CONFIGURATION GUIDE

# RUCKUS FastIron QoS and Traffic Management Configuration Guide, 08.0.90

## Supporting FastIron Software Release 08.0.90

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# Contact Information, Resources, and Conventions


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## 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.ruckusnetworks.com and select **Support**.

### What Support Do I Need?

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

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

### Open a Case

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

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

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

## Self-Service Resources

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

- Technical Documentation—https://support.ruckuswireless.com/documents
- Community Forums—https://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.ruckusnetworks.com.

# Online Training Resources

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

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## Supported hardware

This guide supports the following Ruckus products:

- Ruckus ICX 7850 Series
- Ruckus ICX 7750 Series
- Ruckus ICX 7650 Series
- Ruckus ICX 7450 Series
- Ruckus ICX 7250 Series
- Ruckus ICX 7150 Series

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

## What's New in this Document

**TABLE 2** Summary of Enhancements for FastIron Release 08.0.90, June 30, 2023

| Feature | Description | Described in |
|---|---|---|
| Minor editorial updates | Minor editorial updates were made throughout the Configuration Guide. | All chapters. |
| Updates to address defects | Minor updates on content throughout to address defects. | All chapters. |

**TABLE 3** Summary of Enhancements for FastIron Release 08.0.90 (May 1, 2023)

| Feature | Description | Described in |
|---|---|---|
| Rate Limiting | Ruckus ICX 7650 specific rate limiting configuration | Port-based fixed rate limiting configuration notes on page 51 |

**TABLE 4** Summary of Enhancements in FastIron Release 08.0.90 (April 29, 2022)

| Feature | Description | Described in |
|---|---|---|
| Rate Limiting with Burst and BUM traffic | **Updated:** Editorial corrections were made in the guide. | Port-based fixed rate limiting on page 51<br>How port-based fixed rate limiting works on page 52<br>Configuring port-based fixed rate limiting with burst option on page 57 |

**TABLE 5** Summary of Enhancements in FastIron Release 08.0.90

| Feature | Description | Described in |
|---|---|---|
| ICX 7850 QoS Feature Support | Updates made to identify the QoS support for the ICX 7850 hardware platform. | Updates made to the following:<br>• Packet buffer management on page 27—to list the packet memory and bandwidth<br>• Priority flow control on page 26—to note that the ICX 7850 does not support PFC<br>• Rate shaping configuration notes on page 63—to document the new output rate shaping values for the ICX 7850 modules.<br>Various PFC configuration tasks were updated to note that the ICX 7850 does not support PFC. |
| Various edits | Minor editorial updates made throughout the Configuration Guide. | All chapters. |

# How Command Information is Presented in this Configuration Guide

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

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

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

# Quality of Service


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# Quality of Service overview

Quality of Service (QoS) provides preferential treatment to specific traffic.

Quality of Service (QoS) features are used to prioritize the use of bandwidth in a switch. When QoS features are enabled, traffic is classified as it arrives at the switch, and processed through on the basis of configured priorities. Traffic can be dropped, prioritized for guaranteed delivery, or subject to the delivery options as configured by a number of different mechanisms.

*Classification* is the process of selecting packets on which to perform QoS, reading or ignoring the QoS information, and assigning a priority to the packets. The classification process assigns a priority to packets as they enter the switch. These priorities can be determined on the basis of information contained within the packet or assigned to the packet as it arrives at the switch. Once a packet or traffic flow is identified and marked, then it is mapped to a forwarding priority queue.

Packets on Ruckus devices are classified in up to eight traffic classes with values from 0 to 7. Packets with higher priority classifications are given a precedence for forwarding.

There are two traffic types in QoS:

- Data—These can be either network-to-network traffic or traffic from the CPU. QoS parameters can be assigned and modified for data traffic. The device also supports setting or modifying the IEEE 802.1p user priority or the IP header DSCP field..
- Control—Packets to and from the CPU is considered control traffic. The QoS parameters associated with the control traffic are preassigned and not configurable.

## Classified traffic processing

The *trust level* in effect on an interface determines the type of QoS information the device uses for performing QoS.

A Ruckus ICX device establishes the trust level based on the configuration of various features and whether the traffic is switched or routed. The trust level can be one of the following:

- Ingress port default priority.
- Static MAC address—If the packet does not matches on an ACL that defines a priority and the MAC address of the packet matches a static entry, the packet is classified with the priority of the static MAC entry.

- Layer 2 Class of Service (CoS) value—This is the 802.1p priority value in the Ethernet frame. It can be a value from 0 through 7. The 802.1p priority is also called the *Class of Service*.
- Layer 3 Differentiated Services Code Point (DSCP)—This is the value in the six most significant bits of the IP packet header 8-bit DSCP field. It can be a value from 0 through 63. These values are described in RFCs 2472 and 2475. The DSCP value is sometimes called the *DiffServ value*.
- ACL keyword—An ACL can also prioritize traffic and mark it before sending it along to the next hop. This is described under "QoS options for IP ACLs" section in the *Ruckus FastIron Security Configuration Guide*.

Given the variety of different criteria, there are many possibilities for traffic classification within a stream of network traffic. For this reason, the priority of packets must be resolved based on which criteria takes precedence. Precedence follows the schemes illustrated in the *Determining the trust level of a packet for ICX devices* figure.

## Packet trust level

The following figure illustrates how ICX series devices determine the trust level of a packet. As shown in the flowchart, the first criteria considered is whether the packet matches on an ACL that defines a priority. If this is not the case and the MAC address of the packet matches a static entry, the packet is classified with the priority of the static MAC entry. If neither of these is true, the packet is next classified with the ingress port default priority, then DSCP/ToS value, then 802.1p CoS value, and finally the default priority of zero (0).

**NOTE**
ICX 7150 devices determine internal priority differently. In ICX 7150 devices, ACL matches are first considered, and DSCP/ToS priority is considered next, followed by the priority of the static MAC entry, then default ingress port priority, 802.1p CoS value, and finally the default priority of zero (0).

**FIGURE 1** Determining the trust level of a packet for most ICX devices

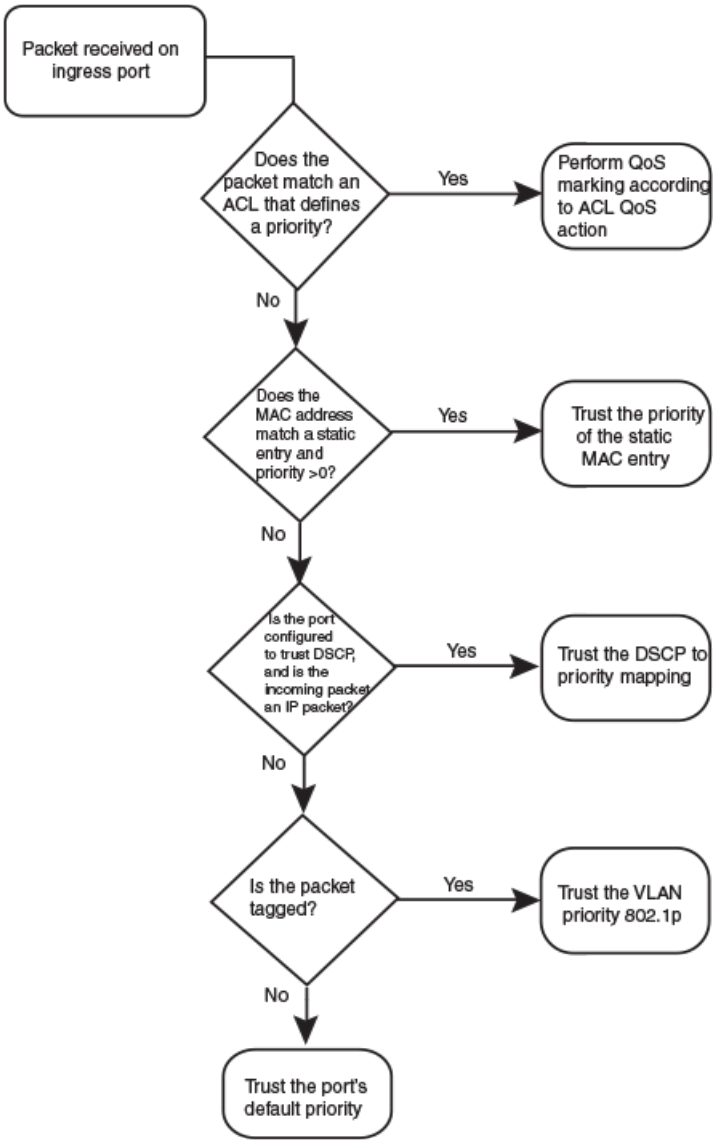
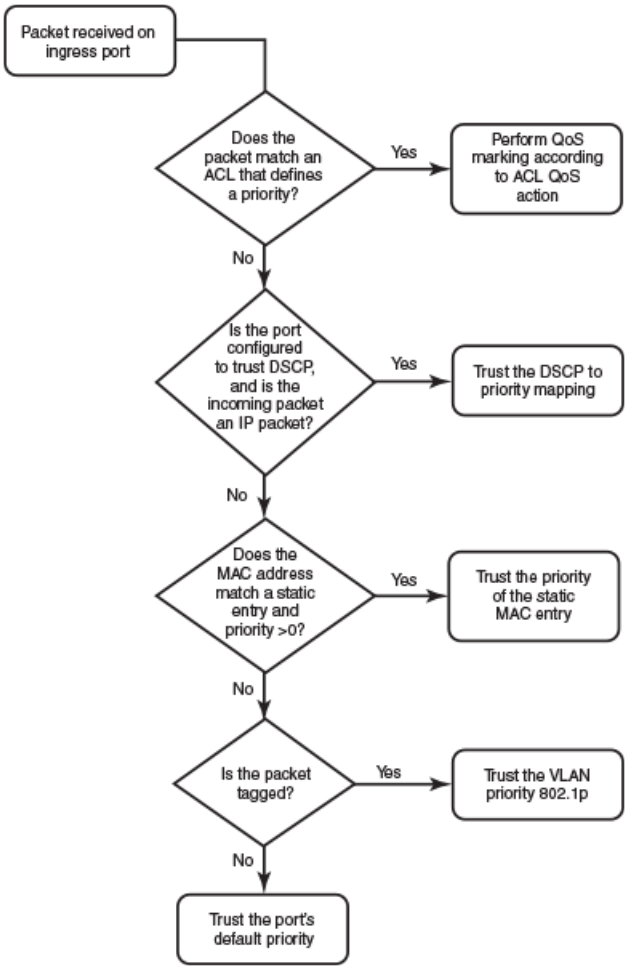


**FIGURE 2** Determining the trust level of a packet for ICX 7150 devices




Once a packet is classified, it is mapped to a forwarding queue. There are eight queues designated from 0 through 7. The internal forwarding priority maps to one of these eight queues. The mapping between the internal priority and the forwarding queue cannot be changed.

The following tables show the default QoS mappings for ICX platforms that are used if the trust level for CoS or DSCP is enabled.

**TABLE 6** Default QoS mappings for ICX platforms, columns 0 to 15

| DSCP value | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.1p (CoS) value | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| DSCP value | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 12 | 14 | 15 |

**TABLE 6** Default QoS mappings for ICX platforms, columns 0 to 15 (continued)

| DSCP value | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Internal forwarding priority | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Forwarding queue | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

**TABLE 7** Default QoS mappings for ICX platforms, columns 16 to 31

| **DSCP value** | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.1p (CoS) value | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| DSCP value | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
| Internal forwarding priority | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| Forwarding queue | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |

**TABLE 8** Default QoS mappings for ICX platforms, columns 32 to 47

| DSCP value | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.1p (CoS) value | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| DSCP value | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
| Internal forwarding priority | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

**TABLE 8** Default QoS mappings for ICX platforms, columns 32 to 47 (continued)

| DSCP value | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Forwarding queue | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |

**TABLE 9** Default QoS mappings for ICX platforms, columns 48 to 63

| DSCP value | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.1p (CoS) value | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| DSCP value | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 |
| Internal forwarding priority | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| Forwarding queue | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |

Mapping between the DSCP value and forwarding queue cannot be changed. However, mapping between DSCP values and other properties can be changed as follows:

- DSCP to internal forwarding priority mapping—You can change the mapping between the DSCP value and the internal forwarding priority value from the default values shown in the above tables. This mapping is used for CoS marking and determining the internal priority when the trust level is DSCP. Refer to Changing the DSCP to internal forwarding priority mappings on page 34.
- VLAN priority (802.1p) to hardware forwarding queue—You can change the mapping between the 802.1p value and hardware forwarding queue from the default value. Refer to Changing the VLAN priority 802.1p to hardware forwarding queue mappings on page 35.

# QoS for Ruckus ICX stackable devices

Ruckus FastIron units in a traditional stack support QoS.

Units in a stack communicate the stack topology information and other proprietary control information through the stacking links. For more information about stacking links and traditional stack technology, refer to the *Ruckus FastIron Stacking Configuration Guide*.

In addition to control information, the stacking links also carry user network data packets. In a traditional stack topology, the priority of stacking-specific control packets is elevated above that of data path packets, preventing loss of control packets, and timed retries that affect performance. This prioritization also prevents stack topology changes that may occur if enough stack topology information packets are lost.

Traditional stack technology reserves one QoS profile to provide a higher priority for stack topology and control traffic.

On Ruckus ICX 7450 stacking devices only, Priority 7 multicast traffic is not treated as Strict Priority. Multicast queues in the Ruckus ICX 7450 are limited, so Priority 6 and Priority 7 Multicast traffic is mapped to Multicast Queue 7. Therefore, even if you configure Priority 7 as Strict Priority and Priority 6 as non-Strict, scheduling weight sched_6_wt+sched_7_wt is applied on Multicast Queue 7 so that Priority 7 traffic is not scheduled as Strict. See User-configurable scheduler profile configuration on page 19 for more information on scheduling weights.

# QoS behaviors in a traditional stack

## *QoS profile restrictions*

In a stacking topology, quality profiles for qosp7 cannot be configured. If an attempt is made to configure a profile for qosp7, the system ignores the configuration.

**NOTE**
This applies only when the device is operating in stacking mode. It does not apply to standalone devices.

## *QoS behavior for trusting Layer 2 (802.1p)*

By default, Layer 2 trust is enabled. Because priority 7 is reserved for stacking control packets, any ingress data traffic with priority 7 is mapped to internal hardware queue 6. All other priorities are mapped to their corresponding queues.

## *QoS behavior for trusting Layer 3 (DSCP)*

When the trust dscp mode is enabled, packets arriving with DSCP values 56 to 63 are mapped to internal hardware queue 6. All other DSCP values are mapped to their corresponding internal hardware queues.

## *QoS behavior on port priority and VLAN priority*

Port priority has a higher precedence than the 802.1p priority examination. If port priority is set to 7, all incoming traffic is mapped to internal hardware queue 6.

When stacking is not enabled on a device, all priorities are mapped to their corresponding queues without restrictions.

## *QoS behavior for 802.1p marking*

By default, 802.1p marking is not enabled in a traditional stack. Outgoing tagged traffic is not marked based on the hardware queue into which ingress traffic was classified. 802.1p marking can be achieved using ACL. For configuration syntax, rules, and examples of QoS marking, refer to the "QoS options for IP ACLs" section in the *Ruckus FastIron Security Configuration Guide*.

# QoS queues

Ruckus devices support the eight QoS queues (qosp0 through qosp7).

The supported queues are:

**TABLE 10** QoS queues

| QoS priority level | QoS queue |
|---|---|
| 0 | qosp0 (lowest priority queue) |
| 1 | qosp1 |

**TABLE 10** QoS queues (continued)

| QoS priority level | QoS queue |
|---|---|
| 2 | qosp2 |
| 3 | qosp3 |
| 4 | qosp4 |
| 5 | qosp5 |
| 6 | qosp6 |
| 7 | qosp7 (highest priority queue) |

**NOTE**
On ICX 7450 devices, both Priority 6 and Priority 7 traffic maps to one multicast queue (MCQ:7).

The queue names listed in the table are the default names. If desired, you can rename the queues as shown in Configuring the QoS queue name and guaranteed bandwidth on page 38.

Packets are classified and assigned to specific queues based on the criteria shown in the figures described in Packet trust level on page 12.

For ICX devices, ingress packets are classified into the eight priorities, which map to eight hardware queues or traffic classes (TCs) based on the priority.

**TABLE 11** QoS queue range of the Ruckus devices

| Device | UC queue (Unicast) | MC queue (Multicast) |
|---|---|---|
| Ruckus ICX 7850 | queue 0-9 | queue 0-9 |
| Ruckus ICX 7750 | queue 0-7 | queue 0-4 |
| Ruckus ICX 7650 | queue 0-9 | queue 0-9 |
| Ruckus ICX 7450 | queue 0-7 | queue 0-3 |
| Ruckus ICX 7250 | queue 0-7 | queue 0-3 |
| Ruckus ICX 7150 | queue 0-7 (each queue is for both unicast + Multicast) | |

**TABLE 12** QoS queue range and priority of the Ruckus devices

| Device | MC queue | Priority |
|---|---|---|
| Ruckus ICX 7750 | queue 4 | Priority 7 |
| | queue 3 | Priority 6 |
| | queue 2 | Priority 5 |
| | queue 1 | Priority 4, 3, 2 |
| | queue 0 | Priority 1 , 0 |
| Ruckus ICX 7450 | queue 3 | Priority 7, 6 |
| | queue 2 | Priority 5 |
| | queue 1 | Priority 4, 3, 2 |
| | queue 0 | Priority 1, 0 |
| Ruckus ICX 7250 | queue 3 | Priority 7, 6 |
| | queue 2 | Priority 5 |
| | queue 1 | Priority 4, 3, 2 |
| | queue 0 | Priority 1, 0 |

# User-configurable scheduler profile

The user-configurable scheduler profile is a template that defines either the scheduling mechanism or scheduling profile (weights assigned to the queues) or both for the egress queues.

A configured user-configurable scheduler profile for egress queues can be applied to any hardware device. The default QoS is applicable to the entire system. If the scheduler profile is configured using the **qos mech strict** command, all devices in the system are configured with the strict priority. The user-configurable scheduler profile is applicable only to the specific devices, leaving the remaining devices running default QoS. On any device, user-configurable scheduler profile has high priority over the default QoS. The user-configurable scheduler profile should be in line with default QoS commands in both stacking and standalone systems.

On Ruckus ICX 7750 devices, scheduler profiles are applied at the port, rather than at the device (port region), level. See the description of the **scheduler-profile** command In the *Ruckus FastIron Command Reference* for more information.

## *User-configurable scheduler profile configuration*

Configuring a user-configurable scheduler profile involves, selecting a proper mechanism and appropriate weights for the traffic classes (TCs) corresponding to that mechanism.

It is highly recommended that you let the system use the default scheduling mechanism unless user knows what parameters you intend to modify and for what reasons.

There are two ways of creating a user-configurable scheduler profile. The scheduler-profile can be created either by specifying a mechanism (WRR, Strict, or Mixed) or by specifying weights.

The user-configurable scheduler profile can be created by specifying a mechanism. There are three available mechanisms:

- Strict Priority (SP)
- Weighted Round Robin (WRR)
- Mixed (combination of SP and WRR)

  **NOTE**
  On a Ruckus ICX 7150, frames may be dropped before they are properly scheduled due to a shallow queue depth. Under this condition, configure the egress buffer profile to support WRR or Mixed mode and increase the port-share level of the profile.

If you create a profile specifying only the weights without specifying the mechanism, the default mechanism is used. The default mechanism for stacking systems is *Mixed* and *WRR* for standalone systems.

If you change the profile mechanism, the weights also get changed according to the mechanism. The weights can be modified according to the following requirements:

- If the mechanism is changed to *WRR*, the default system weights get assigned.
- If the mechanism is changed to *Mixed*, the default mix weights get assigned.
- If the mechanism is changed to *Strict*, the weights are ignored and remain untouched.

Scheduler profile modifications take effect dynamically on an active profile.

The following tables show the default values for the scheduling type for stacking and standalone ICX devices.

**TABLE 13** Default values for scheduling type for stacking systems

| Traffic Class | SP | SP Jumbo | WRR | WRR Jumbo | Mixed | Mixed Jumbo |
|---|---|---|---|---|---|---|
| TC 0 | SP | SP | 3 | 8 | 15 | 15 |
| TC 1 | SP | SP | 3 | 8 | 15 | 15 |
| TC 2 | SP | SP | 3 | 8 | 15 | 15 |

**TABLE 13** Default values for scheduling type for stacking systems (continued)

| Traffic Class | SP | SP Jumbo | WRR | WRR Jumbo | Mixed | Mixed Jumbo |
|---|---|---|---|---|---|---|
| TC 3 | SP | SP | 3 | 8 | 15 | 15 |
| TC 4 | SP | SP | 3 | 8 | 15 | 15 |
| TC 5 | SP | SP | 10 | 16 | 25 | 25 |
| TC 6 | SP | SP | 75 | 44 | SP | SP |
| TC 7 | SP | SP | SP | SP | SP | SP |

**TABLE 14** Default values for scheduling type for standalone systems

| Traffic Class | SP | SP Jumbo | WRR | WRR Jumbo | Mixed | Mixed Jumbo |
|---|---|---|---|---|---|---|
| TC 0 | SP | SP | 3 | 8 | 15 | 15 |
| TC 1 | SP | SP | 3 | 8 | 15 | 15 |
| TC 2 | SP | SP | 3 | 8 | 15 | 15 |
| TC 3 | SP | SP | 3 | 8 | 15 | 15 |
| TC 4 | SP | SP | 3 | 8 | 15 | 15 |
| TC 5 | SP | SP | 3 | 8 | 25 | 25 |
| TC 6 | SP | SP | 7 | 8 | SP | SP |
| TC 7 | SP | SP | 75 | 44 | SP | SP |

# QoS priorities-to-traffic assignment

By default, all traffic is in the best-effort queue (qosp0) and is honored on tagged ports on all FastIron switches.

You can assign traffic to a higher queue based on the following:

- Incoming port (sometimes called the *ingress port*)
- Static MAC entry

When you change the priority, you specify a number from 0 through 7. The priority number specifies the IEEE 802.1 equivalent to one of the eight QoS queues on Ruckus devices. The numbers correspond to the queues as shown in the QoS queues table.

Although it is possible for a packet to qualify for an adjusted QoS priority based on more than one of the criteria, the system always gives a packet the highest priority for which it qualifies. Thus, if a packet is entitled to the premium queue because of its IP source and destination addresses, but is entitled only to the high queue because of its incoming port, the system places the packet in the premium queue on the outgoing port.

## Buffer allocation and threshold for QoS queues

By default, Ruckus FastIron software allocates a certain number of buffers to the outbound transport queue for each port based on QoS priority. The buffers control the total number of packets permitted in the outbound queue for the port. If desired, you can increase or decrease the maximum number of outbound transmit buffers allocated to all QoS queues, or to specific QoS queues on a port or group of ports. For more information, refer to the *Ruckus FastIron Layer 2 Switching Configuration Guide*.

# QoS marking

The term—QoS marking—is the process of initially changing the packet QoS information for the next hop.

Layer 2 (802.1p) and Layer 3 (Differentiated Services Code Point (DSCP)) information in a packet can be marked. As an example of marking traffic coming from a device that does not support DSCP, you can change the packet IP precedence value into a DSCP value before forwarding the packet.

Class of Service (CoS) is a 3-bit field within an Ethernet frame header known as the Priority Code Point (PCP) when using a 802.1 network. This field specifies a priority value between 0 and 7, inclusive, that can be used by Quality of Service (QoS) to differentiate traffic.

The Differentiated Services Code Point (DSCP) is a 6-bit field in an IP header for the classification of packets. Differentiated Services is a technique used to classify and manage network traffic and it helps to provide QoS for modern Internet networks. It can provide services to all kinds of networks.

You can mark a packet's Layer 2 CoS value, its Layer 3 DSCP value, or both values. The Layer 2 CoS or DSCP value that the device marks in the packet is the same value that results from mapping the packet QoS value into a Layer 2 CoS or DSCP value.

Marking is optional and is disabled by default.

# DSCP Remarking Overview

Differentiated Services Code Point (DSCP) remarking can be configured using three main types of configuration with different levels of QoS precedence.

There is a debate between using the terms "marking" or "remarking." Almost all devices initially mark the DSCP packets with a value. Every packet has one of 64 values, a decimal number from 0 to 63, in the DSCP field. Each of these values, including 0, is a legitimate DSCP. When the packet is processed by a DSCP marker, we can use the term "remarking" the packet, even though the DSCP may not change.

DSCP remarking is performed on ICX devices using three different types of configuration:

- ACL—Traffic matching a specific pattern is remarked.
- Interface (Physical, LAG, VE)—Traffic entering a physical, LAG, or VE interface (except traffic matched by an ACL) is remarked with a configured value.
- Global Configuration—Traffic not affected by an ACL match or a logical interface is remarked with a configured value.

Please note that DSCP remarking configuration at the ACL level takes precedence over the DSCP remarking configuration at the interface level. That means if a packet matched an ACL filter that has DSCP remarking configuration while there is also a DSCP remarking configuration on the incoming interface, the packet is remarked with the DSCP value specified on the ACL filter it matched. Similarly, DSCP remarking configuration at the interface level takes precedence over the DSCP remarking configuration at the global level.

## ACL Remarking

ACLs can be configured to match a specific pattern and remark DSCP values. When remarking is not enabled using ACLs, a rogue host that wants preferential treatment for all its traffic could mark the DSCP field for its requirements and send the traffic to the device. Packets matching an ACL takes a precedence if the traffic is to be marked with a DSCP value over logical interface remarking or global remarking configuration.

For configuration syntax, rules, and examples of QoS marking using ACLs, refer to the "QoS options for IP ACLs" section in the *Ruckus FastIron Security Configuration Guide*.

## Interface (Physical, LAG, VE) Interface Remarking

Packets entering a physical, LAG, or VE interface can be remarked with a configured DSCP value. Remarking at the interface level can be referred to as Class of Service (CoS) remarking although the values set are DSCP values. Remember that DSCP remarking configuration at the ACL level takes precedence over the DSCP remarking configuration at the interface level. The configuration is entered through the command-line interface (CLI) at the interface level.

When DSCP marking is configured on a given port, the DSCP field of any IPv4 packet received on the port is re-marked to the configured value.

For a configuration example of QoS remarking at the interface level, see the Configuring DSCP and CoS remarking at the interface level on page 33 task.

For information about the QoS remarking using physical, LAG, or VE interfaces in VXLANs, refer to the Quality of Service Support topic in the *Ruckus FastIron Layer 2 Switching Configuration Guide*.

## Global Remarking Configuration

DSCP remarking can also be configured through the CLI at the global level. The global DSCP remarking can coexist with other security features configured on the same port.

DSCP global remarking can be configured on the ports of the modules that are configured, but not physically present. When the modules are hot-swapped, the marking is automatically applied or removed.

For a configuration example of QoS global remarking, see the Configuring global DSCP and CoS remarking on page 33 task.

# DSCP-based QoS configuration

Ruckus FastIron releases support basic DSCP-based QoS (also called Type of Service [ToS]-based QoS). However, the FastIron family of switches does not support other advanced DSCP-based QoS features.

Ruckus FastIron releases also support marking of the DSCP value. The software can read Layer 3 Quality of Service (QoS) information in an IP packet and select a forwarding queue for the packet based on the information. The software interprets the value in the six most significant bits of the IP packet header 8-bit ToS field as a DSCP value, and maps that value to an internal forwarding priority.

> **NOTE**
> MAC filter and DSCP marking cannot be configured on the same port.

The internal forwarding priorities are mapped to one of the eight forwarding queues (qosp0 through qosp7) on the Ruckus device. During a forwarding cycle, the device gives more preference to the higher-numbered queues, so that more packets are forwarded from these queues. For example, queue qosp7 receives the highest preference, while queue qosp0, the best-effort queue, receives the lowest preference.

## Application notes for DSCP-based QoS

- DSCP-based QoS is not automatically honored for routed and switched traffic. The default is 802.1p to CoS mapping. To honor DSCP-based QoS, you must either use an ACL or enable trust DSCP. .
- When DSCP marking is enabled, the device changes the contents of the inbound packet ToS field to match the DSCP-based QoS value.

## Using ACLs to honor DSCP-based QoS

This section shows how to configure Ruckus devices to honor DSCP-based QoS for routed and switched traffic.

Ruckus ICX 7750 devices support DSCP-based QoS on a per-port basis. DSCP-based QoS is not automatically honored for switched traffic. The default is 802.1p to CoS mapping. To honor DSCP-based QoS, you must enter the **trust dscp** command at the interface level of the CLI.

When the **trust dscp** command is enabled, the interface honors the Layer 3 DSCP value. By default, the interface honors the Layer 2 CoS value.

> **NOTE**
> On Ruckus ICX 7750 or 7650 devices, configuring the **trust dscp** command to honor DSCP-based QoS classification on the ingress port works on all traffic except GRE tunnels; classification on these remains based on Layer 2 (802.1p) trust. For GRE tunnels, you can use ACLs to configure classification based on the DSCP value.

## Remarking configuration considerations and limitations

- When an ACL is configured on a port without remarking and global DSCP remarking is enabled, the global DSCP remarking is enabled for the permitted traffic.
- DSCP and CoS global remarking are supported on the same interface together.
- DSCP and CoS global remarking cannot coexist with MAC filters and MAC-based VLANs.

The following table summarizes the behavior when the remarking is set.

**TABLE 15** DSCP remarking

| DSCP | Remarking set | Not set |
|---|---|---|
| DSCP action | Remark DSCP at the ingress | N/A |
| Traffic class | Apply the TC equivalent to DSCP | Apply the TC equivalent to PCP |

**TABLE 16** PCP remarking

| CoS | Remarking set | Remarking set |
|---|---|---|
| PCP action | Remark PCP at the egress | Remark PCP at the egress |
| Traffic class | N/A | Apply the TC equivalent to PCP |

# QoS mapping configuration

You can optionally change the following QoS mappings:

- DSCP to internal forwarding priority
- VLAN priority (802.1p) to hardware forwarding queue, as described in Changing the VLAN priority 802.1p to hardware forwarding queue mappings on page 35

The mappings are globally configurable and apply to all interfaces.

## Default DSCP to internal forwarding priority mappings

The DSCP values are described in RFCs 2474 and 2475. The following table lists the default mappings of DSCP values to internal forwarding priority values.

**TABLE 17** Default DSCP to internal forwarding priority mappings

| Internal forwarding priority | DSCP value |
|---|---|
| 0 (lowest priority queue) | 0–7 |
| 1 | 8–15 |

**TABLE 17** Default DSCP to internal forwarding priority mappings (continued)

| Internal forwarding priority | DSCP value |
|---|---|
| 2 | 16–23 |
| 3 | 24–31 |
| 4 | 32–39 |
| 5 | 40–47 |
| 6 | 48–55 |
| 7 (highest priority queue) | 56–63 |

Notice that DSCP values range from 0 through 63, whereas the internal forwarding priority values range from 0 through 7. Any DSCP value within a given range is mapped to the same internal forwarding priority value. For example, any DSCP value from 8 through 15 maps to priority 1.

After performing this mapping, the device maps the internal forwarding priority value to one of the hardware forwarding queues.

On ICX devices, you can use QoS queue 1 for priority traffic, even when sFlow is enabled on the port.

You can change the DSCP to internal forwarding mappings. You also can change the internal forwarding priority to hardware forwarding queue mappings.

# QoS scheduling and queuing methods

*Scheduling* is the process of mapping a packet to an internal forwarding queue based on its QoS information and servicing the queues according to a queuing method.

The following QoS queuing methods are supported for the FastIron devices:

- Weighted Round Robin (WRR)—This method ensures that all queues are serviced during each cycle. A WRR algorithm is used to rotate service among the eight queues on the FastIron devices. The rotation is based on the weights you assign to each queue. This method rotates service among the queues, forwarding a specific number of packets in one queue before moving on to the next one.

  **NOTE**
  In stacking mode, the qosp7 queue is reserved as Strict Priority under weighted queuing. Attempts to change the qosp7 setting are ignored.

  WRR is the default queuing method and uses a default set of queue weights.

  The number of packets serviced during each visit to a queue depends on the percentages you configure for the queues. The software automatically converts the percentages you specify into weights for the queues.

  **NOTE**
  Queue cycles on the FastIron devices are based on bytes. These devices service a given number of bytes (based on weight) in each queue cycle.

- Strict Priority (SP)—This ensures service for high-priority traffic. The software assigns the maximum weights to each queue, to cause the queuing mechanism to serve as many packets in one queue as possible before moving to a lower queue. This method biases the queuing mechanism to favor the higher queues over the lower queues.

  For example, strict queuing processes as many packets as possible in qosp3 before processing any packets in qosp2, then processes as many packets as possible in qosp2 before processing any packets in qosp1, and so on.
- Hybrid WRR and SP—This configurable queueing mechanism combines both the SP and WRR mechanisms. The combined method enables the device to give strict priority to delay-sensitive traffic such as VoIP traffic, and weighted round robin priority to other traffic types.

By default, when you select the combined SP and WRR queueing method, the device assigns strict priority to traffic in qosp7 and qosp6, and weighted round robin priority to traffic in qosp0 through qosp5. Thus, the device schedules traffic in queue 7 and queue 6 first, based on the strict priority queueing method. When there is no traffic in queue 7 and queue 6, the device schedules the other queues in round-robin fashion from the highest priority queue to the lowest priority queue.

**NOTE**
Stackable devices that are operating as members of a stack reserve queue 7 for stacking functions. For more information, refer to QoS for Ruckus ICX stackable devices on page 16.

By default, when you specify the combined SP and WRR queuing method, the system balances the traffic among the queues as shown in the following table. If desired, you can change the default bandwidth values.

**TABLE 18** Default bandwidth for combined SP and WRR queueing methods

| Queue | Default bandwidth |
|---|---|
| qosp7 | Strict Priority (highest priority) |
| qosp6 | Strict Priority |
| qosp5 | 25% |
| qosp4 | 15% |
| qosp3 | 15% |
| qosp2 | 15% |
| qosp1 | 15% |
| qosp0 | 15% (lowest priority) |

# IPv6 QoS

QoS features supported for IPv6 environments include packet classification, queueing, traffic shaping, packet marking, and policing of IPv6 packets. These features are available for all FastIron products. The feature set is identical to that in IPv4.

To implement QoS in networks running IPv6, follow the same steps as those to implement QoS in networks running only IPv4. The recommended steps are as follows:

- Identify applications in your network and understand the characteristics of the applications so that you can make decisions about what QoS features to apply.
- Depending on network topology, link-layer header sizes are affected by changes and forwarding.
- Decide the method of classification, marking, and rate limiting. If the same network is carrying IPv4 and IPv6 traffic, decide if you want to treat both the same or differently, and specify match criteria accordingly. If you want to treat them the same, use match statements such as **match dscp** and **set dscp**. If you want to treat them differently, add match criteria such as **match protocol ip** and **match protocol ipv6** in the match criteria.

**NOTE**
The command syntax for IPv6 access control lists (ACLs) is different from the syntax for IPv4. See the “IPv6 ACLs” section in the *Ruckus FastIron Security Configuration Guide*.

# Flow control and buffer management

Using flow control and buffer management techniques, data packet transmission rates and buffer queue capacity can be managed to provide the preferred quality of service (QoS).

Flow control manages the rate of data transmission between two devices to avoid overloading the receiving device with data. Using a technique that allows the receiving device to control the data transmission speed, flow control can prevent data packets being dropped.

Buffer management controls whether the data packets are channeled to buffer queues before processing or allowed to pass through the device. Packet buffer management uses priorities and lower priority data traffic is routed to buffers which have finite memory. If the device buffers are full when a packet arrives, the packet may be dropped.

## Priority flow control

The Ruckus implementation of the priority flow control (PFC) feature prevents frame loss from congestion by pausing traffic based on the congested priority without affecting the traffic of uncongested priorities.

> **NOTE**
> The PFC feature is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices. The ICX 7150, ICX 7650 and ICX 7850 devices do not support PFC.

Flow control enables feedback from a receiver to its sender to communicate buffer availability. The Ruckus implementation of IEEE 802.1Qbb PFC supports eight priorities and four priority groups (PGs) that can be subject to flow control independently. You can configure PGs for priority flow control and ingress buffer management.

> **NOTE**
> PFC in a switch port extender (SPX) environment is only supported on stack units. It is not supported on a Ruckus ICX 7450 switch in an SPX environment.
> PFC is disabled by default. It can be enabled by executing the **priority-flow-control enable** command.

Because multiple priorities can be mapped to a single PG, congestion on one priority in a PG may generate a pause, stopping transmission of all priorities in that PG. Therefore, it is important to create a custom priority-to-PG map to meet your application needs, using either PFC pause honoring or PFC pause transmission.

### *PFC pause honoring*

- The MAC decodes the class enable vector field to extract the priorities and pause the timer value from the packet.
- The per-priority XOFF/XON status is passed to the pausing logic to pause or resume packet scheduling to the corresponding queue of the egress port.

### *PFC pause transmission*

- Priorities 0 through 6 can be mapped to a PG; Priority 7 can not be mapped.
- The mapping is configurable.
- When the buffer threshold of a PG exceeds the XOFF value, a PFC pause frame is sent. The pause frame is encoded with all priorities that belong to the PG in the class enable vector.

A receiver using PFC must predict the potential for buffer exhaustion for a PG and respond by generating an explicit pause frame for that class when that condition arises. At any time, the receiver must have enough ingress buffers available to store any packet that might be in flight while the pause frame travels back to the sender and gets processed there. In Ruckus ICX 7250, ICX 7450, and ICX 7750 devices, the number of ingress buffers is set automatically according to the port speed when PFC is enabled.

**NOTE**
Configuring PFC commands may temporarily interrupt traffic.

You can configure the **qos priority-to-pg** command to change the default priority to PG mapping.

By default, the Ruckus ICX 7250, ICX 7450, and ICX 7750 devices boot up with tail-drop mode, which means that packets are dropped at the egress queues during congestion. By default, all ports honor IEEE 802.3X pause. However, when transmission of the 802.3x pause is disabled, PFC is also disabled. You can configure the **symmetrical-flow-control enable** command to enable the transmission of the 802.3x pause.

**NOTE**
Enabling flow control on ports that have auto-neg enabled causes flap because the port pause capabilities must be advertised and negotiated again with the peer.
Ports that have auto-neg disabled do not experience flap.

### *Conditions*

Ruckus ICX 7150 devices—PFC is not supported.

Ruckus ICX 7250 devices—Symmetrical flow control (SFC) is not supported for ports across stack units.

Ruckus ICX 7450 devices—SFC is not supported for ports across stack units or for ports across master and slave packet processor (pp) devices in Ruckus ICX 7450-48 units.

Ruckus ICX 7650 devices—PFC is not supported.

Ruckus ICX 7750 devices—PFC and SFC are not supported for ports across stack units.

Ruckus ICX 7850 devices— PFC is not supported. SFC is not supported for 1G port as well as for ports across stack units. Port flow control is not supported in 1G port.

# Packet buffer management

The following table lists the packet memory bandwidth and the total packet memory on ICX devices.

**TABLE 19** Packet memory on ICX devices

| ICX device | Total bandwidth | Total packet memory |
|---|---|---|
| Ruckus ICX 7150 | 126 Gbps | 2 MB |
| Ruckus ICX 7250 | 200 Gbps | 4 MB |
| Ruckus ICX 7450 | 200 Gbps | 4 MB |
| Ruckus ICX 7650 | 480 Gbps<br>564 Gbps (IO 48ZP/48ZF)<br>328 Gbps (IO 48P) | 8 MB |
| Ruckus ICX 7750 | 960 Gbps (48C/F)<br>1280 Gbps (32Q) | 12 MB |
| Ruckus ICX 7850 | 2.0 Tb/s<br>3.2 Tb/s | 32 MB |

These devices run in cut-through mode, which means that cut-through eligible packets are not buffered. If a packet must be buffered, it is buffered after Layer 2 and Layer 3 lookup. The packet priority is classified before buffering.

**NOTE**
The ICX 7150, ICX 7250, ICX 7450, and ICX 7650 devices do not run in cut-through mode.

There are two independent packet admission mechanisms: ingress buffer management and egress buffer management.

## Ingress buffer management

On the Ruckus ICX 7150, ingress buffer management tracks buffer utilization on a per-ingress-port basis.

- Loss-less behavior through symmetric flow control is supported.
- Buffers are reserved for high-priority traffic.

As these accounting structures reach their limit, incoming packets to the ingress port are dropped.

On the Ruckus ICX 7250, ICX 7450, 7750 and ICX 7850 devices, ingress buffer management determines whether a packet should be admitted into memory based on the state of available memory and the amount of buffer resources in use by the ingress PG. The aim of the mechanism is to support fair access to buffering resources while also enabling loss-less operation across a network. The memory is logically divided into three sections:

- Guaranteed
- Shared
- Headroom for flow control in on-the-fly packets

Ingress buffer limits are automatically configured based on your configuration to support either loss-less or tail-drop operation. You can configure the **qos ingress-buffer-profile** command to configure a share level, which determines the maximum number of buffers a PG can use as a fraction of the total sharing pool. For example, if PG 0 is at level 4, it can use up to 1/9 of the total sharing buffers in the sharing pool. The actual number of buffers a PG can use depends on the number currently available in the system.

On the Ruckus ICX 7650 and the Ruckus ICX 7850, there is a default profile for ingress buffer management, but it is not configurable because PFC is not supported.

## Egress buffer management

This mechanism tracks buffer utilization on a per-egress port and priority basis. As these accounting structures reach the limit, packets that are destined to the congested egress port-priority are tail-dropped. The aim of the mechanism is to support fair access to the buffering resources among congested egress ports. Any incoming packet is counted only once per egress port regardless of whether it is unicast or multicast. Memory is logically divided into two sections:

- Guaranteed is on a per-port-priority basis.
- Shared is on a per-port basis for the Ruckus ICX 7150 device. It is on a per-port-priority basis for the Ruckus ICX 7250, ICX 7450, 7750, and ICX 7850 devices.

On the Ruckus ICX 7250, ICX 7450, ICX 7650, ICX 7750 and ICX 7850 devices, sharing is a ratio of the remaining buffers. You can configure the share level to determine the maximum number of buffers that an egress queue can use as a fraction of the total sharing pool. For example, if queue 4 is at level 4, it can use up to 1/9 of the total sharing buffers in the sharing pool. You can configure eight levels of sharing. The actual number of buffers that a queue can use depends on the number currently available in the system.

On the Ruckus ICX 7150, buffer sharing is on a per port basis instead of a per queue basis. Also, the buffer sharing level is calculated with a fraction of the total number of buffers. For example, level7-1/2 allows 1/2 of the total buffers as sharing buffers, which is 1 MB.

By default, the ICX 7750 runs in cut-through mode. In contrast, the ICX 7150, ICX 7250, ICX 7450, and the ICX 7650 devices run in store-and-forward as the default mode. In the ICX 7850 device, 1 Gig always operates in store-and-forward mode, irrespective of the global switch mode configuration.

# Configuring QoS

The configuration of QoS includes the following:

- Port priority
- Static MAC entries to priority queues
- QoS marking
- DSCP to internal forwarding priority mappings
- VLAN priority 802.1p to hardware forwarding queue mappings
- Queuing method
- QoS queue naming and percentage of a port outbound bandwidth guaranteed to the queues
- Minimum bandwidth of WRR queues
- Bandwidth allocation for hybrid WRR and SP queues
- Priority flow control
- Ingress and egress buffer profile

## Displaying user-configurable scheduler profile information

Follow these steps to display configurable scheduler profile information.

1. Display a specific profile. The following profile is from the ICX 7650.

```
device# show qos scheduler-profile test
User Scheduler Profile: test    Scheduling Option: Mixed-SP-WRR

Ports attached: (U1)    --
Ports attached: (U2)    --
Ports attached: (LAG)   --
Ports attached: (LAG)   -- Unicast per
Queue details:               Bandwidth%
Traffic Class 0                    15%
Traffic Class 1                    15%
Traffic Class 2                    15%
Traffic Class 3                    15%
Traffic Class 4                    15%
Traffic Class 5                    25%
Traffic Class 6                    sp
Traffic Class 7                    sp
Multicast per Queue details: Bandwidth%
Traffic Class 0                    15%
Traffic Class 1                    15%
Traffic Class 2                    15%
Traffic Class 3                    15%
Traffic Class 4                    15%
Traffic Class 5                    25%
Traffic Class 6                    sp
Traffic Class 7                    sp

Minimum Guaranteed Rate:
Unicast per Queue details:  Bandwidth%
Traffic Class 0                     0
Traffic Class 1                     0
Traffic Class 2                     0
Traffic Class 3                     0
Traffic Class 4                     0
Traffic Class 5                     0
Traffic Class 6                     0
Traffic Class 7                     0
```

2. Display all user profiles.

```
device# show scheduler-profile all

User Scheduler Profile: test    Scheduling Option: Mixed-SP-WRR

Ports attached: (U1)      --
Ports attached: (U2)      --
Ports attached: (LAG)     --
Ports attached: (LAG)     --
Unicast per Queue details:   Bandwidth%
Traffic Class 0                    15%
Traffic Class 1                    15%
Traffic Class 2                    15%
Traffic Class 3                    15%
Traffic Class 4                    15%
Traffic Class 5                    25%
Traffic Class 6                    sp
Traffic Class 7                    sp
Multicast per Queue details: Bandwidth%
Traffic Class 0                    15%
Traffic Class 1                    15%
Traffic Class 2                    15%
Traffic Class 3                    15%
Traffic Class 4                    15%
Traffic Class 5                    25%
Traffic Class 6                    sp
Traffic Class 7                    sp

Minimum Guaranteed Rate:     Bandwidth%
Unicast per Queue details:   Bandwidth%
Traffic Class 0                     0%
Traffic Class 1                     0%
Traffic Class 2                     0%
Traffic Class 3                     0%
Traffic Class 4                     0%
Traffic Class 5                     0%
Traffic Class 6                     0%
Traffic Class 7                     0%

User Scheduler Profile: test2    Scheduling Option: Weighted round-robin

Ports attached: (U1)   --
Ports attached: (U2)   --
Ports attached: (LAG)  --
Ports attached: (LAG)  --
Unicast per Queue details:   Bandwidth%
Traffic Class 0                     3%
Traffic Class 1                     3%
Traffic Class 2                     3%
Traffic Class 3                     3%
Traffic Class 4                     3%
Traffic Class 5                     3%
Traffic Class 6                     7%
Traffic Class 7                    75%
Multicast per Queue details: Bandwidth%
Traffic Class 0                     3%
Traffic Class 1                     3%
Traffic Class 2                     3%
Traffic Class 3                     3%
Traffic Class 4                     3%
Traffic Class 5                     3%
Traffic Class 6                     7%
Traffic Class 7                    75%

Minimum Guaranteed Rate:     Bandwidth%
Unicast per Queue details:   Bandwidth%
Traffic Class 0                     0%
Traffic Class 1                     0%
Traffic Class 2                     0%
Traffic Class 3                     0%
```

```
Traffic Class 4                     0%
Traffic Class 5                     0%
Traffic Class 6                     0%
Traffic Class 7                     0%
```

# Changing a port priority

Follow these steps to change the QoS priority of a specific port.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Enter interface configuration mode.

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

3. Set the port priority.

   ```
   device(config-if-e1000-1/1/1)# priority 7
   ```

   This step assigns priority 7 to untagged switched traffic received on port 1/1/1.

4. Return to privileged EXEC mode.

   ```
   device(config-if-e1000-1/1/1)# end
   ```

5. Verify the configuration.

   ```
   device# show interface brief
   Port       Link    State   Dupl Speed Trunk Tag Pvid Pri MAC             Name
   1/1/1      Down    None    None None  None  Yes 4000 7   cc4e.248b.b050  ERSPAN
   1/1/2      Down    None    None None  None  No  5    0   cc4e.248b.b050
   1/1/3      Down    None    None None  None  No  5    0   cc4e.248b.b052
   1/1/4      Down    None    None None  None  No  5    0   cc4e.248b.b053
   1/1/5      Down    None    None None  2     Yes N/A  0   cc4e.248b.b054
   ...
   ```

   The interface priority is listed under the heading `Pri`.

## *Changing a port priority configuration example*

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# priority 7
device(config-if-e1000-1/1/1)# end
device# show interface brief
```

# Assigning static MAC entries to priority queues

Follow these steps to configure a static MAC entry and assign the entry to the premium queue.

By default, all MAC entries are in the best-effort queue. When you configure a static MAC entry, you can assign the entry to a higher QoS level.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Enter VLAN configuration mode.

```
device(config)# vlan 1
```

3. Assign the priority.

```
device(config-vlan-1)# static-mac-address 0000.0063.67FF ethernet 1/1/1 priority 7
```

4. Return to privileged EXEC mode.

```
device(config-vlan-1)# end
```

5. Verify the MAC address configuration.

```
device# show mac-address ethernet 1/1/1
Total static entries from port 1/1/1 = 1
MAC-Address     Port                Type          VLAN
0000.0063.67ff  1/1/1               Static        1
```

6. Verify the priority configuration.

```
device# show running-config interface ethernet 1/1/1
interface ethernet 1/1/1
 port-name ERSPAN
 dual-mode
 rate-limit input fixed 40000 burst 120000
 mon profile 1 both
 priority 7
 speed-duplex 1000-full
 broadcast limit 96 kbps
 multicast limit 400 kbps
 unknown-unicast limit 96 kbps
 pvst-mode
 port security
  age 2 absolute
!
```

7. Save the configuration.

```
device# write memory
```

## *Assign static MAC entries to priority queues configuration example*

```
device# configure terminal
device(config)# vlan 1
device(config-vlan-1)# static-mac-address 0000.0063.67FF ethernet 1/1/1 priority 7
device(config-vlan-1)# end
device# show mac-address ethernet 1/1/1
device# show running-config interface ethernet 1/1/1
device# write memory
```

# Configuring global DSCP and CoS remarking

Follow these steps to configure global DSCP and CoS remarking. DSCP and CoS remarking are disabled by default.

**NOTE**
When configuring DSCP and CoS values globally, remember that any DSCP values set using ACLs or set for individual ports take precedence over gl;obally configured DSCP or CoS values.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Set the DSCP value.

```
device(config)# ip dscp-remark 3
```

This example shows how to set the DSCP value to 3 for all IP packets.

**NOTE**
If DHCP snooping is enabled, you cannot globally enable DSCP remarking. When you enter the global configuration **ip dscp-remark** command, the following error message is displayed.

```
Error: DHCP Snooping is configured on the system. Cannot enable DSCP remarking
```

3. Enable CoS marking globally and set the PCP value to 3 for all VLAN tagged packets.

```
device(config)# ip pcp-remark 3
```

4. Return to privileged EXEC mode.

```
device(config)# exit
```

5. Save the configuration.

```
device# write memory
```

Global remarking configuration example:

```
device# configure terminal
device(config)# ip dscp-remark 3
device(config)# ip pcp-remark 3
device(config)# exit
device# write memory
```

# Configuring DSCP and CoS remarking at the interface level

Follow these steps to configure DSCP and CoS remarking for specific ports. DSCP and CoS remarking are disabled by default.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter interface configuration mode to set DSCP and CoS values for a specific port.

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

3. Set the DSCP value to 4 of all IP packets on the port.

```
device(config-if-e1000-1/1/1)# ip dscp-remark 4
```

4. Set the PCP value to 4 of all IP packets on the port.

```
device(config-if-e1000-1/1/1)# ip pcp-remark 4
```

5. Return to privileged EXEC mode.

```
device(config-if-e1000-1/1/1)# end
```

6. Verify the configuration.

```
device# show running-config interface ethernet 1/1/1
interface ethernet 1/1/1
 port-name ERSPAN
 dual-mode
 ip dscp-remark 4
 ip pcp-remark 4
 rate-limit input fixed 40000 burst 120000
 mon profile 1 both
 priority 7
 speed-duplex 1000-full
 broadcast limit 96 kbps
 multicast limit 400 kbps
 unknown-unicast limit 96 kbps
 pvst-mode
 port security
 age 2 absolute
!
```

7. Save the configuration.

```
device# write memory
```

DSCP and CoS remarking configuration example for Ethernet interface 1/1/1:

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# ip dscp-remark 4
device(config-if-e1000-1/1/1)# ip pcp-remark 4
device(config-if-e1000-1/1/1)# end
device# show running-config interface ethernet 1/1/1
device# write memory
```

# Changing the DSCP to internal forwarding priority mappings

Follow this example to change the DSCP to internal forwarding priority mappings for all the DSCP ranges.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Change the DSCP to internal forwarding priority mappings.

```
device(config)# qos-tos map dscp-priority 1 2 3 4 5 6 7 8 to 6
device(config)# qos-tos map dscp-priority 8 to 5
device(config)# qos-tos map dscp-priority 16 to 4
device(config)# qos-tos map dscp-priority 24 to 2
device(config)# qos-tos map dscp-priority 32 to 0
device(config)# qos-tos map dscp-priority 40 to 7
device(config)# qos-tos map dscp-priority 48 to 3
device(config)# qos-tos map dscp-priority 56 to 6
```

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration.

```
device# show qos-tos
DSCP-->Traffic-Class map: (DSCP = d1d2: 00, 01...63)

     d2|  0   1   2   3   4   5   6   7   8   9
  d1   |
  -----+----------------------------------------
   0   |  1   6   6   6   6   6   6   6   6   1
   1   |  1   1   1   1   1   1   4   2   2   2
   2   |  2   2   2   2   2   3   3   3   3   3
   3   |  3   3   0   4   4   4   4   4   4   4
   4   |  7   5   5   5   5   5   5   5   3   6
   5   |  6   6   6   6   6   6   6   7   7   7
   6   |  7   7   7   7

Traffic-Class-->802.1p-Priority map (use to derive DSCP--802.1p-Priority):

Traffic | 802.1p
Class   | Priority
--------+---------
   0    |    0
   1    |    1
   2    |    2
   3    |    3
   4    |    4
   5    |    5
   6    |    6
   7    |    7
--------+---------
```

This output displays mappings in the DSCP to forwarding priority portion of the QoS information display. To read this part of the display, select the first part of the DSCP value from the d1 column and select the second part of the DSCP value from the d2 row. For example, to read the DSCP to forwarding priority mapping for DSCP value 24, select 2 from the d1 column and select 4 from the d2 row.

5. Save the configuration.

```
device# write memory
```

### *Change the DSCP to internal forwarding priority mappings configuration example*

```
device# configure terminal
device(config)# qos-tos map dscp-priority 1 2 3 4 5 6 7 8 to 6
device(config)# qos-tos map dscp-priority 8 to 5
device(config)# qos-tos map dscp-priority 16 to 4
device(config)# qos-tos map dscp-priority 24 to 2
device(config)# qos-tos map dscp-priority 32 to 0
device(config)# qos-tos map dscp-priority 40 to 7
device(config)# qos-tos map dscp-priority 48 to 3
device(config)# qos-tos map dscp-priority 56 to 6
device(config)# exit
device# show qos-tos
device# write memory
```

## Changing the VLAN priority 802.1p to hardware forwarding queue mappings

Follow this example to map a VLAN priority to a different hardware forwarding queue.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Map a VLAN priority.

```
device(config)# qos tagged-priority 2 qosp0
802.1p priority 2 mapped to qos profile qosp0
```

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration.

```
device# show running-config | include qosp0
qos scheduler-profile voice profile qosp0 15 qosp1 15 qosp2 15 qosp3 15 qosp4 15 qosp5 25 qosp6 sp
qosp7 sp
...
qos tagged-priority 2 qosp0
```

5. Save the configuration.

```
device# write memory
```

### *Change the VLAN priority 802.1p to hardware forwarding queue mappings configuration example*

```
device# configure terminal
device(config)# qos tagged-priority 2 qosp0
device(config)# exit
device# show running-config | include qosp0
device# write memory
```

## Selecting the QoS queuing method

Follow these steps to change the queuing method.

By default, Ruckus devices use the weighted round robin (WRR) method of packet prioritization.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Select the QoS queuing method.

   - Change the queuing method to strict priority (SP).

     ```
     device(config)# qos mechanism strict
     bandwidth scheduling mechanism: strict priority
     Qos profile bandwidth percentages are ignored
     ```

   - Change the queuing method to mixed SP and WRR.

     ```
     device(config)# qos mechanism mixed-sp-wrr
     bandwidth scheduling mechanism: mixed weighted priority with strict priority
     Unicast Traffic
     Profile qosp7     : Priority7(Highest) Set as strict priority
     Profile qosp6     : Priority6          Set as strict priority
     Profile qosp5     : Priority5          bandwidth requested  25% calculated  25%
     Profile qosp4     : Priority4          bandwidth requested  15% calculated  15%
     Profile qosp3     : Priority3          bandwidth requested  15% calculated  15%
     Profile qosp2     : Priority2          bandwidth requested  15% calculated  15%
     Profile qosp1     : Priority1          bandwidth requested  15% calculated  15%
     Profile qosp0     : Priority0(Lowest)  bandwidth requested  15% calculated  15%
     Multicast Traffic
     Profile qosp7                           : Priority7(Highest)        Set as strict priority
     Profile qosp6                           : Priority6                 Set as strict priority
     Profile qosp5                           : Priority5                 bandwidth requested  25%
     calculated  25%
     Profile qosp4                           : Priority4                 bandwidth requested  15%
     calculated  15%
     Profile qosp3                           : Priority3                 bandwidth requested  15%
     calculated  15%
     Profile qosp2                           : Priority2                 bandwidth requested  15%
     calculated  15%
     Profile qosp1                           : Priority1                 bandwidth requested  15%
     calculated  15%
     Profile qosp0                           : Priority0(Lowest)         bandwidth requested  15%
     calculated  15%
     ```

   Observe that the verification step is not necessary with either of these choices.

3. Return to privileged EXEC mode.

   ```
   device(config)# exit
   ```

4. Verify the configuration

```
device# show qos scheduler-profile all
User Scheduler Profile: test    Scheduling Option: Mixed-SP-WRR

Ports attached: (U1)      --
Ports attached: (U2)      --
Ports attached: (LAG)     --
Ports attached: (LAG)     --
Unicast per Queue details:      Bandwidth%
Traffic Class 0                     15%
Traffic Class 1                     15%
Traffic Class 2                     15%
Traffic Class 3                     15%
Traffic Class 4                     15%
Traffic Class 5                     25%
Traffic Class 6                     sp
Traffic Class 7                     sp
Multicast per Queue details:    Bandwidth%
Traffic Class 0                     15%
Traffic Class 1                     15%
Traffic Class 2                     15%
Traffic Class 3                     15%
Traffic Class 4                     15%
Traffic Class 5                     25%
Traffic Class 6                     sp
Traffic Class 7                     sp

Minimum Guaranteed Rate:        Bandwidth%
Unicast per Queue details:      Bandwidth%
Traffic Class 0                      0%
Traffic Class 1                      0%
Traffic Class 2                      0%
Traffic Class 3                      0%
Traffic Class 4                      0%
Traffic Class 5                      0%
Traffic Class 6                      0%
Traffic Class 7                      0%
```

5. Save the configuration.

```
device# write memory
```

### *Select the QoS queuing method configuration example*

```
device# configure terminal
device(config)# qos mechanism mixed-sp-wrr
device(config)# exit
device# show qos scheduler-profile all
device# write memory
```

## Configuring the QoS queue name and guaranteed bandwidth

Follow these steps to change a queue name and the minimum percentage of a port outbound bandwidth guaranteed to the queue.

**NOTE**
Stackable devices that are operating as members of a stack reserve queue 7 for stacking functions.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Change minimum percentage of a port outbound bandwidth guaranteed to the queues.

```
device(config)# qos guaranteed-rate qosp0 10 qosp1 10 qosp2 15 qosp3 15 qosp4 10 qosp5 10 qosp6 10
qosp7 10
```

3. Change the name of QoS queue 3.

```
device(config)# qos name qosp3 r3d3
```

   The default queue names are qosp7, qosp6, qosp5, qosp4, qosp3, qosp2, qosp1, and qosp0. You can change one or more of the names if desired.

4. Return to privileged EXEC mode.

```
device(config)# exit
```

5. Verify the configuration

```
device# show qos guaranteed-rate
Profile qosp7     : Minimum Guaranteed bandwidth 10
Profile qosp6     : Minimum Guaranteed bandwidth 10
Profile qosp5     : Minimum Guaranteed bandwidth 10
Profile qosp4     : Minimum Guaranteed bandwidth 10
Profile r3d3      : Minimum Guaranteed bandwidth 15
Profile qosp2     : Minimum Guaranteed bandwidth 15
Profile qosp1     : Minimum Guaranteed bandwidth 10
Profile qosp0     : Minimum Guaranteed bandwidth 10
```

6. Save the configuration.

```
device# write memory
```

### *QoS queue configuration example*

```
device# configure terminal
device(config)# qos guaranteed-rate qosp0 10 qosp1 10 qosp2 15 qosp3 15 qosp4 10 qosp5 10 qosp6 10 qosp7
10
device(config)# qos name qosp3 r3d3
device(config)# exit
device# show qos guaranteed-rate
device# write memory
```

## Changing the minimum bandwidth percentages of the WRR queues

If you are using the weighted round robin mechanism instead of the strict priority mechanism, you can change the weights for each queue by changing the minimum percentage of bandwidth you want each queue to guarantee for its traffic.

By default, the eight QoS queues on Ruckus FastIron devices receive the minimum guaranteed percentages of a port's total bandwidth, as shown in the following table. Note that the defaults differ when jumbo frames are enabled.

**TABLE 20** Default minimum bandwidth percentages on Ruckus ICX devices

| Queue | Default minimum percentage of bandwidth | |
|---|---|---|
| | Without jumbo frames | With jumbo frames |
| qosp7 | 75% | 44% |
| qosp6 | 7% | 8% |
| qosp5 | 3% | 8% |
| qosp4 | 3% | 8% |

**TABLE 20** Default minimum bandwidth percentages on Ruckus ICX devices (continued)

| Queue | Default minimum percentage of bandwidth | |
|---|---|---|
| qosp3 | 3% | 8% |
| qosp2 | 3% | 8% |
| qosp1 | 3% | 8% |
| qosp0 | 3% | 8% |

When the queuing method is WRR, the software internally translates the percentages into weights. The weight associated with each queue controls how many packets are processed for the queue at a given stage of a cycle through the weighted round robin algorithm.

**NOTE**
Queue cycles on the FastIron devices are based on bytes. These devices service a given number of bytes (based on the weight) in each queue cycle.
The bandwidth allocated to each queue is based on the relative weights of the queues. You can change the bandwidth percentages allocated to the queues by changing the queue weights.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Change the bandwidth percentages for the queues.

```
device(config)# qos profile qosp7 25 qosp6 15 qosp5 12 qosp4 12 qosp3 10 qosp2
10 qosp1 10 qosp0 6
Profile qosp7 : Priority7 bandwidth requested 25% calculated 25%
Profile qosp6 : Priority6 bandwidth requested 15% calculated 15%
Profile qosp5 : Priority5 bandwidth requested 12% calculated 12%
Profile qosp4 : Priority4 bandwidth requested 12% calculated 12%
Profile qosp3 : Priority3 bandwidth requested 10% calculated 10%
Profile qosp2 : Priority2 bandwidth requested 10% calculated 10%
Profile qosp1 : Priority1 bandwidth requested 10% calculated 10%
Profile qosp0 : Priority0 bandwidth requested 6% calculated 6%
```

The assigned bandwidths must total 100%. The configuration is immediately verified by the command output.

There is no minimum bandwidth requirement for a given queue.

**NOTE**
FastIron devices do not adjust the bandwidth percentages you enter.

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Save the configuration.

```
device# write memory
```

## *Change the minimum bandwidth percentages of the WRR queues example*

```
device# configure terminal
device(config)# qos profile qosp7 25 qosp6 15 qosp5 12 qosp4 12 qosp3 10 qosp2
10 qosp1 10 qosp0 6
device(config)# exit
device# write memory
```

# Allocating bandwidth for hybrid WRR and SP queues

Follow these steps to change the default bandwidth percentages for the queues when the device is configured to use the combined SP and WRR queuing mechanism.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Change minimum percentage of a port outbound bandwidth guaranteed to the queues.

```
device(config)# qos profile qosp7 sp qosp6 sp qosp5 20 qosp4 15 qosp3 15 qosp2 20  qosp1 15 qosp0 15
bandwidth scheduling mechanism: mixed weighted priority with strict priority
Unicast Traffic
Profile qosp7: Priority7(Highest) Set as strict priority
Profile qosp6: Priority6          Set as strict priority
Profile qosp5: Priority5          bandwidth requested  20% calculated  20%
Profile qosp4: Priority4          bandwidth requested  15% calculated  15%
Profile qosp3: Priority3          bandwidth requested  15% calculated  15%
Profile qosp2: Priority2          bandwidth requested  20% calculated  20%
Profile qosp1: Priority1          bandwidth requested  15% calculated  15%
Profile qosp0: Priority0(Lowest)  bandwidth requested  15% calculated  15%
Multicast Traffic
Profile qosp7+qosp6            : Priority7(Highest),6  Set as strict priority
Profile qosp5+qosp4+qosp3+qosp2: Priority5,4,3,2       bandwidth requested  70% calculated  70%
Profile qosp1+qosp0            : Priority1,0(Lowest)   bandwidth requested  30% calculated  30%
```

   The assigned bandwidths must total 100%. The configuration is immediately verified by the command output.

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Display all QoS configuration settings.

```
device# show running-config | include qos
qos ingress-buffer-profile prof1 priority-group 0 xoff level2-1/32
qos ingress-buffer-profile prof1 priority-group 2 xoff level2-1/32
qos ingress-buffer-profile prof1 priority-group 3 xoff level2-1/32
qos ingress-buffer-profile prof1 priority-group 1 xoff level1-1/64
qos mechanism mixed-sp-wrr
qos profile qosp7 sp qosp6 sp qosp5 20 qosp4 15 qosp3 15 qosp2 20 qosp1 15 qosp0 15
qos scheduler-profile voice mechanism mixed-sp-wrr
qos scheduler-profile voice profile qosp0 15 qosp1 15 qosp2 15 qosp3 15 qosp4 15 qosp5 25 qosp6 sp
qosp7 sp
qos scheduler-profile voice guaranteed-rate qosp0 5 qosp1 5 qosp2 5 qosp3 5 qosp4 5 qosp5 25 qosp6 5
qosp7 5
qos priority-to-pg  qosp0 0 qosp1 0 qosp2 1 qosp3 1 qosp4 1 qosp5 2 qosp6 3 qosp7 4
qos guaranteed-rate qosp7 10 qosp6 10 qosp5 10 qosp4 10 qosp3 15 qosp2 15 qosp1 10 qosp0 10
qos tagged-priority 2 qosp0
qos-tos map dscp-priority 32 to 0
qos-tos map dscp-priority 0 to 1
qos-tos map dscp-priority 24 to 2
qos-tos map dscp-priority 48 to 3
qos-tos map dscp-priority 16 to 4
qos-tos map dscp-priority 1 2 3 4 5 6 7 8 to 6
qos-tos map dscp-priority 56 to 6
qos-tos map dscp-priority 40 to 7
```

5. Display information about QoS profiles.

```
device# show qos-profiles all
bandwidth scheduling mechanism: mixed weighted priority with strict priority
Unicast Traffic
Profile qosp7: Priority7(Highest) Set as strict priority
Profile qosp6: Priority6          Set as strict priority
Profile qosp5: Priority5          bandwidth requested  20% calculated  20%
Profile qosp4: Priority4          bandwidth requested  15% calculated  15%
Profile qosp3: Priority3          bandwidth requested  15% calculated  15%
Profile qosp2: Priority2          bandwidth requested  20% calculated  20%
Profile qosp1: Priority1          bandwidth requested  15% calculated  15%
Profile qosp0: Priority0(Lowest)  bandwidth requested  15% calculated  15%
Multicast Traffic
Profile qosp7+qosp6            : Priority7(Highest),6      Set as strict priority
Profile qosp5+qosp4+qosp3+qosp2: Priority5,4,3,2           bandwidth requested  70% calculated  70%
Profile qosp1+qosp0            : Priority1,0(Lowest)       bandwidth requested  30% calculated  30%
```

6. Save the configuration.

```
device# write memory
```

### *Allocate bandwidth for hybrid WRR and SP queues configuration example*

```
device# configure terminal
device(config)# qos profile qosp7 sp qosp6 sp qosp5 20 qosp4 15 qosp3 15 qosp2 20  qosp1 15 qosp0 15
device(config)# exit
device# show running-config | include qos
device# write memory
```

## Enabling priority flow control globally

Follow these steps to enable PFC globally.

**NOTE**
PFC is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices. The ICX 7150, ICX 7650, and the ICX 7850 devices do not support PFC.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enable PFC globally.

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

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration.

```
device# show priority-flow-control
Global PFC Status: Enabled
PFC Disabled on PG0
PFC Disabled on PG1
PFC Enabled on PG2
PFC Disabled on PG3
```

5. Save the configuration.

```
device# write memory
```

### *Enable priority flow control globally configuration example*

```
device# configure terminal
device(config)# priority-flow-control enable
device(config)# exit
device# show priority-flow-control
device# write memory
```

## Enabling priority flow control for a single priority group

Follow these steps to enable PFC for a single priority group (PG).

**NOTE**
PFC is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices. The ICX 7150, ICX 7650, and the ICX 7850 devices do not support PFC.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enable PFC for PG 1.

```
device(config)# priority-flow-control 1
```

There are four PGs numbered from 0 through 3.

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration.

```
device# show priority-flow-control
Global PFC Status: Enabled
PFC Disabled on PG0
PFC Enabled on PG1
PFC Enabled on PG2
PFC Disabled on PG3
```

Observe that PFC for PG 1 is enabled.

5. Save the configuration.

```
device# write memory
```

### *Enable priority flow control for a single priority group configuration example*

```
device# configure terminal
device(config)# priority-flow-control 1
device(config)# exit
device# show priority-flow-control
device# write memory
```

# Enabling priority flow control on an interface

Follow these steps to enable PFC on an interface.

> **NOTE**
> PFC is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices. The ICX 7150, ICX 7650, and the ICX 7850 devices do not support PFC.

PFC must be enabled on at least one PG before you can use this command to configure an interface.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enable interface configuration mode.

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

3. Enable PFC on the interface.

```
device(config-if-e10000-1/1/1)# priority-flow-control enable
```

4. Return to privileged EXEC mode.

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

5. Verify the configuration.

```
device# show running-config interface ethernet 1/1/1
interface ethernet 1/1/1
 port-name ERSPAN
 dual-mode
 ip dscp-remark 4
 ip pcp-remark 4
 rate-limit input fixed 40000 burst 120000
 mon profile 1 both
 priority 7
 speed-duplex 1000-full
 broadcast limit 96 kbps
 multicast limit 400 kbps
 unknown-unicast limit 96 kbps
 pvst-mode

 priority-flow-control enable

 port security
 age 2 absolute
!
```

   Observe that PFC for PG 1 is enabled.

6. Save the configuration.

```
device# write memory
```

## *Enable PFC on an interface configuration example*

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e10000-1/1/1)# priority-flow-control enable
device(config-if-e10000-1/1/1)# exit
device# show running-config interface ethernet 1/1/1
device# write memory
```

# Enabling priority flow control on multiple ports

Follow these steps to enable PFC on multiple ports.

> **NOTE**
> PFC is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices. The ICX 7150, ICX 7650, and the ICX 7850 devices do not support PFC.

PFC must be enabled on at least one PG before you can configure this feature on an interface.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter interface configuration mode for multiple interfaces.

```
device(config)# interface ethernet 1/1/2 ethernet 1/1/3
```

3. Enable PFC on the interfaces.

```
device(config-mif-1/1/2,1/1/4)# priority-flow-control enable
```

4. Enter interface configuration mode for a range of interfaces.

```
device(config-mif-1/1/2,1/1/4)# interface ethernet 1/1/17 to 1/1/20
```

5. Enable PFC on the interfaces.

```
device(config-mif-1/1/17-1/1/24)# priority-flow-control enable
```

6. Return to privileged EXEC mode.

```
device(config-mif-1/1/32-1/1/43)# end
```

7. Verify the configuration.

```
device# show running-config interface ethernet 1/1/2 ethernet 1/1/4
interface ethernet 1/1/2
 ip address 1.1.1.1 255.255.255.0
 ip address 2.2.2.2 255.255.255.0
 rate-limit input fixed 40000 burst 125000
 rate-limit output shaping 1304
 rate-limit output shaping 500 priority 7
 priority-flow-control enable
!
interface ethernet 1/1/4
 priority-flow-control enable
!
device# show running-config interface ethernet 1/1/17 to 1/1/20
interface ethernet 1/1/17
 priority-flow-control enable
!
interface ethernet 1/1/18
 priority-flow-control enable
!
interface ethernet 1/1/19
 priority-flow-control enable
!
interface ethernet 1/1/20
 priority-flow-control enable
!
```

8. Save the configuration.

```
device# write memory
```

### *Enable priority flow control on multiple ports configuration example*

```
device# configure terminal
device(config)# interface ethernet 1/1/2 ethernet 1/1/3
device(config-mif-1/1/2,1/1/4)# priority-flow-control enable
device(config-mif-1/1/2,1/1/4)# interface ethernet 1/1/17 to 1/1/20
device(config-mif-1/1/17-1/1/24)# priority-flow-control enable
device(config-mif-1/1/32-1/1/43)# end
device# show running-config interface ethernet 1/1/2 ethernet 1/1/4
device# show running-config interface ethernet 1/1/17 to 1/1/20
device# write memory
```

## Configuring the share level for an ingress buffer profile

Follow these steps to configure the share level for an ingress buffer profile.

The share level is the maximum number of buffers that a priority group (PG) can use as a portion of the of the total sharing pool.

**NOTE**
Configuration of the ingress buffer share level is supported only on Ruckus ICX 7250, ICX 7450, and ICX 7750 devices.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure the share level.

```
device(config)# qos ingress-buffer-profile prof1 priority-group 0 xoff level6-1/3
```

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration

```
device# show qos ingress-buffer-profile prof1
Ingress Buffer Profile: prof1
Ports attached:  --
Per PG Details:  XOFF Level:
PG 0                    level6-1/3
PG 1                    level1-1/64
PG 2                    level2-1/32
PG 3                    level2-1/32
```

5. Save the configuration.

```
device# write memory
```

### *Ingress buffer profile configuration example*

```
device# configure terminal
device(config)# qos ingress-buffer-profile prof1 priority-group 0 xoff level6-1/3
device(config)# exit
device# show qos ingress-buffer-profile prof1
device# write memory
```

# Configuring the share queue level for an egress buffer profile

The share level is the maximum number of buffers that a priority group (PG) can use as a portion of the total sharing pool.

> **NOTE**
> Configuration of the egress buffer share queue level is supported only on Ruckus ICX 7250, ICX 7450, ICX 7650, ICX 7750, and ICX 7850 devices.

Follow these steps to configure the egress buffer share queue level.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure the share level.

```
device(config)# qos egress-buffer-profile egress1 queue-share-level level3-1/16 7
```

3. Return to privileged EXEC mode.

```
device(config)# exit
```

4. Verify the configuration

```
device# show qos egress-buffer-profile egress1
Egress Buffer Profile: egress1
Ports attached:  --

 Per Queue Details:      Share Level:
Queue 0                  level5-1/5
Queue 1                  level4-1/9
Queue 2                  level4-1/9
Queue 3                  level4-1/9
Queue 4                  level4-1/9
Queue 5                  level4-1/9
Queue 6                  level4-1/9
Queue 7                  level3-1/16
```

5. Save the configuration.

```
device# write memory
```

## *Share queue level for an egress buffer profile configuration example*

```
device# configure terminal
device(config)# qos egress-buffer-profile egress1 queue-share-level level3-1/16 7
device(config)# exit
device# show qos egress-buffer-profile egress1
device# write memory
```

# Configuring the share port level for an egress buffer profile

The share port level for an egress buffer profile defines the maximum number of buffers that a port can use as a portion of the total memory.

> **NOTE**
> The configuration of the egress buffer share port level is supported only on the Ruckus ICX 7150. For the Ruckus ICX 7250, ICX 7450, ICX 7650, ICX 7750, and ICX 7850 devices, you can change the queue share level for an individual queue which has a finer granularity than the port share level for an individual port.

After the egress-buffer share port level is defined, it can be associated with one or more ports.

Perform the following steps to configure the egress-buffer share port level.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure the share level.

```
device(config)# qos egress-buffer-profile egress2 port-share-level level3-1/16
```

   In this step, the egress2 buffer profile is configured with a queue share level 3 for a maximum 1/16 portion of the total buffer memory that can be used in a sharing pool.

3. Access interface mode for the port to which you want to apply the profile.

```
device(config)# interface ethernet 2/1/4
```

4. Attach the profile to the port.

```
device(config-if-e10000-2/1/4)# egress-buffer-profile egress2
```

5. Return to privileged EXEC mode.

```
device(config)# Ctrl-z
```

6. Verify the configuration

```
device# show qos egress-buffer-profile egress2
Egress Buffer Profile: egress2
Ports attached:  2/1/4

Port share level: level3-1/16
```

7. Save the configuration.

```
device# write memory
```

### *Share port level for an egress buffer profile configuration example*

```
device# configure terminal
device(config)# qos egress-buffer-profile egress2 port-share-level level3-1/16
device(config)# interface ethernet 2/1/4
device(config-if-e10000-2/1/4)# egress-buffer-profile egress2
device(config)# Ctrl-z
device# show qos egress-buffer-profile egress2
device# write memory
```

## Configuring a port to the egress queue drop counters

The Ruckus ICX 7150 has only one set of egress queue drop counters and can monitor only one port for the incrementing of the counters. By default, the device monitors the local CPU port for control packet drops. However, you can configure the device to monitor a different port for packet drops.

On the Ruckus ICX 7250, ICX 7450, ICX 7750 and ICX 7850 devices, each port has its own set of drop counters.

**NOTE**
This task is supported only on the Ruckus ICX 7150.

Perform the following steps to configure a port that the device monitors for the egress queue drop counters.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Configure the port that the device monitors for the egress queue drop counters.

```
device(config)# qos monitor-queue-drop-counters 1/1/12
```

   In this step, the counters are associated to port 1/1/12.

3. Return to privileged EXEC mode.

```
device(config)# Ctrl-z
```

4. Verify the configuration

```
device# show running-config | include qos
...
qos monitor-queue-drop-counters 1/1/12
...
```

5. Save the configuration.

```
device# write memory
```

## *Egress queue drop counters configuration example*

```
device# configure terminal
device(config)# qos monitor-queue-drop-counters 1/1/12
device# write memory
```

To display the queue drop counters, use the **show interfaces ethernet** command for the port.

# Rate Limiting and Rate Shaping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# Rate Limiting

## Non ACL-based rate limiting

### *Port-based fixed rate limiting configuration notes*

- Rate limiting is available only on inbound ports.
- Ingress port rate-limiting and egress port-shaping are supported on PE ports.
- The rate limit on IPv6 hardware takes several seconds to take effect at higher configured rate limit values. For example, if the configured rate limit is 750 Mbps, line-rate limiting could take up to 43 seconds to take effect.
- You can enable rate limiting on Static LAG only. You cannot enable rate limiting on other types of LAG.
- You can configure rate limiting on individual ports of the LAG. You cannot configure rate limiting on the LAG itself.
- The Ruckus ICX 7650 applies rating limiting starting with the Layer 1 overhead. All other ICX devices begin counting the packet size from the Layer 2 header onwards.

#### Port-based fixed rate limiting

You can configure a fixed rate limiting policy on a port in the inbound direction only. This feature allows you to specify the maximum number of bytes in kilobits per second (kbps) a given port can receive. The port drops bytes that exceed the limit you specify.

Fixed rate limiting applies to all traffic on the rate-limited port. It counts the number of bytes that a port receives in one second intervals. If the number of bytes exceeds the maximum number you specified when you configured the rate, the port drops all further inbound packets for the duration of the one-second interval. Unused bandwidth is not carried over from one interval to the next. Once the one-second interval is complete, the port clears the counter and re-enables traffic.

> **NOTE**
> Ruckus recommends that you do not use fixed rate limiting on ports that receive route control traffic or Spanning Tree Protocol (STP) control traffic. If the port drops control packets due to the Fixed rate limiting policy, routing or STP can be disrupted.

When you specify the maximum number of bytes, you specify it in kilobits per second (kbps). The fixed rate limiting policy applies to one-second intervals and allows the port to receive the number of bytes you specify in the policy but drops additional bytes. Unused bandwidth is not carried over from one interval to the next.

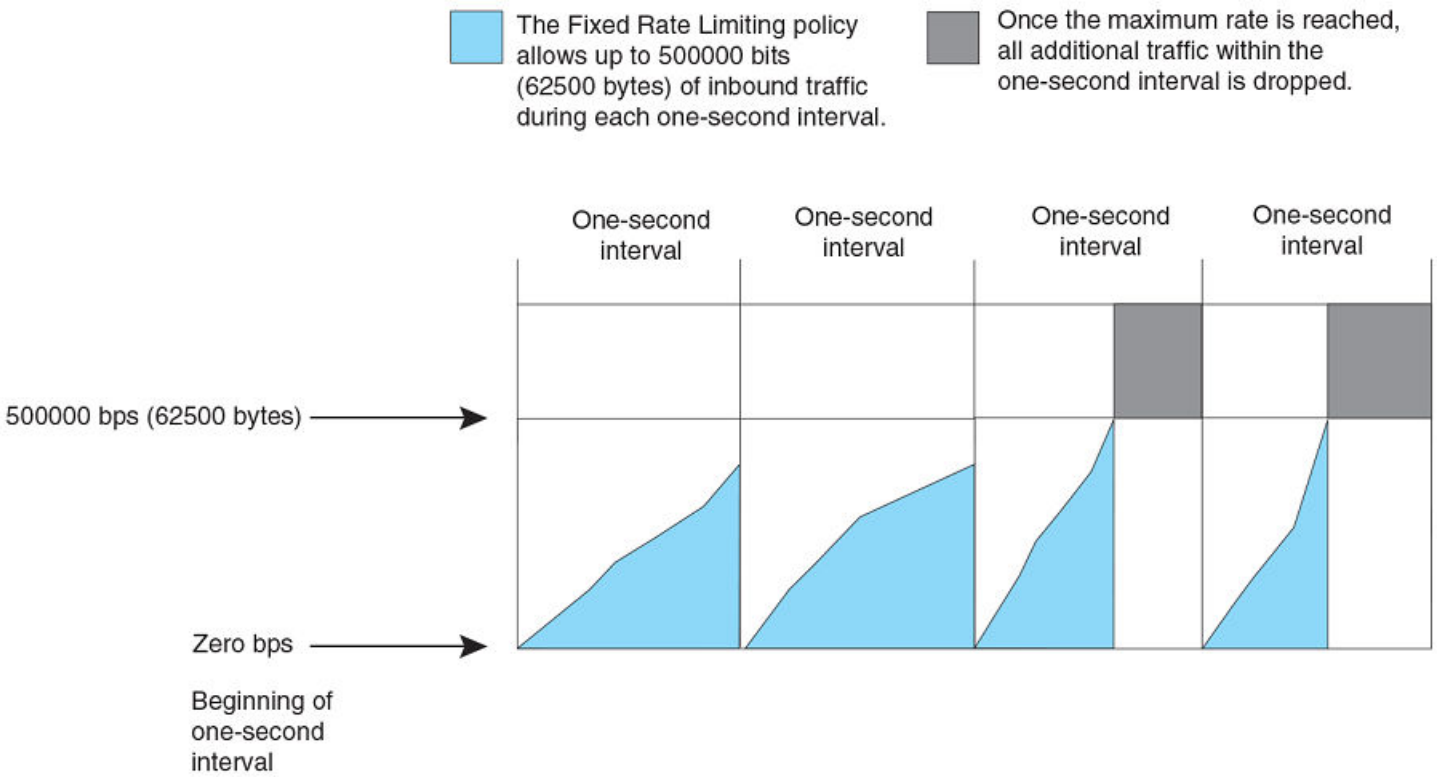
Unused bandwidth can be used to consume bursts in traffic. When a group of packets which has shorter inter-packet gaps comes in, a higher bandwidth is required to consume these bursts. This additional bandwidth is borrowed from unused bandwidth in an set interval.

Each device supports line-rate rate limiting in hardware. The device creates entries in Content Addressable Memory (CAM) for the rate limiting policies. CAM entries enable the device to perform the rate limiting in hardware instead of sending the traffic to the CPU. The device sends the first packet in a given traffic flow to the CPU, which creates a CAM entry for the traffic flow. A CAM entry consists of the source and destination addresses of the traffic. The device uses the CAM entry for rate limiting all the traffic within the same flow. A rate limiting CAM entry remains in the CAM for two minutes before aging out.

## How port-based fixed rate limiting works

The following figure shows an example of how fixed rate limiting works. In this example, a fixed rate limiting policy is applied to a port to limit the inbound traffic to 500,000 bits (62,500 bytes) a second. During the first two one-second intervals, the port receives less than 500,000 bits in each interval. However, the port receives more than 500,000 bits during the third and fourth one-second intervals and consequently drops the excess traffic.

**FIGURE 3** Fixed rate limiting

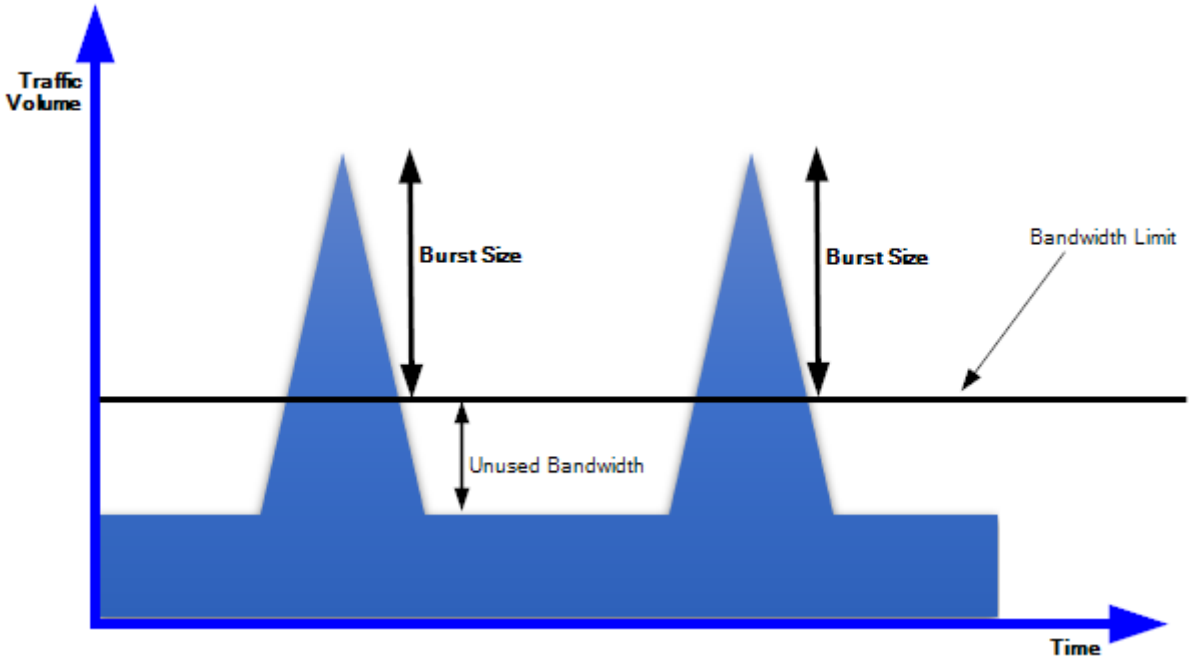



**NOTE**

The software counts the bytes by polling statistics counters for the port every 100 milliseconds, which provides 10 readings each second. As such, the fixed rate limiting policy has an accuracy of within 10% of the port's line rate. It is possible, then, for the policy to sometimes allow more traffic than the limit you specify, but the extra traffic is never more than 10% of the port's line rate.

The following figure shows how adding a burst size to fixed rate limiting works.

**FIGURE 4** Rate Limiting with Burst Option




An example of this is, traffic coming into port 1 and going out of port 2 is a 1G link. The rate is limited to 10Mb on port one. This means only 10Mb data is going out of port 2. If only 9MB of traffic is sent, it will all go through without even hitting the set rate-limit. This leaves 1Mb of unused bandwidth. This 1Mb of unused bandwidth can be borrowed in case if a burst of packets comes in. Now, the "rate-limit fixed 10000 **burst <burst size>"** can be used if you want to restrict the borrowing of 1M to say only 0.1M.

## *CPU rate limiting*

CPU rate limiting is a CPU protection scheme that limits certain traffic types.

Unnecessary traffic to the switch CPU lowers the efficiency of the CPU and delays handling of other traffic that requires processing. CPU rate limiting identifies the traffic type and assigns a maximum rate limit to the traffic type. The traffic types which are subjected to rate limiting include broadcast ARP and other exceptions, such as TTL exceed, IP MTU failed, reverse path check failed, IP fragments, and unsupported tunneling. Each of these types is rate-limited individually.

The following table shows the rate limits for each rate-limited packet type. You cannot configure these rates.

All currently supported FastIron devices support the CPU rate-limiting feature.

**TABLE 21** CPU rate limits for packet type

| Packet type | Rate limit in packets per second |
|---|---|
| ARP | 6000 |
| IP TTL exceed | 150 |
| Reverse path check failed | |
| IP MTU failed | 3000 |
| IP tunnel-terminated packets which are fragmented or has options | |
| IP tunnel-terminated packets with unsupported GRE tunnel header | |

**TABLE 21** CPU rate limits for packet type (continued)

| Packet type | Rate limit in packets per second |
|---|---|
| IP Unicast packets mirrored to CPU due to ICMP redirect | 100 |
| Bridge packets forward to CPU | 5000 |

### *Rate limiting broadcast, unknown unicast, and multicast traffic*

Ruckus ICX devices can forward all flooded traffic at wire speed within a VLAN. However, some third party networking devices cannot handle high rates of broadcast, unknown unicast, and multicast (BUM) traffic.

If high rates of traffic are being received by the device on a given port of that VLAN, you can limit the number of BUM packets or bytes received each second on that port. This can help to control the number of such packets or bytes that are flooded on the VLAN to other devices.

Ruckus ICX devices support byte-based and packet-based rate limiting.

**NOTE**
We do not support BUM rate-limiting on PE ports in an SPX environment.

# Traffic policy ACL-based rate limiting

### *Traffic policies for ACL-based rate limit configuration notes*

Traffic policies are rules that define rate limits on packets permitted by ACLs. As traffic policies apply rate limits on specific interfaces using ACLs, this method is also called ACL-based rate limiting.

The process for applying a traffic policy to an interface involves:

1. Creating a traffic policy
2. Adding a reference to the traffic policy in an ACL entry
3. Binding the ACL associated with this ACL entry to an interface

Traffic policies consist of policy names and policy definitions::

- Traffic policy name—A string of up to eight alphanumeric characters that identifies individual traffic policy definitions.
- Traffic policy definition (TPD)—The command filter associated with a traffic policy name. A TPD can define any one of the following:
  - Rate limiting policy
  - ACL counting policy
  - Combined rate limiting and ACL counting policy

#### ACL-based rate limiting using traffic policies

ACL-based rate limiting provides the facility to limit the rate for IP traffic that matches the permit conditions in extended IP ACLs. This feature is available in the Layer 2 and Layer 3 code.

To configure ACL-based rate limiting, you create individual traffic policies , and then reference the traffic policies in one or more ACL entries (also called clauses or statements). The traffic policies become effective on ports to which the ACLs are bound.

When you configure a traffic policy for rate limiting, the device automatically enables rate limit counting, similar to the two-rate three-color marker (trTCM) mechanism described in RFC 2698 for adaptive rate limiting, and the single-rate three-color marker (srTCM) mechanism described in RFC 2697 for fixed rate limiting. This feature counts the number of bytes and trTCM or srTCM conformance level per packet to which rate limiting traffic policies are applied.

You can configure ACL-based rate limiting on the following interface types:

- Physical Ethernet interfaces
- Virtual interfaces
- Trunk ports
- Specific VLAN members on a port.
- A subset of ports on a virtual interface.

For more information on ACLs, refer to the *Ruckus FastIron Security Configuration Guide*.

### ACL-based fixed rate limiting

Fixed rate limiting enforces a strict bandwidth limit. The device forwards traffic that is within the limit but either drops all traffic that exceeds the limit, or forwards all traffic that exceeds the limit at the lowest priority level, according to the action specified in the traffic policy.

### ACL-based adaptive rate limiting

Adaptive rate limiting enforces a flexible bandwidth limit that allows for bursts above the limit. You can configure adaptive rate limiting to forward traffic, modify the IP precedence of and forward traffic, or drop traffic based on whether the traffic is within the limit or exceeds the limit.

## *Traffic policies for ACL-based rate limit restrictions and limitations*

When you apply a traffic policy to an interface, you do so by adding a reference to the traffic policy in an ACL entry, instead of applying the individual traffic policy to the interface. The traffic policy becomes an active traffic policy or active TPD when you bind its associated ACL to an interface.

Note the following when configuring traffic policies:

- Traffic policies applies to IP ACLs only.
- The maximum number of supported active TPDs is a system-wide parameter and depends on the device you are configuring. The total number of active TPDs cannot exceed the system maximum. Refer to the “Maximum number of traffic policies supported on a device” section.
- You can reference the same traffic policy in more than one ACL entry within an ACL. For example, two or more ACL statements in ACL 101 can reference a TPD named TPD1.
- You can reference the same traffic policy in more than one ACL. For example, ACLs 101 and 102 could both reference a TPD named TPD1.
- Rate limits and ACL counting are applied at the traffic policy level, and are cumulative across ACLs and ACL entries on which they are applied. However, they are not cumulative across port regions.
- To modify or delete an active traffic policy, you must first unbind the ACL that references the traffic policy.
- When you define a TPD (when you enter the traffic-policy command), explicit marking of CoS parameters, such as traffic class and 802.1p priority, are not available on the device. In the case of a TPD defining rate limiting, the device re-marks CoS parameters based on the DSCP value in the packet header and the determined conformance level of the rate limited traffic, as shown in the following table.

**TABLE 22** CoS parameters for packets that use rate limiting traffic policies

| Packet conformance level | Packet DSCP value | Traffic class and 802.1p priority |
|---|---|---|
| 0 (Green)<br>Or<br>1 (Yellow) | 0 - 7 | 0 (lowest priority queue) |
| | 8 - 15 | 1 |
| | 16 - 23 | 2 |
| | 24 - 31 | 3 |
| | 32 - 39 | 4 |
| | 40 - 47 | 5 |
| | 48 - 55 | 6 |
| | 56 - 63 | 7 (highest priority queue) |
| 2 (Red) | N/A | 0 (lowest priority queue) |

- When you define a TPD, reference the TPD in an ACL entry, and then apply the ACL to a VE in the Layer 3 router code, the rate limit policy is accumulative for all of the ports in the port region. If the VE or VLAN contains ports that are in different port regions, the rate limit policy is applied per port region.

  For example, TPD1 has a rate limit policy of 600M and is referenced in ACL 101. ACL 101 is applied to VE 1, which contains ethernet ports 1/1/1 to 1/1/4. Because ethernet ports 1/1/1 and 1/1/2 are in a different port region than ports 1/1/3 and 1/1/4, the rate limit policy will be 600M for ports 1/1/1 and 1/1/2, and 600M for ports 1/1/3 and 1/1/4.

### Maximum number of traffic policies supported on a device

The maximum number of supported active traffic policies is a system-wide parameter and depends on the device you are configuring, as follows:

- By default, up to 1024 active traffic policies are supported on Layer 2 switches. This value is fixed on Layer 2 switches and cannot be modified.
- For FastIron devices the number of active traffic policies supported on Layer 3 switches varies depending on the configuration and the available system memory. The default value and also the maximum number of traffic policies supported on Layer 3 switches is 50.

# Configuring rate limiting

## *Configuring port-based fixed rate limiting*

Follow these steps to configure a ports rate limiting policy.

These commands configure a fixed rate limiting policy that allows Ethernet port 1/1/1 to receive a maximum of 500 kbps. If the port receives additional bytes during a given one-second interval, all inbound packets on the port are dropped until the next one-second interval starts.

When traffic reaches the rate limiting threshold, Traffic Domain 2 (TD2) sends traditional pause or Priority Flow Control (PFC) frames, depending on the flow-control configuration.

When PFC is enabled, TD2 transmits PFC for all priorities mapped to the lossless priority group that reaches the XOFF limit (TD2 chip limitation).

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Enter interface configuration mode.

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

3. Set the fixed rate limiting policy.

```
device(config-if-e1000-1/1/1)# rate-limit input fixed 500
device(config-if-e1000-1/1/1)# end
```

4. Verify the configuration.

```
device# show rate-limit input
Total rate-limited interface count: 5.
    Port       Configured Input Rate    Actual Input Rate
    1/1/1      65000                    65000
    1/1/2      195000                   195000
    1/1/6      1950                     1950
    1/5/2      230432                   230000
    1/5/6      234113                   234000
```

### Fixed rate limiting configuration example

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# rate-limit input fixed 500
device(config-if-e1000-1/1/1)# end
device# show rate-limit input
```

## *Configuring port-based fixed rate limiting with burst option*

Follow these steps to configure a rate limiting policy for a port with a burst size included.

These commands configure a fixed rate limiting policy with a burst option that allows Ethernet port 1/1/1 to receive a maximum of 10000 kbps (i.e. 10 Mbps and therefore forward a maximum of 10 Mb to the egress port. Now if only 9 Mb of traffic is sent, there is 1 Mb of unused bandwidth. This 1 Mb of unused bandwidth can be borrowed in case if a burst of packets comes in. Now, the burst size option can be used to restrict the borrowing of the 1 Mb to only 0.1Mb (i.e. 1000 kbps).

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter interface configuration mode.

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

3. Set the fixed rate limiting policy.

```
device(config-if-e1000-1/1/1)# rate-limit input fixed 10000 burst 1000
device(config-if-e1000-1/1/1)# end
```

4. Verify the configuration.

```
device# show rate-limit input
Total rate-limited interface count: 5.
    Port       Configured Input Rate    Actual Input Rate
    1/1/1      10000                    10000end
    1/1/2      195000                   195000
    1/1/6      1950                     1950
    1/5/2      230432                   230000
    1/5/6      234113                   234000
```

### Fixed rate limiting with burst configuration example

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e1000-1/1/1)# rate-limit input fixed 10000 burst 10000
device(config-if-e1000-1/1/1)# end
device# show rate-limit input
```

## *Configuring rate limiting for BUM traffic*

If high rates of traffic are being received by the device on a given port of that VLAN, you can limit the number of BUM packets or bytes received each second on that port.

1. Enter global configuration mode.

   ```
   device# configure terminal
   ```

2. Enter interface configuration mode.

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

3. Enable BUM rate limits.

   a) Set a broadcast rate limit by port speed.

      ```
      device(config-if-e40000-1/1/1)# broadcast limit 96 kbps
      ```

      The limit is measured in kilo bits per second (kbps).

   b) Set an unknown unicast rate limit by port speed.

      ```
      device(config-if-e40000-1/1/1)# unknown-unicast limit 96 kbps
      ```

   c) Set a multicast rate limit by packets per second.

      ```
      device(config-if-e40000-1/1/1)# multicast limit 400 kbps
      ```

4. Verify the configuration.

   ```
   device(config-if-e40000-1/1/1)# show running-config interface | begin broadcast
    broadcast limit 96 kbps
    multicast limit 400 kbps
    unknown-unicast limit 96 kbps
   ...
   ```

### Rate limiting BUM traffic configuration example

```
device# configure terminal
device(config)# interface ethernet 1/1/1
device(config-if-e40000-1/1/1)# broadcast limit 96 kbps
device(config-if-e40000-1/1/1)# unknown-unicast limit 96 kbps
device(config-if-e40000-1/1/1)# multicast limit 400
device(config-if-e40000-1/1/1)# show running-config interface | begin broadcast
```

## *Configuring ACL-based fixed rate limiting using traffic policies*

Use the procedure in this section to configure ACL-based fixed rate limiting. Before configuring this feature, see what to consider in the “Configuration notes and feature limitations for traffic policies” section.

These commands:

- Set the maximum number of traffic policies.

- Create a fixed traffic policy that enables ACL statistics (counting).
- Create a new extended ACL entry and binds the ACL to an interface.
- Verify the configuration.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Set the maximum number of traffic policies supported on a device.
   a) Set the maximum number.

```
device(config)# system-max hw-traffic-conditioner 25
```

   b) Save the configuration.

```
device(config)# write memory
```

   c) Reload the software to place the change into effect.

```
device(config)# reload
```

   Ruckus does not recommend setting the system maximum for traffic policies to 0 (zero), because this renders traffic policies ineffective.
3. Create a traffic policy and set parameters.
   - Create a policy that drops packets that exceed the limit.

```
device(config)# traffic-policy TPDF1 rate-limit fixed 10000 exceed-action drop count
```

   - Create a policy that permits packets that exceed the limit.

```
device(config)# traffic-policy TPDF1 rate-limit fixed 10000 exceed-action permit-atlow-pri count
```

   The command sets the fragment threshold at 10,000 packets per second. If the port receives more than 10,000 packets in a one-second interval, the device takes the specified action. If the port receives additional bits during a given one-second interval, the port either drops all packets on the port until the next one-second interval starts or permits packets that exceed the limit.
4. Create an extended ACL entry or modify an existing extended ACL entry that references the traffic policy.

```
device(config)# access-list 101 permit ip host 10.10.12.2 any traffic-policy TPDF1
```

5. Bind the ACL to an interface.
   a) Enter interface configuration mode.

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

   b) Bind the ACL to the interface.

```
device(config-if-e1000-1/1/5)# ip access-group 101 in
```

   c) Exit interface configuration mode.

```
device(config-if-e1000-1/1/5)# exit
```

   These commands allow port 1/1/5 to receive a maximum traffic rate of 100 kbps. If the port receives additional bits during a given one-second interval, the port drops the additional inbound packets that are received within that one-second interval.

   The software allows you to add a reference to a non-existent TPD in an ACL statement and to bind that ACL to an interface. The software does not issue a warning or error message for non-existent TPDs.

6. Verify the configuration.

```
device(config)# show traffic-policy TPDF1
Traffic Policy - TPDF1:
Metering Enabled, Parameters:
     Mode: Fixed Rate-Limiting
      cir: 100 kbps, cbs: 2000 bytes, pir: 200 kbps, pbs: 4000 bytes
Counting Not Enabled
Number of References/Bindings:1
```

7. View the ACL and rate limit counters

```
device(config)# show access-list accounting ethernet 1/1/5 in
MAC Filters Accounting Information
    0: DA ANY SA 0000.0000.0001 - MASK FFFF.FFFF.FFFF
       action to take : DENY
     Hit Count:   (1Min)                  0    (5Sec)                  0
                  (PktCnt)                0  (ByteCnt)                0
    ---------------------------------------------------------------
65535: Implicit Rule deny any any
     Hit Count:   (1Min)         5028   (5Sec)               2129
                  (PktCnt)       5028 (ByteCnt)            643584
    ---------------------------------------------------------------
```

8. Clear the ACL and rate limit counters.
   a) Clear the ACL counters.

```
device(config)# clear access-list accounting traffic-policy TPDF1
```

   b) Clear the rate limit counters.

```
device(config)# clear statistics traffic-policy TPDF1
```

### ACL-based fixed rate limiting using traffic policies configuration example

```
device# configure terminal
device(config)# system-max hw-traffic-conditioner 25
device(config)# write memory
device(config)# reload
device(config)# traffic-policy TPDF1 rate-limit fixed 10000 exceed-action drop
device(config)# access-list 101 permit ip host 10.10.12.2 any traffic-policy TPDF1
device(config)# interface ethernet 1/1/5
device(config-if-e1000-1/1/5)# ip access-group 101 in
device(config-if-e1000-1/1/5)# exit
device(config)# show traffic-policy TPDF1
device(config)# clear access-list accounting traffic-policy TPDF1
device(config)# clear statistics traffic-policy TPDF1
```

## *Configuring ACL-based adaptive rate limiting using traffic policies*

You can configure adaptive rate limiting to forward traffic, modify the IP precedence of and then forward traffic, or drop traffic based on whether the traffic is within the limit or exceeds the set limit.

These commands:

- Set the maximum number of traffic policies.
- Create an adaptive traffic policy that enables ACL statistics (counting).
- Create a new extended ACL entry and binds the ACL to an interface.

- Verify the configuration.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Set the maximum number of traffic policies supported on a device.

   a) Set the maximum number.

```
device(config)# system-max hw-traffic-conditioner 25
```

   b) Save the configuration.

```
device(config)# write memory
```

   c) Reload the software to place the change into effect.

```
device(config)# reload
```

   Ruckus does not recommend setting the system maximum for traffic policies to 0 (zero), because this renders traffic policies ineffective.

3. Create a traffic policies and set parameters.

   a) Create a policy, TPDrop, that drops packets that exceed the limit.

```
device(config)# traffic-policy TPDrop rate-limit adaptive cir 10000 cbs 1600 pir 20000 pbs 4000
exceed-action drop count
```

   b) Create a policy, TPallow, that permits packets that exceed the limit.

```
device(config)# traffic-policy TPallow rate-limit adaptive cir 10000 cbs 1600 pir 20000 pbs 4000
exceed-action permit-at-low-pri count
```

   The command sets the fragment threshold at 10,000 packets per second. If the port receives more than 10,000 packets in a one-second interval, the device takes the specified action. If the port receives additional bits during a given one-second interval, the port either drops all packets on the port until the next one-second interval starts or permits packets that exceed the limit.

4. Verify the traffic policy configuration.

```
device(config)# show traffic-policy
Traffic Policy - TPallow:

        Metering Enabled, Parameters:
                Mode: Adaptive Rate-Limiting
                cir: 400000 kbps,    cbs: 125000 kbits,    pir: 12000000 kbps,    pbs: 1250000000
kbits

        Counting Enabled
        Number of References/Bindings: 1
Traffic Policy - TPDrop:

        Metering Enabled, Parameters:
                Mode: Adaptive Rate-Limiting
                cir: 10000 kbps,    cbs: 1600 kbits,    pir: 20000 kbps,    pbs: 4000 kbits

        Counting Enabled
        Number of References/Bindings: 0
```

5. Create new, extended ACL entries.
   a) Create a new extended ACL entry or modify an existing extended ACL entry that references the traffic policy.

```
device(config)# access-list 104 permit ip host 1.1.1.2 any traffic-policy TPallow
```

   b) Configure an IPv4 extended ACL or an IPv6 ACL.

```
device(config)# access-list 105 permit ip any any 802.1p-priority matching 3 traffic-policy
TPdrop
```

   You would configure the device to rate limit traffic for a specified 802.1p priority value by creating an IPv4 extended ACL or IPv6 ACL that includes the traffic policy and 802.1p priority matching value.

6. Verify the ACLs.

```
device(config)# show access-list all
...
Extended IP access list 104 : 1 entry
permit ip host 1.1.1.2 any traffic-policy TPallow

Extended IP access list 105 : 1 entry
permit ip any any 802.1p-priority-matching 3 traffic-policy TPdrop
...
```

7. Bind the ACL to an interface.
   a) Enter interface configuration mode.

```
device(config)# interface ethernet 1/1/6
```

   b) Bind the ACL to the interface.

```
device(config-if-e1000-1/1/6)# ip access-group 104 in
device(config-if-e1000-1/1/6)# exit
```

8. Clear the ACL and rate limit counters.
   a) Clear the ACL counters.

```
device(config)# clear access-list accounting traffic-policy TPallow
Traffic Policy TPallow: cleared
```

   b) Clear the rate limit counters.

```
device(config)# clear statistics traffic-policy TPdrop
```

### ACL-based adaptive rate limiting using traffic policies configuration example

```
device# configure terminal
device(config)# system-max hw-traffic-conditioner 25
device(config)# write memory
device(config)# reload
device(config)# traffic-policy TPDrop rate-limit adaptive cir 10000 cbs 1600 pir 20000 pbs 4000 exceed-
action drop coun
device(config)# traffic-policy TPallow rate-limit adaptive cir 10000 cbs 1600 pir 20000 pbs 4000 exceed-
action permit-at-low-pri count
device(config)# show traffic-policy
device(config)# access-list 104 permit ip host 1.1.1.2 any traffic-policy TPallow
device(config)# access-list 105 permit ip any any 802.1p-priority matching 3 traffic-policy TPdrop
device(config)# show access-list all
device(config)# interface ethernet 1/1/6
device(config-if-e1000-1/1/6)# ip access-group 104 in
device(config-if-e1000-1/1/6)# exit
device(config)# clear access-list accounting traffic-policy TPDA4
device(config)# clear statistics traffic-policy TPDA4
```

# Rate Shaping

## Rate shaping configuration notes

Outbound rate shaping is a port-level feature that is used to shape the rate and control the bandwidth of outbound traffic on a port.

Rate shaping smooths excess and bursty traffic to the configured maximum limit before it is sent out on a port. Packets are stored in available buffers and then forwarded at a rate no greater than the configured limit. This process provides for better control over the inbound traffic of neighboring devices.

The following apply when configuring outbound rate shaping:

- Outbound rate shaping can be configured only on physical ports, not on virtual or loopback ports.
- Ruckus ICX devices have one global rate shaper for a port and one rate shaper for each port priority queue. Rate shaping is done on a single-token basis, where each token is defined to be 1 byte.
- When outbound rate shaping is enabled on a port on an IPv4 device, the port QoS queuing method (*qos mechanism* ) will be strict mode. This applies to IPv4 devices only. On IPv6 devices, the QoS mechanism is whatever method is configured on the port, even when outbound rate shaping is enabled.
- You can configure a rate shaper for a port and for the individual priority queues of that port. However, if a port rate shaper is configured, that value overrides the rate shaper value of a priority queue if the priority queue rate shaper is greater than the rate shaper for the port.
- You can configure rate shaping on individual ports of the link aggregation group (LAG). You cannot configure rate shaping on the LAG itself.
- You can enable rate shaping on the individual ports for static and dynamic LAG. You cannot enable rate shaping on other types of LAG (for example, keepalive).
- We do not support port-based rate shaping for PE ports.
- You cannot configure rate shaping on devices where the packet-forwarding method is cut-through. On ICX 7750 devices, the default packet-forwarding method is cut-through so you must first configure the **store-and-forward** command to change the method to store-and-forward. On ICX 7450 devices, store-and-forward is the default method.

  **NOTE**
  You must save the configuration and reload for the change to take effect. Refer to the description of the **store-and-forward** command for more information.

- When configuring rate shaping on dynamic LAG for ICX 7750 devices, you should configure the queues where the Link Aggregation Control Protocol (LACP) packets are not forwarded. If you configure rate shaping on dynamic LAG ports (either on the port or on the queue), LACP packets can be dropped and cause a dynamic LAG failure

For more information on LAG configuration, refer to the *Ruckus FastIron Layer 3 Routing Configuration Guide*.

The configured rate shaping values are rounded up to the nearest multiples of minimum values supported on the platform. The following table shows the minimum and maximum values for output rate shaping on various devices. Values are in kilobits per second (Kbps) for all the platforms.

**TABLE 23** Output Rate Shaping on FastIron Devices

| Device | Module | Minimum | Maximum |
|---|---|---|---|
| Ruckus ICX 7850 | 10 Gbps ports | 128 Kbps | 10,000,000 Kbps |
| Ruckus ICX 7850 | 25 Gbps ports | 128 Kbps | 25,000,000 Kbps |
| Ruckus ICX 7850 | 40 Gbps ports | 128 Kbps | 40,000,000 Kbps |
| Ruckus ICX 7850 | 100 Gbps ports | 128 Kbps | 999,000,000 Kbps |
| Ruckus ICX 7750 | 10 Gbps ports | 128 Kbps | 10,000,000 Kbps |
| Ruckus ICX 7750 | 40 Gbps ports | 8 Kbps | 40,000,000 Kbps |
| Ruckus ICX 7450 | 1 Gbps ports | 8 Kbps | 999,936 Kbps |
| Ruckus ICX 7650 | 1 Gbps ports | 8 Kbps | 999,936 Kbps |
| Ruckus ICX 7650 | 10 Gbps ports | 8 Kbps | 10,000,000 Kbps |
| Ruckus ICX 7650 | 40 Gbps ports | 8 Kbps | 40,000,000 Kbps |
| Ruckus ICX 7650 | 100 Gbps ports | 8 Kbps | 100,000,000 Kbps |
| Ruckus ICX 7450 | 10 Gbps ports | 128 Kbps | 10,000,000 Kbps |
| Ruckus ICX 7450 | 40 Gbps ports | 8 Kbps | 40,000,000 Kbps |
| Ruckus ICX 7250 | 1 Gbps ports | 8 Kbps | 999,936 Kbps |
| Ruckus ICX 7250 | 10 Gbps ports | 128 Kbps | 10,000,000 Kbps |
| Ruckus ICX 7150 | 1 Gbps ports | 8 Kbps | 999,936 Kbps |
| Ruckus ICX 7150 | 10 Gbps ports | 128 Kbps | 10,000,000 Kbps |

# Configuring rate shaping

Follow these steps to configure outbound rate shaping on an Ethernet or a link aggregation group (LAG) port.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter interface configuration mode.

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

3. Configure the maximum rate at which outbound traffic is sent out on a port.

```
device(config-if-e1000-1/1/2)# rate-limit output shaping 1300
Outbound Rate Shaping on Port 1/1/2 Config: 1300 Kbps, Actual: 1304 Kbps
```

4. Configure the maximum rate at which outbound traffic is sent out on a port priority queue.

```
device(config-if-e1000-1/1/2)# rate-limit output shaping 500 priority 7
Outbound Rate Shaping on Port 1/1/2 for Priority 7
         Config: 500 Kbps, Actual: 500 Kbps
device(config-if-e1000-1/1/2)# end
```

5. Verify the configuration.

```
device# show rate-limit output-shaping
Outbound Rate Shaping Limits in Kbps:
Port   PortMax Prio0 Prio1 Prio2 Prio3 Prio4 Prio5 Prio6 Prio7
1/1/2     1304     -     -     -     -     -     -     -   500
1/1/3     1302     -     -     -     -     -     -     -     -
1/1/4      651     -     -     -     -     -     -     -     -
```

### *Outbound rate shaping configuration example*

```
device# configure terminal
device(config)# interface ethernet 1/1/2
device(config-if-e1000-1/1/2)# rate-limit output shaping 500 priority 7
device(config-if-e1000-1/1/2)# exit
device(config)# show rate-limit output-shaping
```

## Configuring rate shaping on a LAG port

This feature is supported on individual ports of a LAG group.

To configure the maximum rate at which outbound traffic is sent out on a LAG port, configure the following on each LAG port where outbound traffic is shaped.

1. Enter global configuration mode.

```
device# configure terminal
```

2. Enter LAG mode for an existing LAG. In this example it is a static LAG lag1.

```
device(config)# lag lag1
```

3. Configure the maximum rate at which outbound traffic is sent out on the LAG port

```
device(config-lag-lag1)# rate-limit output shaping ethe 1/1/5 651
Outbound Rate Shaping on Port 1/1/5 Config: 651 Kbps, Actual: 656 Kbps
device(config-lag-lag1)# exit
```

   Be sure to use the abbreviated form of Ethernet - ethe.

4. Verify the configuration.

```
device(config)# show rate-limit output-shaping
Outbound Rate Shaping Limits in kbps:
    Port    PortMax    Prio0    Prio1    Prio2    Prio3    Prio4    Prio5    Prio6    Prio7
   1/1/5        656        -        -        -        -        -        -        -        -
```

### *Outbound rate shaping on a LAG port configuration example*

```
device# configure terminal
device(config)# lag lag1
device(config-lag-lag1)# rate-limit output shaping ethe 1/1/5 651
device(config-lag-lag1)# exit
device(config)# show rate-limit output-shaping
```

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