4E:24:D0:8B:81 allow telnet ssh
mac CC:4E:24:D0:8B:81 allow snmp
```

The following example allows access to Telnet and SSH packets from the specified IPv4 address.

```
device# configure terminal
device(config)# management access src-ip 10.10.10.1 255.255.255.255 allow telnet ssh
```

The following example drops all management traffic (Telnet, SSH, SNMP, HTTP) from the specified MAC address.

```
device(config)# management access mac CC:4E:24:D0:8B:81 deny all
```

The following example configures management access permissions for two groups of source IPv4 addresses and a MAC address. Management access is allowed for Telnet and SSH packets.

```
device(config)# management access src-ip 10.10.10.0 255.255.255.0 src-ip 1.1.1.1 255.255.255.255 mac CC:4E:
24:D0:8B:81 allow telnet ssh
```

The following example removes management access permissions for the group of IPv4 addresses specified.

```
device(config)# no management access src-ip 10.10.10.1 255.255.255.255 allow telnet ssh
```

Restricting Remote Access to the Device to Specific VLAN IDs

You can restrict management access to a RUCKUS device to ports within a specific port-based VLAN. VLAN-based access control applies to the following access methods:

- Telnet access

- SNMP access

By default, access is allowed for these methods on all ports. Once you configure security for a given access method based on VLAN ID, access to the device using that method is restricted to only the ports within the specified VLAN.

VLAN-based access control works in conjunction with other access control methods. For example, if you configure Telnet access only to specific client IP addresses, and you also configure VLAN-based access control for Telnet, the only Telnet clients that can access the device are clients that have IP addresses or MAC addresses permitted by the **management access** command and are connected to a port that is in a permitted VLAN. Clients that have a permitted IP address or MAC address but are connected to a port in a VLAN that is not permitted still cannot access the device through Telnet.

Using a Specific VLAN to Restrict Remote Access

Remote access to RUCKUS ICX devices can be controlled using a specific VLAN ID.

Complete the following steps to restrict remote management access. All steps are optional. You can configure different types of access in any order.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Restrict Telnet access to clients in a specific VLAN.

   ```
   device(config)# telnet server enable vlan 10
   ```

   This command allows Telnet access to the device only to clients connected to ports within port-based VLAN 10.

3. Restrict SNMP access to clients in a specific VLAN.

   ```
   device(config)# snmp-server enable vlan 40
   ```

   This command allows SNMP access to the device only to clients connected to ports within port-based VLAN 40.

   NOTE
   You can also configure SNMP access for a specific Ethernet port or range of ports. Refer to the *RUCKUS FastIron Command Reference* for more information on the **snmp-server enable** command.

Managing ICX Switches from SmartZone

Supported ICX Models

The following ICX switch models can be managed from SmartZone:

- ICX 7150
- ICX 7250
- ICX 7450
- ICX 7550
- ICX 7650
- ICX 7850

The following table defines ICX and SmartZone release compatibility.

NOTE
ICX switches with FIPS mode enabled do not support management by SmartZone.

NOTE
FastIron 09.0.10a and later releases support management by SmartZone 6.1 and above.

TABLE 50 ICX and SmartZone Release Compatibility Matrix

	SmartZone 5.0[13]	SmartZone 5.1[13]	SmartZone 5.1.1	SmartZone 5.1.2	SmartZone 5.2	SmartZone5.2.1	SmartZone 6.0	SmartZone 6.1
FastIron 08.0.80	Yes	Yes	Yes[13]	No	No	No	No	No
FastIron 08.0.90a	No	No	Yes	Yes	Yes	Yes	Yes	No
FastIron 08.0.91	No	No	Yes	Yes	Yes	No	No	No

[13] Does not support ICX configuration.

TABLE 50 ICX and SmartZone Release Compatibility Matrix (continued)

	SmartZone 5.0[13]	SmartZone 5.1[13]	SmartZone 5.1.1	SmartZone 5.1.2	SmartZone 5.2	SmartZone5.2.1	SmartZone 6.0	SmartZone 6.1
FastIron 08.0.92	No	No	No	Yes	Yes	Yes	Yes	Yes
FastIron 08.0.95	No	No	No	No	No	Yes	Yes	Yes
FastIron 08.0.95a	No	No	No	No	No	Yes	Yes	Yes
FastIron 08.0.95b	No	No	No	No	No	Yes	Yes	Yes
FastIron 08.0.95c	No	No	No	No	Yes	Yes	Yes	Yes
FastIron 09.0.10a	No	No	No	No	No	No	No	Yes

The following table provides details on switch management feature compatibility between ICX and SmartZone releases.

TABLE 51 Switch Management Feature Compatibility Matrix

Feature	SmartZone Release	ICX FastIron Release
Switch Registration	5.0 and later	08.0.80 and later
Switch Inventory	5.0 and later	08.0.80 and later
Switch Health and Performance Monitoring	5.0 and later	08.0.80 and later
Switch Firmware Upgrade	5.0 and later	08.0.80 and later
Switch Configuration File Backup and Restore	5.0 and later	08.0.80 and later
Client Troubleshooting: Search by Client MAC Address	5.1 and later	08.0.80 and later
Remote Ping and Traceroute	5.1 and later	08.0.80 and later
Switch Custom Events	5.1 and later	08.0.80 and later
Remote CLI Change	5.2.1 and later	08.0.90 and later
Switch Configuration: Zero-Touch Provisioning	5.1.1 and later	08.0.90a and later
Switch-specific Settings: Hostname, Jumbo Mode, IGMP Snooping, and DHCP Server	5.1.1 and later	08.0.90a and later
Switch Port Configuration	5.1.1 and later	08.0.90a and later
Switch AAA Configuration	5.1.1 and later	08.0.90a and later
Switch Client Visibility	5.1.2 and later	08.0.90a and later
Manage Switches from Default Group in SZ-100/vSZ-E	5.1.2 and later	08.0.90a and later
Download Syslogs for a Selected Switch[14]	5.2.1 and later	08.0.91 and later
Switch Topology	5.2 and later	08.0.92 and later
Designate a VLAN as Management VLAN	5.2.1 and later	08.0.95 and later
Change Default VLAN	5.2.1 and later	08.0.95 and later

[13] Does not support ICX configuration.
[14] To download system logs from SmartZone for a particular ICX switch, TFTP must be enabled.

TABLE 51 Switch Management Feature Compatibility Matrix (continued)

Feature	SmartZone Release	ICX FastIron Release
Configure the PoE Budget per Port on ICX through the Controller GUI with 1W Granularity	5.2.1 and later	08.0.95 and later
Configuring Protected Ports	5.2.1 and later	08.0.95 and later
Configuring QoS	5.2.1 and later	08.0.95 and later
Configuring Syslog	5.2.1 and later	08.0.95 and later
Geo Redundancy Active-Standby Mode	6.0 and later	08.0.95b and later
Generic CLI Configuration	6.0 and later	08.0.95b and later
DNS-based SmartZone Discovery	5.1.2 and later	08.0.95c and later
Storm Control Configuration	6.1 and later	08.0.95 and later
IPv6 Support (connection through static configuration only)	6.1 and later	09.0.10a and later
Save Boot Preference	6.1 and later	09.0.10a and later
Virtual Cable Testing	6.1 and later	09.0.10a and later
Blink LEDs	6.1 and later	09.0.10a and later
Flexible Authentication Configuration	6.1 and later	09.0.10a and later

Overview of ICX Switch Management

Beginning with SmartZone 5.0, the SmartZone administrator can monitor and manage switches and routers in the ICX 7000 series. SmartZone 5.1.1 introduced the capability to configure switches.

SmartZone ICX-Management supports the following ICX switch activities:

- Registration and authentication
- Switch inventory (for example, model, firmware version, and last backup)
- Health and performance monitoring (for example, status, traffic statistics, errors, and clients) with alarms
- Zero-touch provisioning
- Configuration changes
- Port settings
- Configuration copy
- Configuration file backup and restore
- Firmware upgrade
- Client troubleshooting
- Remote Ping and Traceroute

NOTE
Refer to the Supported ICX Models on page 235 for more details.

Preparing ICX Devices to be Managed by SmartZone

ICX devices running either router or switch images can be managed by SmartZone. The following items are required to manage ICX devices:

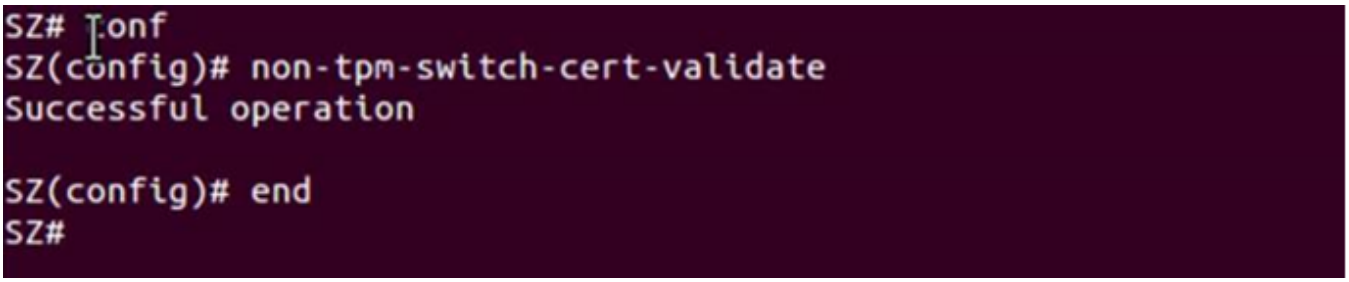
NOTE
Refer to the Supported ICX Models on page 235 for detailed information on software compatibility requirements and feature availability.

- The SmartZone IP address must be reachable by the ICX device through the Management interface or through switch or router interfaces.
- The ICX device must be made aware of the configured SmartZone IP address in one of the following ways:
  - Configure the DHCP server to use DHCP option 43.
  - Issue the following command at the global configuration level:

    ```
    ICX(conf)# manager active-list SmartZone_Control_IP_Address
    ```

  - Add an entry in the DNS server with the hostname ruckuscontroller or ruckuscontroller.*local domain* that points to the SmartZone IP address.
- On some ICX 7250 and ICX 7450 devices, self-signed certificates are used. SmartZone honors these certificates when the **non-tpm-switch-cert-validate** command is entered on the SmartZone console, as shown in the following example.

FIGURE 21 Command Required to Disable Certificate Check



NOTE
ICX 7150, ICX 7650, and ICX 7850 devices are shipped with embedded certificates that are used for authentication with SmartZone.

- When SmartZone or ICX devices are behind network address translation (NAT), be sure to forward TCP ports 443 and 22 through NAT.
- Virtual platform requirements for supporting ICX devices are listed in the following table.

NOTE
Each unit in a stack is considered a separate switch unit for capacity management purposes.

TABLE 52 Virtual Platform Requirements for Supporting ICX Devices

Platform	Maximum Number of Switches Per Node	RAM	vCPU	Disk Storage
vSZ-E	200	18 GB	4	100 GB
vSZ-H	2000	30 GB	12	300 GB

The scaling limits in the table apply to switch-only deployments. For a mix of APs and switches, the scaling limits vary accordingly. SmartZone supports a 5-to-1 AP-to-switch ratio.

vSZ-E Example: vSZ-E supports up to 1,000 APs on a single node. If 200 APs are currently managed by SmartZone, there is room for 800 more APs or 160 ICX switches (800 divided by 5).

vSZ-H Example: vSZ-H supports up to 2,000 ICX switches on a single node. If 500 switches are currently managed, there is room for 1,500 more switches, or 7,500 APs (1500 multiplied by 5).

ICX Switch Behavior with SmartZone

NOTE
The full range of ICX-Management capabilities (including configuration support in SmartZone 5.1.1 or later) is available only when ICX devices have been upgraded to FastIron 08.0.90a or later using a Unified Forwarding Image (UFI). Beginning with FastIron 08.0.90, RUCKUS ICX devices support unified images that require custom upgrades from prior releases. Any ICX switch that is running a FastIron 08.0.80 non-UFI image on the ICX switch must follow a two-step image upgrade process to FastIron 08.0.90a through SmartZone controller image updates. If an ICX switch from the factory has a FastIron 08.0.80 non-UFI image, it must first be upgraded with a FastIron 08.0.90 UFI, followed by a FastIron 08.0.90a UFI, to avoid any boot configuration issues. Refer to the *RUCKUS FastIron Software Upgrade Guide* for more information.

NOTE
Campus Fabric (SPX) is not compatible with SmartZone. When SPX is enabled using the **spx cb-enable** command, SmartZone is disabled automatically. The following messages and syslog entry are displayed.

```
Console message
===============
Disabling SZ since SPX is enabled...
SZ Disable Initiated...
SZ Connection would be disconnected now if connected...

Syslog
=======
Aug  4 00:57:14:W:SZ:Disabling SZ, because SZ is not supported in SPX
```

If SPX is enabled on an ICX device and you try to enable SmartZone using the **no manager disable** command, the following warning message is displayed.

```
ICX(config)# no manager disable
SZ configuration is not allowed in SPX enabled setup. Please disable SPX to enable SZ
When ICX is managed through SZ, if 'spx cb-enable' is configured, SZ will be disconnected from ICX.
```

When an ICX switch is managed by SmartZone, the following considerations apply:

- All local configuration methods continue to be available to the local administrator, which means the switch can be configured through the console, Telnet, SSH, SNMP, or the web.
- It is recommended that the ICX switch be configured with the same NTP server as SmartZone.
- In an ICX stack, if a stack switchover or failover occurs, the original connection to SmartZone is closed, and the new active switch initiates a connection with SmartZone.

Enabling an ICX Device to Be Managed by SmartZone

There are several ways to make an ICX device aware of the SmartZone IP address:

- Use switch registrar discovery.
- Use DHCP option 43.
- Configure the ICX device manually using FastIron commands.

All of these methods are supported for new ICX switches with no configuration as well as for ICX switches with existing configuration.

Configuring the ICX Source Address to Be Used by SmartZone

By default, the IP address of the management port is included in the manager query as the ICX source address for an ICX-Management connection. Use the **management source-interface protocol manager** command to specify a different ICX source address.

> **NOTE**
> Only ICX devices with a router image support the **management source-interface protocol manager** command.

The **management source-interface protocol manager** command can specify an Ethernet, LAG, loopback, or virtual Ethernet (VE) interface. The IP address with the lowest number for the specified interface is used for the connection.

The following example configures an Ethernet port as the ICX source address for an ICX-Management connection.

```
ICX# configure terminal
ICX(config)# management source-interface ethernet 1/1/3 protocol manager
```

Refer to the *RUCKUS FastIron Command Reference* for more information.

Configuring a Custom Port Number for Connection to SmartZone

By default, ICX switches use TCP destination port 22 to connect with SmartZone. Use the **manager ssh-port** command to configure a different port number for connecting with SmartZone.

The following example configures an ICX switch to connect to SmartZone over SSH port 25. A warning message is displayed as shown if a session is already established. You must confirm the configuration update when prompted before the new connection is established. Check configuration status with the **show manager status** command.

```
device# configure terminal
device(config)# manager ssh-port
  DECIMAL   Enter a decimal value (Default 22)
device(config)# manager ssh-port 25

device(config)# manager ssh-port 25  <-- Warning message -->
Current session if established will be dropped to establish a new session with port 25.
Are you sure? (enter 'y' or 'n'): y  <-- You must confirm the configuration.
!
!
device(config)# exit

device# show manager status

============    MGMT Agent State Info     ===================

Config Status:Enabled Operation Status:Enabled
State:SSH CONNECTED     Prev State:SSH CONNECTING       Event:SZ_SSH_CONNECT_EVENT

SWR List                : None
DNS List                :
Active List             : 10.176.160.115
Active List IPV6        : None
DHCP Option 43          : No
DHCP Opt 43 List        : None
Backup List             : None
Backup List IPV6        : None
Merged List             : 10.176.160.115

SZ IP Used              : 10.176.160.115
```

```
Port List               : 987
Server Port Used        : 443
Query Status            : APPROVED

SSH Tunnel Status -:
Tunnel Status           : Established
SSH Port                : 25          <-- configuration confirmed
CLI IP/Port             : 127.255.255.253/22866
SNMP IP/Port            : 127.255.255.254/63989
Syslog IP/Port          : 127.0.0.1/20514
HTTP CLIENT IP/Port     : 127.0.0.1/5080
HTTP SERVER IP/Port     : 127.255.255.252/40042
Timer Status            : Not Running
```

NOTE

If you configure a custom port on an ICX switch, the SmartZone controller settings must also be updated. Refer to the appropriate version of the RUCKUS SmartZone administration guide for details.

Setting Up Switch Registrar Discovery

The switch registrar is a RUCKUS-hosted cloud service that enables SmartZone discovery from ICX devices.

You can configure the ICX device to retrieve the correct SmartZone management IP address, IP address set, or fully qualified domain name (FQDN) from the switch registrar. The switch registrar must be set up in advance through Managed Service Provider (MSP) with SmartZone IP addresses or an FQDN and the ICX serial numbers they can manage.

NOTE

If SmartZone management is not enabled on the ICX device, switch registrar discovery does not occur.

How Switch Registrar Discovery Works

The ICX device sends an HTTP GET message to a default server host, sw-registrar.ruckuswireless.com, for the list of SmartZone management IP addresses or an FQDN, unless the system administrator configures an alternate host. The SmartZone IP address or FQDN obtained in response to the GET message is used to query the SmartZone device to set up a connection. If the ICX device receives a set of IP addresses from the switch registrar, it stores the information and tries the addresses in turn until a successful connection is established with the SmartZone device. The IP address, set of IP addresses, or FQDN obtained through the switch registrar is given priority above all other addresses in the list of SmartZone IP addresses, including addresses received from other sources such as the DHCP list, the active list, and the backup list. Once the ICX device has obtained a SmartZone IP address from the switch registrar, it no longer attempts switch registrar discovery.

This query is performed only for greenfield deployments and when the ICX device boots up with no startup configuration. ICX switches being upgraded from older releases that already have a configuration in place will not have the registrar-based SmartZone discovery turned on. The HTTPS session used for the database query uses the device certificate installed on the switch for SSL session establishment. For the initial release of the switch registrar, no server certificate validation will be performed.

Disabling or Enabling Switch Registrar Discovery

The system administrator can disable or enable switch registrar discovery from the command line.

NOTE

The registrar IP list is removed when you disable the switch registrar.

To disable switch registrar discovery, enter the **no manager registrar** command in global configuration mode, and use the **write memory** command to save the change, as shown in the following example.

```
ICX# configure terminal
ICX(config)# no manager registrar
ICX(config)# write memory
```

To restart the switch registrar discovery process, use one of the following commands at the privileged EXEC level:

- **manager registrar-query-restart**
- **manager reset**

To enable switch registrar discovery on an alternate registrar host server and save the entry to the startup configuration, enter the following commands.

```
ICX# configure terminal
ICX(config)# manager registrar sw-alternate.ruckuswireless.com
ICX(config)# write memory
```

NOTE
The **manager registrar** *hostname* command is for test purposes only. The **manager registrar-query-restart** command by itself is sufficient to initiate registrar-based SmartZone discovery.

Confirming Successful Switch Registrar Discovery

To display log entries specific to registrar queries, use the **show manager log** command.

When the switch registrar database has been successfully queried, a syslog message similar to the following is displayed.

```
Aug 8 21:47:17:I:MGMT Agent: SZ Switch Registrar Query to 54.186.143.194 Success
```

When the ICX device requires a restart to connect to the SmartZone address because a new registrar list has been received, a syslog message similar to the following is displayed.

```
Aug 8 21:47:17:I:MGMT Agent: Disconnect to SZ: 54.16.143.194, Got SZ ip via registrar
```

You can use the **show running-config** command to check for the name of the registrar host and the registrar list of SmartZone IP addresses.

The following example indicates that the ICX device uses the default switch registrar host and has obtained one SmartZone IP address (of a possible set of two addresses).

```
ICX# show running-config
!
!
manager registrar
manager registrar-list 23.251.150.119
!
!
```

You can also enter the **show manager status** command to obtain information on the switch registrar, as shown in the following example.

```
ICX# show manager status

============    MGMT Agent State Info     ===================

Config Status:Enabled Operation Status:Enabled
State:SSH CONNECTED  Prev State:SSH CONNECTING             Event:SZ_SSH_CONNECT_EVENT

SWR List                          : None
DNS List                :
Active List             : 10.176.160.116
Active List IPV6        : 2620:107:90d0:ab40::116
DHCP Option 43          : No
DHCP Opt 43 List        : None
```

```
Backup List             : None
Backup List IPV6        : None
Merged List             : 2620:107:90d0:ab40::116 10.176.160.116

SZ IP Used              : 2620:107:90d0:ab40::116
Port List               : 987
Server Port Used        : 443
Query Status            : APPROVED

SSH Tunnel Status -:
Tunnel Status           : Established
CLI IP/Port             : 127.255.255.253/59449
SNMP IP/Port            : 127.255.255.254/8253
Syslog IP/Port          : 127.0.0.1/20514
HTTP CLIENT IP/Port     : 127.0.0.1/5080
HTTP SERVER IP/Port     : 127.255.255.252/63098
Timer Status            : Not Running
```

Troubleshooting Switch Registrar Discovery

In the event that switch registrar discovery fails, check for the following conditions:

- The running configuration contains "manager disable".
- The switch registrar is not configured on the ICX device.
- The DNS configuration needed to resolve the switch registrar address is not present on the ICX device.
- The ICX device could not reach the switch registrar due to routing issues.

NOTE
If the switch registrar is enabled and you enter the **no manager disable** command, switch registrar discovery is still started when the registrar IP list is empty.

NOTE
The switch registrar discovery process continues to run until the configuration issues are fixed, a successful query result is obtained, or you enter a command to disable the switch registrar.

Preparing Stacking Devices to Connect to SmartZone

Consider the following guidelines when preparing ICX stacking devices to be discovered and managed by SmartZone:

- Define the stack configuration on the SmartZone device before connecting cables between the SmartZone and ICX devices.
- The devices to be managed in the stack must be part of a "firmware version" switch group configured on the SmartZone device.

If only the ICX device intended to be the stack active controller is an active switch under SmartZone control and is part of a configured "firmware version" switch group, perform the following steps to establish a stack:

- Connect all cables between ICX devices to form the desired stack configuration.
- On the active controller, enter the following commands in privileged EXEC mode:
  - **stack enable** (enables stacking on the active controller)
  - **stack zero-touch-enable** (triggers automatic discovery of the stack units and connections)
  - **write memory** (saves the running configuration to startup flash)

  No commands need to be entered on the other stack units in this case.

If all switches intended to be members of a stack have already joined and have been approved by SmartZone and are already part of a "firmware version" switch group, enter the following commands on the ICX devices to form a stack:

- On the active controller, enter the following commands in privileged EXEC mode:
  - **stack enable** (enables stacking on the active controller)
  - **stack zero-touch-enable** (triggers automatic discovery of the stack units and connections)
  - **write memory** (saves the running configuration to startup flash)
- On all other prospective stack members, configure the following commands in global configuration mode:
  - **stack suggested-id**
  - **stack ztp-force**
  - **write memory**

Configuring DHCP to Provide SmartZone IP Addresses to an ICX Switch

A DHCP server can be configured to send SmartZone IP addresses to ICX devices using DHCP Option 43.

Configure DHCP Option 43 on the DHCP server, using **RKUS.scg-address** to identify the SmartZone IP addresses.

A single SmartZone IP address or a comma-separated list can be configured. SmartZone IP addresses are sent with a sub-option value of 6. The ICX device ignores all other data in DHCP Option 43 if SmartZone IP addresses are present.

The following example shows a DHCP Option 43 configuration on a DHCP server. The IP addresses listed are examples only.

```
subnet 192.168.12.0 netmask 255.255.255.0 {
   range  192.168.12.100 192.168.12.199;
   option routers 192.168.12.1;
   option subnet-mask 255.255.255.0;
   option broadcast-address 192.168.12.255;
   option ntp-servers 192.168.11.22;
   class "Ruckus AP" {
      match if option vendor-class-identifier = "Ruckus CPE";
      option vendor-class-identifier "Ruckus CPE";
      default-lease-time 86400;
      vendor-option-space RKUS;
      option RKUS.scg-address "192.168.11.200, 192.168.11.201, 192.168.11.202";
   }
}
```

Manually Configuring the SmartZone IP Address on an ICX Switch

Complete the following steps to configure a list of SmartZone IP addresses on the ICX device.

1. Enter the **manager active-list** command followed by one or more priority IP addresses for the SmartZone device, as shown in the following example.

   The IP addresses listed are examples only.

   ```
   ICX# configure terminal
   ICX(config)# manager active-list 192.168.11.200 192.168.11.201 192.168.11.202
   ```

2. Use the **sz passive-list** *ip-address* command to configure the SmartZone IP addresses to be used for redundancy.

```
ICX(config)# sz passive-list 10.176.160.118
```

Displaying the SmartZone Connection Status

Use the **show manager status** command to display the SmartZone IP address lists and information about the status of the connection.

```
ICX7450-24# show manager status

============    MGMT Agent State Info     ===================

Config Status:Enabled Operation Status:Enabled
State:SSH CONNECTED  Prev State:SSH CONNECTING              Event:SZ_SSH_CONNECT_EVENT

SWR List                            : None
DNS List                :
Active List             : 10.176.160.116
Active List IPV6        : 2620:107:90d0:ab40::116
DHCP Option 43          : No
DHCP Opt 43 List        : None
Backup List             : None
Backup List IPV6        : None
Merged List             : 2620:107:90d0:ab40::116 10.176.160.116

SZ IP Used              : 2620:107:90d0:ab40::116
Port List               : 987
Server Port Used        : 443
Query Status            : APPROVED

SSH Tunnel Status -:
Tunnel Status           : Established
CLI IP/Port             : 127.255.255.253/59449
SNMP IP/Port            : 127.255.255.254/8253
Syslog IP/Port          : 127.0.0.1/20514
HTTP CLIENT IP/Port     : 127.0.0.1/5080
HTTP SERVER IP/Port     : 127.255.255.252/63098
Timer Status            : Not Running
```

Disconnecting the ICX Switch from SmartZone

Use the **manager disconnect** command to disconnect the ICX switch from SmartZone and initiate a new connection based on the currently available list of SmartZone IP addresses.

Enter the **manager disconnect** command as shown.

This command can be executed on the local terminal.

```
ICX# manager disconnect
SZ Disconnect initiated...
```

Disabling SmartZone Management on the ICX Switch

When SmartZone management is disabled on the switch, the switch will not initiate a connection with SmartZone even if a SmartZone IP address is available.

Enter the **manager disable** command to disable SmartZone management on the ICX switch.

```
ICX(config)# manager disable
```

Managing ICX Switches from RUCKUS Cloud

ICX Management in RUCKUS Cloud

NOTE
FastIron release 09.0.10a or later supports Cloud management; however, RUCKUS does not recommend upgrading ICX switches for Cloud management until the RUCKUS Cloud adopts 09.0.10a or later firmware.

RUCKUS Cloud 20.01 introduces switch management capability, providing single pane-of-glass management across wired and wireless products.

NOTE
Cloud 21.03 and later releases allow switches with existing configuration to be added to the Cloud. Users can continue to make configuration changes via the Cloud or the CLI.

RUCKUS Cloud supports the following features:

- Adding and monitoring switches or stacks
- ICX configuration, including
  - Switch Configuration profiles
  - Port settings
  - LAG management
  - VLAN interfaces
- Client visibility
- Troubleshooting
- Configuration changes from the CLI (Cloud 20.11 and later).

Refer to RUCKUS Cloud documentation for more information.

Pre-requisites for ICX Cloud Management

Perform the steps in the following sections to connect to the Cloud.

Get the Switch Ready

- **New Factory Default Switch** - If the ICX switch has 'Ruckus Cloud Ready' mentioned on the Switch label, continue to add the switch to your RUCKUS Cloud account. Models ICX7150-C08P/PT, ICX7150-C10ZP, and ICX7150-24F must be upgraded to FastIron 08.0.95ca (UFI router image) regardless of the label (UFI switch image for ICX7150-C08P/PT). Refer to *Upgrade the Switch* for the upgrade procedure.
- **Switch with Existing Configuration** - If the switch has existing configuration, ensure that the switch is running FastIron 08.0.90d (or 08.0.92d for models ICX 7150-C08P/PT, ICX7150-C10ZP and ICX7150-24F) before adding them to the Cloud. If the switches are not running

the minimum recommended version, upgrade the switch to FastIron 08.0.95c directly, and add them to the Cloud. Refer to 'Connect the Switch to the Cloud.'

Upgrade the Switch

For switches that do not have a 'cloud-ready label' or switches running a version earlier than FastIron 08.0.90d, use one of the following methods to upgrade the switches to 08.0.92d (UFI router image).

- Download FastIron 08.0.92d firmware (use UFI router image) from the following link:

  https://support.ruckuswireless.com/software_terms_and_conditions/2915-ruckus-icx-fastiron-08-0-95ca-ga-software-release-zip
- For a USB upgrade, use the procedure outlined at one of the following links:

  https://www.youtube.com/watch?v=wDdeUBzwfNI (video)

  Image Download Using USB from the *RUCKUS FastIron Software Upgrade Guide*.
- For a TFTP upgrade, follow the procedure outlined in *The Upgrade Process* from the *RUCKUS FastIron Software Upgrade Guide*.

Perform these steps.

1. Check the current running version via switch CLI using the **show version** command.
2. Use a direct upgrade to UFI or a two-step upgrade to UFI, depending on the current version.
   a. Switches running 08.0.80 and later can be directly upgraded to an 08.0.92d UFI router image.

      Example:

      ```
      copy tftp flash <TFTP server IP address> SPR08092dufi.bin primary
      ```

   b. Switches running 08.0.70x or earlier releases need to go through a two-step upgrade process.

      Example:

      ```
      copy tftp flash <TFTP server IP address> SPR08090d.bin primary
      reload
      copy tftp flash <TFTP server IP address> SPR08092dufi.bin primary
      ```

3. After upgrade, check the version again, and make sure the switch is running the UFI image.

```
SSH@7150-C12p# show version

  Copyright ( c ) Ruckus Networks, Inc. All rights reserved.

    UNIT 1: compiled on Jun 9 2020 at 11:41:55 labeled as SPR08092d

     (32950564 bytes) from Primary SPR08092d.bin (UFI)<-- This should appear.
```

Connect the Switch to the Cloud

NOTE
An out-of-band management port must not be used to connect to the Cloud.

Factory-default ICX switches and ICX switches with pre-existing configuration use different methods to connect to the RUCKUS Cloud.

Factory-default Switches

There are two options to connect a factory-default RUCKUS switch to the Cloud:

- RUCKUS recommends that the ICX switch obtain an IP address from a DHCP server for connecting to the Cloud. If DHCP is used to connect to the RUCKUS Cloud, the ICX switch automatically creates default VLAN 1 and router Interface VE1 with the IP addresses obtained from the DHCP server.
- In the absence of a DHCP server, use the **manager network-config** wizard to connect to the Cloud. The **manager network-config** wizard automatically creates router interface VE1 after the wizard completes. Refer to The Static IP Configuration Wizard on page 249 for more information.

Switches with Pre-existing Configuration

For switches with existing configuration, "manager registrar" should be present in the running-config. Use the **show manager status** command to verify and update the configuration as needed.

To obtain the most recent SWR list from the switch registrar server, use the **manager registrar-query-restart** command.

If necessary, use the **manager reset** command to re-establish a connection with the Cloud.

Upon Connection

Once the ICX switch is connected to the RUCKUS Cloud:

- If it is the first time the ICX switch is connecting to the Cloud, the switch reloads after the necessary firmware is applied.
- RUCKUS Cloud assigns a username and password to the switch once it is managed by the RUCKUS Cloud. Even if the switch is disconnected from the Cloud, the switch username and password remain the same. The password can be obtained from the RUCKUS Cloud GUI under the Venue's switch settings.

  NOTE
  The credentials are applicable for factory-default switches only. For switches with pre-exisitng configuration, you can continue using the existing authentication credentials configured on the switches.

CLI Configuration Changes

FastIron release 08.0.95b, along with RUCKUS Cloud Version 20.11, introduces capability to make configuration changes via the CLI, even when the switch is connected to the Cloud.

The Static IP Configuration Wizard

Enter the **manager network-config** command to facilitate configuration of an IP address and related settings to easily connect an ICX switch to RUCKUS Cloud.

The following example shows the ICX Management configuration wizard and user entries for the static IP address, network mask, gateway IP address, and DNS server IP address.

```
ICX# manager network-config
Please enter IP address: 10.10.10.10
Please enter network mask: 255.255.255.128
Please enter gateway IP address: 10.10.10.1
Please enter DNS server IPs: 8.8.8.8
```

```
!
!
```

Considerations for Managing ICX Switches from the Cloud

NOTE
Cloud 21.03 and later releases allow switches with existing configuration to be added to the Cloud. Users can continue to make configuration changes via the Cloud or the CLI.

The following limitations apply to ICX-Management from the Cloud:

- Only ICX 7150, ICX 7550, ICX 7650, and ICX 7850 switches can connect to the Cloud.
- An ICX switch must have an IPv4 address to connect to the cloud.
- In-Service Software Upgrade (ISSU) is not supported through the cloud.

Disconnecting from the Cloud

Enter the **manager disconnect** command in Privileged EXEC mode to disconnect from RUCKUS Cloud.

Checking the Cloud Connection Status

ICX 7150, ICX 7650, and ICX 7850 switches have an LED that indicates when the device is managed from the cloud. The following table interprets the LED status. Refer to the FastIron hardware installation guide for the specific ICX device for more information.

TABLE 53 Cloud LED Status

Connection State	LED Status / Color
Connected	Solid Green
Attempting to connect (Connecting)	Slow flash green (one flash every two seconds)
Disconnected	Off
Receiving configuration from cloud	Fast flashing green (two flashes every seconds)

The **show manager status** command indicates when an ICX switch is managed from the cloud. The Operation Status: Enabled field indicates that the ICX switch is connected to the cloud, and the State: CLOUD SSH CONNECTED field indicates the ICX switch is being managed from the cloud.

When the ICX switch is disconnected from the cloud and managed locally, the Operation Status: Disabled, State: Disabled, and Previous State: CLOUD SSH CONNECTED fields are displayed.

The following example connects an ICX device to RUCKUS Cloud.

```
ICX# manager connect

ICX# show manager status

============    MGMT Agent State Info     ===================
Config Status: None     Operation Status: Enabled
State: CLOUD SSH CONNECTED  Prev State: CLOUD SSH CONNECTING Event: NONE

SWR List            : None
Active List         : 34.66.162.73,
DHCP Option 43      : No
DHCP Opt 43 List    : None
```

```
Backup List        : None
Merged List         : 34.66.162.73, 34.66.162.71, 34.66.162.72, 34.66.162.74

SZ IP Used          : 34.66.162.71
Query Status        :
        Response Received

SSH Tunnel Status - :
Tunnel Status     : Established
CLI IP/Port       : 127.255.255.253/44294
SNMP IP/Port      : 127.255.255.254/1461
Syslog IP/Port    : 127.0.0.1/20514
HTTP SERVER IP/Port: 127.255.255.252/39691
HTTP CLIENT IP/Port: 127.0.0.1/5080

Timer Status        : Not Running
```

The following example disconnects the ICX device from RUCKUS Cloud.

```
ICX# manager disconnect

ICX# show manager status

============    MGMT Agent State Info     ==================
Config Status: Disabled    Operation Status: Disabled
State: DISABLED             Prev State: CLOUD SSH CONNECTED  Event: NONE

SWR List            : 10.176.160.115
Active List         : None
DHCP Option 43      : No
DHCP Opt 43 List    : None
Backup List         : None
Merged List         : 10.176.160.115
Switch registrar host: sw-registrar.ruckuswireless.com
Switch registrar discovery retry count: 0
Switch registrar host resolve failure count: 1

SZ IP Used          : 10.176.160.115
Query Status        :
    Not Initiated

SSH Tunnel Status - :
 Tunnel Status      : Not Initiated
 CLI IP/Port        : /0
 SNMP IP/Port       : /0
 Syslog IP/Port     : /0
 HTTP SERVER IP/Port: /0
 HTTP CLIENT IP/Port: /0

Timer Status        : Not Running
```

Refer to the **show manager status** command in the *RUCKUS FastIron Command Reference* for more information.

ICX-Management Troubleshooting

TABLE 54 Basic Validation to Attempt First for ICX Connections to SmartZone

Validate	Troubleshoot	Check	Recover
UFI loaded	ICX# show version | include UFI	Image filename followed by "(UFI)"	If UFI is not present in the output, reload the UFI.
Upgrade successful	ICX# hmon client status all-clients	Oper. State: Up for these processes: nginx wmsgi PySzAgtSrv.py	If any of the processes is not present, re-upgrade. If any of the processes is not up, reload the ICX device.
Clock correct	ICX# show clock	Clock time correct	Set the system clock or configure NTP.
Certificate installed	Verify hardware and version: ICX# show version | include HW Check for certificate and possible key corruption: ICX# dm verify-device-certs	Hardware model Presence of certificate Valid key	For ICX 7250 and 7450 models (non-TPM devices): 1. Zeroize the current key: ICX(config)# crypto device-key-zeroize ICX(config)# crypto device-cert-zeroize 2. Reload the ICX device. For all other ICX models (TPM devices), you must create an RMA if the certificate is not valid.

TABLE 55 ICX Switch Not Registering with SmartZone

Validate	Troubleshoot	Check	Recover
Switch registrar is configured.	ICX# show running-config | include registrar	"manager registrar" in command output	If no configuration exists, configure the registrar.
DNS is configured.	ICX# show running-config | include dns	ip dns server-address *x.x.x.x*	If no configuration exists, configure a DNS server.
DNS is reachable.	ICX# ping *x.x.x.x* (DNS server IP address)	Response to ping	If there is no response to ping, debug with the **show manager status** command (see next row).
Switch registrar status	ICX# show manager status | include registrar	Registrar host is present (typically, sw-registrar.ruckuswireless.com). Discovery retry count Host resolve failure count	If the DNS is not reachable (host resolve failure count >0), try these options: Configure a different DNS server. Remove the registrar and configure the SmartZone IP address: ICX(config)# no manager registrar ICX(config)# manager active-list *x.x.x.x* If the registrar is unreachable (discovery retry count >0), try these options: Check network settings. ICX# traceroute *x.x.x.x* (registrar IP address)

TABLE 55 ICX Switch Not Registering with SmartZone (continued)

Validate	Troubleshoot	Check	Recover
SZ agent state	ICX# show manager status	SZ agent makes these transitions: Init: Initializing Query: Trying to reach SmartZone and register Connecting: Registration complete. Establishing connection. Connected: Session with SmartZone established. SSH Tunnel status is "Established."	If SZ agent state is "Query" and does not change, go to Table 56. If SZ agent state is "Connecting" and does not change, contact RUCKUS Support.

TABLE 56 SZ Agent Stuck in Query State

Validate	Troubleshoot	Check	Recover
Output from the **show manager status** command is unchanged.	ICX# show log | include management	"Failed to connect to management device at *ip_address*" with an HTTP error code. Make sure the IP address listed is the address to which the switch should connect.	For wrong IP address, remove the registrar, and configure the SmartZone IP address: ICX(config)# no manager registrar ICX(config)# no manager active-list ICX(config)# manager active-list *x.x.x.x*
		HTTP Error Code 400 - Authentication	Verify the device certificate. If the certificate is corrupted on the non-tpm device, use the following command to delete the certificate and key, and reload: ICX(config)# crypto device-key-zeroize
		HTTP Error Code 401 - Unauthorized switch (switch not recognized by SZ or not pre-approved)	Move the ICX switch manually from the default group, or create a rule for SmartZone to automatically add the switch to an existing group.
		HTTP Error Code 403 - Switch registration rejected by SZ due to license capacity	Add licenses on SmartZone, or reconfigure the ICX switch to use another SmartZone device.
		HTTP Error Code 409 - Switch is online already	Try the following steps for on-premises SmartZone: 1. ICX(config)# manager disable 2. Delete the switch from the switch group on SmartZone. 3. ICX(config)# no manager disable Try these steps for RUCKUS Cloud: 1. ICX# manager disconnect 2. In the cloud GUI, delete the switch, and add it back. 3. ICX# manager connect
		HTTP Error Code 500 - SZ server encountered an unexpected condition that prevented it from fulfilling the request	Make sure SmartZone is up and running without errors.
		HTTP Error Code 503 - The volume of switches is over system capacity, or switch was deleted.	Follow the same steps used to handle a 409 error. Or reconfigure the ICX switch to use another SmartZone device.

TABLE 57 Miscellaneous Issues

Issue	Recover
"User authentication issue" displayed on screen	Disconnect and reconnect ICX-Management: ICX(config)# manager disable ICX(config)# no manager disable If the issue affects service, reload the ICX device as a last resort.
ICX information not displayed correctly	
ICX backups fail	

350 West Java Dr., Sunnyvale, CA 94089 USA
https://www.commscope.com