JUNIPER NETWORKS

Junos® OS

Layer 2 Overview, Routing Instances, and Basic Services Feature Guide for Routing Devices

Release
13.2

Published: 2013-07-22

Juniper Networks, Inc.
1194 North Mathilda Avenue
Sunnyvale, California 94089
USA
408-745-2000
www.juniper.net

Junos® OS Layer 2 Overview, Routing Instances, and Basic Services Feature Guide for Routing Devices
13.2

The information in this document is current as of the date on the title page.

YEAR 2000 NOTICE

Juniper Networks hardware and software products are Year 2000 compliant. Junos OS has no known time-related limitations through the year 2038. However, the NTP application is known to have some difficulty in the year 2036.

END USER LICENSE AGREEMENT

The Juniper Networks product that is the subject of this technical documentation consists of (or is intended for use with) Juniper Networks software. Use of such software is subject to the terms and conditions of the End User License Agreement ("EULA") posted at http://www.juniper.net/support/eula.html. By downloading, installing or using such software, you agree to the terms and conditions of that EULA.

Table of Contents

List of Figures

List of Tables

About the Documentation

Documentation and Release Notes

To obtain the most current version of all Juniper Networks® technical documentation, see the product documentation page on the Juniper Networks website at http://www.juniper.net/techpubs/.

If the information in the latest release notes differs from the information in the documentation, follow the product Release Notes.

Juniper Networks Books publishes books by Juniper Networks engineers and subject matter experts. These books go beyond the technical documentation to explore the nuances of network architecture, deployment, and administration. The current list can be viewed at http://www.juniper.net/books.

Supported Platforms

For the features described in this document, the following platforms are supported:

- MX Series

Using the Examples in This Manual

If you want to use the examples in this manual, you can use the **load merge** or the **load merge relative** command. These commands cause the software to merge the incoming configuration into the current candidate configuration. The example does not become active until you commit the candidate configuration.

If the example configuration contains the top level of the hierarchy (or multiple hierarchies), the example is a *full example*. In this case, use the **load merge** command.

If the example configuration does not start at the top level of the hierarchy, the example is a *snippet*. In this case, use the **load merge relative** command. These procedures are described in the following sections.

Merging a Full Example

To merge a full example, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration example into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following configuration to a file and name the file **ex-script.conf**. Copy the **ex-script.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   system {
     scripts {
       commit {
         file ex-script.xsl;
       }
     }
   }
   interfaces {
     fxp0 {
       disable;
       unit 0 {
         family inet {
           address 10.0.0.1/24;
         }
       }
     }
   }
   ```

2. Merge the contents of the file into your routing platform configuration by issuing the **load merge** configuration mode command:

   ```
   [edit]
   user@host# load merge /var/tmp/ex-script.conf
   load complete
   ```

Merging a Snippet

To merge a snippet, follow these steps:

1. From the HTML or PDF version of the manual, copy a configuration snippet into a text file, save the file with a name, and copy the file to a directory on your routing platform.

   For example, copy the following snippet to a file and name the file **ex-script-snippet.conf**. Copy the **ex-script-snippet.conf** file to the **/var/tmp** directory on your routing platform.

   ```
   commit {
     file ex-script-snippet.xsl; }
   ```

2. Move to the hierarchy level that is relevant for this snippet by issuing the following configuration mode command:

```
[edit]
user@host# edit system scripts
[edit system scripts]
```

3. Merge the contents of the file into your routing platform configuration by issuing the **load merge relative** configuration mode command:

```
[edit system scripts]
user@host# load merge relative /var/tmp/ex-script-snippet.conf
load complete
```

For more information about the **load** command, see the *CLI User Guide*.

Documentation Conventions

Table 1 on page xi defines notice icons used in this guide.

Table 1: Notice Icons

Icon	Meaning	Description
	Informational note	Indicates important features or instructions.
	Caution	Indicates a situation that might result in loss of data or hardware damage.
	Warning	Alerts you to the risk of personal injury or death.
	Laser warning	Alerts you to the risk of personal injury from a laser.

Table 2 on page xi defines the text and syntax conventions used in this guide.

Table 2: Text and Syntax Conventions

Convention	Description	Examples
Bold text like this	Represents text that you type.	To enter configuration mode, type the**configure** command: user@host> **configure**
`Fixed-width text like this`	Represents output that appears on the terminal screen.	`user@host>` **show chassis alarms** `No alarms currently active`

Table 2: Text and Syntax Conventions *(continued)*

Convention	Description	Examples
Italic text like this	• Introduces or emphasizes important new terms. • Identifies book names. • Identifies RFC and Internet draft titles.	• A policy *term* is a named structure that defines match conditions and actions. • *Junos OS System Basics Configuration Guide* • RFC 1997, *BGP Communities Attribute*
Italic text like this	Represents variables (options for which you substitute a value) in commands or configuration statements.	Configure the machine's domain name: **[edit]** **root@# set system domain-name** *domain-name*
Text like this	Represents names of configuration statements, commands, files, and directories; configuration hierarchy levels; or labels on routing platform components.	• To configure a stub area, include the **stub** statement at the **[edit protocols ospf area area-id]** hierarchy level. • The console port is labeled **CONSOLE**.
< > (angle brackets)	Enclose optional keywords or variables.	**stub <default-metric** ***metric*****>;**
| (pipe symbol)	Indicates a choice between the mutually exclusive keywords or variables on either side of the symbol. The set of choices is often enclosed in parentheses for clarity.	**broadcast | multicast** **(*string1* | *string2* | *string3*)**
# (pound sign)	Indicates a comment specified on the same line as the configuration statement to which it applies.	**rsvp { # Required for dynamic MPLS only**
[ ] (square brackets)	Enclose a variable for which you can substitute one or more values.	**community name members [** ***community-ids*** **]**
Indention and braces ({ })	Identify a level in the configuration hierarchy.	**[edit]** **routing-options {** ** static {** ** route default {** ** nexthop** *address*; ** retain;** ** }** ** }** **}**
; (semicolon)	Identifies a leaf statement at a configuration hierarchy level.	
GUI Conventions		
Bold text like this	Represents graphical user interface (GUI) items you click or select.	• In the Logical Interfaces box, select **All Interfaces**. • To cancel the configuration, click **Cancel**.
> (bold right angle bracket)	Separates levels in a hierarchy of menu selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

We encourage you to provide feedback, comments, and suggestions so that we can improve the documentation. You can send your comments to techpubs-comments@juniper.net, or fill out the documentation feedback form at https://www.juniper.net/cgi-bin/docbugreport/ . If you are using e-mail, be sure to include the following information with your comments:

- Document or topic name
- URL or page number
- Software release version (if applicable)

Requesting Technical Support

Technical product support is available through the Juniper Networks Technical Assistance Center (JTAC). If you are a customer with an active J-Care or JNASC support contract, or are covered under warranty, and need post-sales technical support, you can access our tools and resources online or open a case with JTAC.

- JTAC policies—For a complete understanding of our JTAC procedures and policies, review the *JTAC User Guide* located at http://www.juniper.net/us/en/local/pdf/resource-guides/7100059-en.pdf.
- Product warranties—For product warranty information, visit http://www.juniper.net/support/warranty/.
- JTAC hours of operation—The JTAC centers have resources available 24 hours a day, 7 days a week, 365 days a year.

Self-Help Online Tools and Resources

For quick and easy problem resolution, Juniper Networks has designed an online self-service portal called the Customer Support Center (CSC) that provides you with the following features:

- Find CSC offerings: http://www.juniper.net/customers/support/
- Search for known bugs: http://www2.juniper.net/kb/
- Find product documentation: http://www.juniper.net/techpubs/
- Find solutions and answer questions using our Knowledge Base: http://kb.juniper.net/
- Download the latest versions of software and review release notes: http://www.juniper.net/customers/csc/software/
- Search technical bulletins for relevant hardware and software notifications: https://www.juniper.net/alerts/

- Join and participate in the Juniper Networks Community Forum: http://www.juniper.net/company/communities/
- Open a case online in the CSC Case Management tool: http://www.juniper.net/cm/

To verify service entitlement by product serial number, use our Serial Number Entitlement (SNE) Tool: https://tools.juniper.net/SerialNumberEntitlementSearch/

Opening a Case with JTAC

You can open a case with JTAC on the Web or by telephone.

- Use the Case Management tool in the CSC at http://www.juniper.net/cm/.
- Call 1-888-314-JTAC (1-888-314-5822 toll-free in the USA, Canada, and Mexico).

For international or direct-dial options in countries without toll-free numbers, see http://www.juniper.net/support/requesting-support.html.

PART 1

Overview

CHAPTER 1

MX Series Routers

MX Series Router Architecture

The key components of the Juniper Networks MX Series 3D Universal Edge Routers are the Dense Port Concentrators (DPCs), Modular Port Concentrators/Modular Interface Cards (MPCs/MICs), the Routing Engine (RE), and the Switch Control Board (SCB).

The DPCs are optimized for Ethernet density and are capable of supporting up to 40 Gigabit Ethernet or 4 10-Gigabit Ethernet ports. The DPC assembly combines packet forwarding and Ethernet interfaces on a single board, with four 10-Gbps Packet Forwarding Engines. Each Packet Forwarding Engine consists of one chip for Layer 3 processing and one Layer 2 network processor. The DPCs interface with the power supplies and Switch Control Boards.

Designed for flexibility, MPCs leverage the Junos Trio chipset to deliver the industry's highest density GbE, 10GbE, and 100GbE, as well as the flexibility of modular interfaces, across the MX Series portfolio. These advanced capabilities allow mix and match interfaces to create service-specific and "pay as you grow" configurations. The MPC houses the PFEs to deliver up to 120 Gbps of comprehensive Layer 3 routing (IPv4 and IPv6), and Layer 2 switching. These MPCs also support inline services and advanced Hierarchical QoS (H-QoS) per MX Series slot.

Modular Interface Cards (MICs) install into Modular Port Concentrators (MPCs) and provide the physical connections to various network media types. MICs allow different physical interfaces to be supported on a single line card. You can install MICs of different media types on the same router as long as the router supports those MICs. MICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each MIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets through the MIC interfaces, the MPCs encapsulate the packets received. MICs are hot-removable and hot-insertable. You can install up to two MICs in the slots in each MPC.

The RE provides control plane functions and runs Junos OS. Software processes that run on the RE maintain the routing tables, manage the routing protocols used on the router, control the router interfaces, control some chassis components, and provide the interface for system management and user access to the router. REs communicate with DPCs and MPCs via dedicated out-of-band management channels, providing a clear distinction between the control and forwarding planes. Integrated into the SCB is the switch fabric, which interconnects all of the DPCs and MPCs within the chassis. The RE installs directly into the SCB.

The SCB powers cards on and off; controls clocking, resets and booting; and monitors and controls systems functions, including fan speed, board power status, Power Distribution Module (PDM) status and control, and the system front panel. Integrated into the SCB is the switch fabric, which interconnects all of the DPCs and MPCs within the chassis, supporting up to 48 Packet Forwarding Engines. The Routing Engine installs directly into the SCB.

NOTE: The MX80 3D Universal Edge Router leverages the technology used in the MPCs, common across the MX Series, and can accommodate multiple combinations of Modular Interface Cards (MICs) for increased flexibility. The MX80 is a single board router with a built-in RE and one Packet Forwarding Engine (PFE). The PFE has two "pseudo" Flexible PIC Concentrators (FPC 0 and FPC 1). Because there is no switching fabric, the single PFE takes care of both ingress and egress packet forwarding.

The MX Series router has been optimized for Ethernet services. Examples of the wide range of Ethernet services provided by the MX Series include:

- Virtual private LAN service (VPLS) for multipoint connectivity—Native support for VPLS services
- Virtual leased line (VLL) for point-to-point services—Native support for point-to-point services
- RFC 2547.bis IP/MPLS VPN (L3VPN)—Full support for MPLS VPNs throughout the Ethernet network
- Video distribution IPTV services
- Ethernet aggregation at the campus/enterprise edge—Supports dense 1-Gigabit Ethernet, 10-Gigabit Ethernet, and 100-Gigabit Ethernet configurations, and provides full Layer 3 support for campus edge requirements
- Ethernet aggregation at the multiservice edge—Supports up to 480 1-Gigabit Ethernet ports or 48 10-Gigabit Ethernet ports for maximum Ethernet density along, with full Layer 2 and Layer 3 VPN support for MSE applications

Related Documentation

- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 9

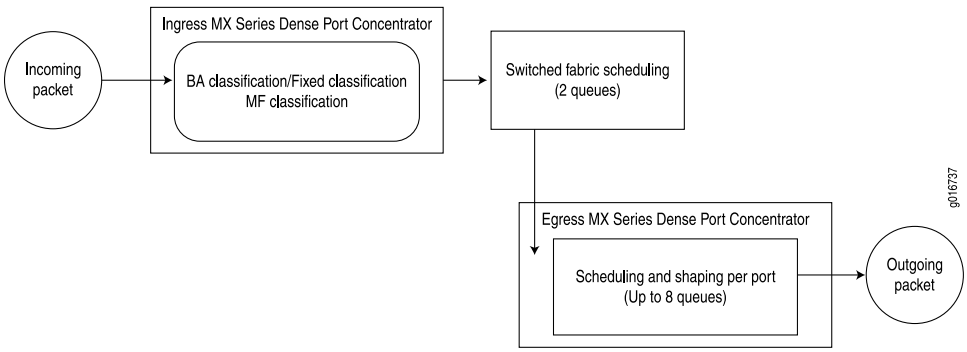
- Ethernet Frame Counts and Statistics on MX Series Routers on page 13

MX Series Router Packet Forwarding and Data Flow

The architecture for Juniper Networks MX Series 3D Universal Edge Routers such as the MX960 Ethernet Services Router is similar in concept, but different in particulars, from other routing platforms.

The general architecture for the MX Series router is shown in Figure 1 on page 5.

Figure 1: MX Series Router Packet Forwarding and Data Flow



Related Documentation

- MX Series Router Architecture on page 3
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 9
- Ethernet Frame Counts and Statistics on MX Series Routers on page 13

Line Cards Supported on MX Series Routers

Juniper Networks MX Series 3D Universal Edge Routers process incoming and outgoing packets on several different types of line cards, including Dense Port Concentrators (DPCs), Flexible Port Concentrators (FPCs) with associated Physical Interface Cards (PICs), Trio Modular Port Concentrators (MPCs) with associated Modular Interface Cards (MICs). FPCs are populated with PICs for various interface types. DPCs and MPCs combine the functions of FPCs and the PICs, and with associated physical interfaces support a variety of interface types. The configuration syntax for each type of line card is the same: ***type-fpc/pic/port***.

- FPCs and PICs on page 6
- DPCs on page 6
- Modular Port Concentrator (MPC) and Modular Interface Card (MIC) Interfaces on page 6

FPCs and PICs

An FPC occupies two slots when installed in an MX Series router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs
- MX480 router—3 FPCs
- MX240 router—1 FPC

PICs provide the physical connection to various network media types. The PICs are inserted into a slot in a router. You can install PICs of different media types on the same router as long as the router supports those PICs.

MX Series 3D Universal Edge Routers support 2 PICs per Flexible PIC Concentrator (FPC). The maximum number of supported PICs varies per router:

- MX960 router—12 PICs
- MX480 router—6 PICs
- MX240 router—2 PICs

DPCs

A DPC provides multiple physical interfaces and Packet Forwarding Engines on a single board that installs into a slot within the MX Series 3D Universal Edge Routers. The maximum number of supported DPCs varies per router:

- MX960 router—12 DPC slots
- MX480 router—6 DPC slots
- MX240 router—3 DPC slots

NOTE: In the Junos OS CLI, you use the FPC syntax to configure or display information about DPCs, and you use the PIC syntax to configure or display information about Packet Forwarding Engines on the DPCs.

In addition to Layer 3 routing capabilities, the DPCs also have many Layer 2 functions that allow MX Series routers to be used for many virtual LAN (VLAN) and other Layer 2 network applications.

Modular Port Concentrator (MPC) and Modular Interface Card (MIC) Interfaces

A Modular Port Concentrator supports two Modular Interface Card (MIC) interfaces. The maximum number of supported MPCs varies per router:

- MX960 router—12 MPC slots
- MX480 router—6 MPC slots

- MX240 router—3 MPC slots
- MX80 router—One fixed 10-Gigabit Ethernet MIC with four ports for uplink connections.

NOTE: The MX80 router is available as a modular (MX80) or fixed (MX80-48T) chassis. Both chassis have a fixed Modular Interface Card (MIC) that has 3 10-Gigabit Ethernet ports. The fixed MX80 router has an additional 48 10/100/1000Base-T RJ45 ports. The modular chassis has two dedicated slots for MICs.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 9
- Ethernet Frame Counts and Statistics on MX Series Routers on page 13

Understanding Trio Layer 2 Feature Parity

A variety of Layer 2 features are supported on M Series and MX Series routers. The features supported by the Trio family of line cards are listed in Table 3 on page 7.

Table 3: Trio Layer 2 Feature Parity

Feature	Feature Parity with Junos OS Release	Feature Supported in Junos OS Release
MX routers only: load balancing enhancements for Layer 2 Link Aggregation	9.1R1	10.4R1
Ethernet OAM IEEE 802.1ag MIP support	9.1R1	10.4R1
Link Layer Discovery Protocol (LLDP)	9.1R1	10.4R1
MX Series routers only: BPDU guard	9.1R1	10.4R1
MX Series routers only: BPDU loop guard	9.1R1	10.4R1
For next generation VPNs: IRB support with LDP-VLPS and BGP-VPLS interworking	9.1R1	10.4R1
MPLS: BGP multihoming for inter-AS VPLS	9.1R1	10.4R1
MX Series routers only: Ethernet as a core-facing interface in VPLS	9.1R1	10.4R1
Disables next-hop flood in connectivity fault management (CFM)	9.1R1	10.4R1

Related Documentation

- *Protocols and Applications Supported by MX240, MX480, MX960, MX2010, and MX2020 MPCs*

- *Protocols and Applications Supported by MX240, MX480, MX960, and MX2020 Enhanced MPCs (MPCEs)*

CHAPTER 2

Features Operating At Layer 2 But Configured at Layer 3

Layer 2 and Layer 3 Features on MX Series Routers

You can configure MX Series routers to provide simultaneous support for Layer 2 and Layer 3 Ethernet services. In many cases, Layer 2 protocols run on some interfaces, and Layer 3 protocols run on others.

The *Junos OS Layer 2 Switching and Bridging Library for Routing Devices* discusses Layer 2 configurations on supported routers, including Layer 2 statement summaries and configuration statement examples. For more complete Layer 2 configuration examples for MX Series routers, see the *Ethernet Networking Feature Guide for MX Series Routers*.

For more information about configuring Layer 3 features and functions (such as class of service), see the relevant Junos configuration guides.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Ethernet Frame Counts and Statistics on MX Series Routers on page 13

Multicast Snooping on MX Series Routers

Because MX Series routers can support both Layer 3 and Layer 2 functions at the same time, you can configure the Layer 3 multicast protocols Protocol Independent Multicast (PIM) and the Internet Group Membership Protocol (IGMP) as well as Layer 2 VLANs on an MX Series router.

Normal encapsulation rules restrict Layer 2 processing to accessing information in the frame header and Layer 3 processing to accessing information in the packet header.

However, in some cases, an interface running a Layer 2 protocol needs information available only at Layer 3. In multicast applications, the VLANs need the group membership information and multicast tree information available to the Layer 3 IGMP and PIM protocols. In these cases, the Layer 3 configurations can use PIM or IGMP snooping to provide the needed information at the VLAN level.

For information about configuring multicast snooping for the operational details of a Layer 3 protocol on behalf of a Layer 2 spanning-tree protocol process, see "Understanding Multicast Snooping and VPLS Root Protection" on page 19.

Snooping configuration statements and examples are not included in the *Junos OS Layer 2 Switching and Bridging Library for Routing Devices*. For more information about configuring PIM and IGMP snooping, see the *Multicast Protocols Feature Guide for Routing Devices*.

Related Documentation

- Understanding Multicast Snooping and VPLS Root Protection on page 19
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 38
- Example: Configuring Multicast Snooping for a Bridge Domain on page 43

VPLS

In a Layer 3 network only, you can configure virtual private LAN service (VPLS), which is an Ethernet-based point-to-multipoint Layer 2 VPN. It enables you to connect geographically dispersed Ethernet local area networks (LAN) sites to each other across an MPLS backbone. For ISP customers who implement VPLS, all sites appear to be in the same Ethernet LAN even though traffic travels across the service provider's network.

For information about configuring VPLS, see the *Junos OS VPNs Library for Routing Devices*.

Related Documentation

- MX Series Router Architecture on page 3
- Layer 2 and Layer 3 Features on MX Series Routers on page 9

Layer 2 VPNs

In a Layer 3 network only, you can configure Layer 2 virtual private network (VPN) under a Layer 2 VPN routing instance type **l2vpn**.

In a Layer 2 environment, you can use a **l2vpn** routing instance to transparently carry Layer 2 traffic over an IP/MPLS backbone. Layer 2 traffic is sent to the provider edge (PE) router in Layer 2 format. The PE router encapsulates the frames and transports them over the IP/MPLS backbone to the PE router on the other side of the cloud. The remote PE router removes encapsulation and sends the frames to the receiving site in Layer 2 format.

For information about configuring an **l2vpn** routing instance and Layer 2 VPNs, see the *Junos OS VPNs Library for Routing Devices*.

For a detailed Layer 2 VPN example configuration, see the *Junos OS Feature Guides*.

For information about tunnel interfaces, see the *Junos OS Network Interfaces Library for Routing Devices*.

Related Documentation

- MX Series Router Architecture on page 3
- Layer 2 and Layer 3 Features on MX Series Routers on page 9

CHAPTER 3

Caveat

Ethernet Frame Counts and Statistics on MX Series Routers

The following considerations apply to Ethernet frame counts and statistics on Juniper Networks MX Series 3D Universal Edge Routers:

- Interface counters *do not* include the 7-byte Ethernet frame preamble and the frame delimiter byte.
- In Media Access Control (MAC) statistics. the frame size includes the MAC header and cyclical redundancy check (CRC) *before* any VLAN rewrite or other rules are applied.
- In traffic statistics, the frame size includes the Layer 2 header without the trailer CRC and *after* any VLAN rewrite or other rules are applied.

Related Documentation

- MX Series Router Architecture on page 3
- MX Series Router Packet Forwarding and Data Flow on page 5
- Line Cards Supported on MX Series Routers on page 5
- Layer 2 and Layer 3 Features on MX Series Routers on page 9

CHAPTER 4

Layer 2 Routing Instances

Routing Instances Overview

A routing instance is a routing entity for a router. You can create multiple instances of BGP, IS-IS, OSPF, OSPFv3, RIP, and static routes. Each instance contains a routing table, applied routing policies, routing table group, interfaces that belong to that instance, and a protocol-specific route configuration related to that instance.

You configure a primary routing instance at the **[edit protocols]** hierarchy level. You configure additional routing instances at the **[edit routing-instances]** or **[edit logical-systems *logical-system-name* routing-instance]** hierarchy level.

You use routing instances to:

- Create administrative separation in a large network to segregate customer traffic and associated settings. The customers see only the routes belonging to them.
- Create overlay networks in which separate services are routed only towards routers participating in that service, such as voice. The overlay network isolates routes belonging to one service from another service by exporting routes, applying tags, and filtering based on tags.

Each routing instance consists of sets of the following:

- A set of routing tables
- A set of interfaces that belong to these routing tables
- A set of routing option configurations

Each routing instance has a unique name and a corresponding IP unicast table. For example, if you configure a routing instance with the name **my-instance**, its corresponding IP unicast table will be **my-instance.inet.0**. All routes for **my-instance** are installed into **my-instance.inet.0.**

Routes are installed into the default routing instance **inet.0** by default, unless a routing instance is specified.

For details about configuring interfaces, see the *Junos OS Network Interfaces Library for Routing Devices*.

Related Documentation

- Layer 2 Routing Instance Types on page 16
- Layer 2 Routing Instances Configuration Hierarchy on page 17
- Configuring a VPLS Routing Instance on page 33
- Configuring a Virtual Switch Routing Instance on page 34
- Configuring a Layer 2 Control Protocol Routing Instance on page 35

Layer 2 Routing Instance Types

Although routing instances are primarily intended to maintain separation of tables and protocols at Layer 3 (mirroring the traditional IP network separation at Layer 3), many aspects of routing instances make them convenient to use for Layer 2 applications and architectures as well. In Layer 2 applications, routing instances still help to maintain table, interface, and customer insulation, but with regard to media access control (MAC) addresses and VLAN tags as much as IP addresses.

You can configure three types of routing instances (**instance-types**) in Layer 2 networks on MX Series routers, as described in the indicated sections:

- **layer2-control** (MX Series routers only)—Layer 2 control protocol routing instance. For configuration information, see *Configuring Layer 2 Protocol Tunneling*, *Configuring BPDU Protection on Individual Interfaces*, and *Configuring BPDU Protection on All Edge Ports*.
- **virtual-switch** (MX Series routers only)—Virtual switch routing instance. For configuration information, see *Configuring a Layer 2 Virtual Switch*.
- **vpls**—Virtual private LAN service (VPLS) routing instance. For configuration information, see *Configuring a Bridge Domain*.

The other five types of routing instances are configured only for Layer 3 networks, and are described in the indicated Junos configuration guide:

- **forwarding**—Forwarding instance. For more information, see the *Junos OS Routing Protocols Library for Routing Devices*.
- **l2vpn**—Layer 2 VPN routing instance. For more information, see the *Junos OS VPNs Library for Routing Devices*.
- **no-forwarding**—Nonforwarding routing instance. For more information, see the *Junos OS Routing Protocols Library for Routing Devices*.
- **virtual-router**—Virtual routing instance. For more information, see the *Junos OS Routing Protocols Library for Routing Devices*.
- **vrf**—VPN routing and forwarding (VRF) instance. For more information, see the *Junos OS Routing Protocols Library for Routing Devices*.

Related Documentation

- Routing Instances Overview on page 15
- Layer 2 Routing Instances Configuration Hierarchy on page 17
- Configuring a VPLS Routing Instance on page 33
- Configuring a Virtual Switch Routing Instance on page 34
- Configuring a Layer 2 Control Protocol Routing Instance on page 35

Layer 2 Routing Instances Configuration Hierarchy

Use the **vpls** routing instance type for point-to-multipoint LAN implementations between a set of sites in a VPN.

To configure routing instances for Layer 2 networks, include the following statements:

```
routing-instances {
  routing-instance-name {
    description text;
    forwarding-options {
      ...forwarding-options...
    }
    instance-type (layer2-control | virtual-switch | vpls);
    interface interface-name;
    no-vrf-advertise;
    route-distinguisher (as-number:number | ip-address:number);
    vrf-export [ policy-names ];
    vrf-import [ policy-names ];
    vrf-table-label;
    vrf-target {
      export community-name;
      import community-name;
    }
    protocols {
      ... protocols-configuration ...
    }
    routing-options {
      ... routing-options-configuration ...
    }
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        routing-interface routing-interface-name;
        vlan-id (Bridge Domain or VLAN) (none | all | number);
        vlan-tags outer number inner number;
        bridge-options {
          interface-mac-limit limit {
            packet-action drop;
          }
          interface interface-name {
            interface-mac-limit limit {
              packet-action drop;
            }
```

```
            }
            mac-statistics;
            mac-table-size limit {
              packet-action drop;
            }
            no-mac-learning;
            static-mac mac-address;
          }
        }
      }
    }
  }
```

With the exception of the **instance-type virtual-switch** statement (which configures a virtual-switch routing instance) on M Series routers, you can include the statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

On M Series routers, the **instance-type virtual-switch** statement is not supported at the **[edit logical-systems *logical-system-name*]** hierarchy level.

Related Documentation

- Routing Instances Overview on page 15
- Layer 2 Routing Instance Types on page 16
- Configuring a VPLS Routing Instance on page 33
- Configuring a Virtual Switch Routing Instance on page 34
- Configuring a Layer 2 Control Protocol Routing Instance on page 35

CHAPTER 5

Basic Layer 2 Services

Understanding Multicast Snooping and VPLS Root Protection

Snooping occurs when a Layer 2 protocol such as a spanning-tree protocol is aware of the operational details of a Layer 3 protocol such as the Internet Group Management Protocol (IGMP) or other multicast protocol. Snooping is necessary when Layer 2 devices such as VLAN switches must be aware of Layer 3 information such as the media access control (MAC) addresses of members of a multicast group.

VPLS root protection is a spanning-tree protocol process in which only one interface in a multihomed environment is actively forwarding spanning-tree protocol frames. This protects the root of the spanning tree against bridging loops, but also prevents both devices in the multihomed topology from snooped information, such as IGMP membership reports.

For example, consider a collection of multicast-capable hosts connected to two customer edge (CE) routers (CE1 and CE2) which are connected to each other (a CE1–CE2 link is configured) and multihomed to two provider edge (PE) routers (PE1 and PE2, respectively). The active PE only receives forwarded spanning-tree protocol information on the active PE-CE link, due to root protection operation. As long as the CE1–CE2 link is operational, this is not a problem. However, if the link between CE1 and CE2 fails, and the other PE becomes the active spanning-tree protocol link, no multicast snooping information is available on the new active PE. The new active PE will not forward multicast traffic to the CE and the hosts serviced by this CE router.

The service outage is corrected once the hosts send new group membership IGMP reports to the CE routers. However, the service outage can be avoided if multicast snooping information is available to both PEs in spite of normal spanning-tree protocol root protection operation.

NOTE: **You can configure multicast snooping to ignore messages about spanning tree topology changes for the virtual-switch routing-instance type only.**

Related Documentation

- *VPLS Multihomed Layer 2 Ring and MPLS Infrastructure Overview* in the *Junos OS Layer 2 Switching and Bridging Library for Routing Devices*
- Multicast Snooping on MX Series Routers on page 9 in the *Junos OS Layer 2 Switching and Bridging Library for Routing Devices*
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 38 in the *Junos OS Layer 2 Switching and Bridging Library for Routing Devices*
- Example: Configuring Multicast Snooping for a Bridge Domain on page 43 in the *Junos OS Layer 2 Switching and Bridging Library for Routing Devices*
- *Multicast Protocols Feature Guide for Routing Devices*

Load Balancing and Ethernet Link Aggregation Overview

You can create a link aggregation group (LAG) for a group of Ethernet ports. Layer 2 bridging traffic is load balanced across the member links of this group, making the configuration attractive for congestion concerns as well as for redundancy. You can configure up to 128 LAG bundles on M Series and T Series routers and 480 LAG bundles on a Juniper Networks MX Series Ethernet Services Router. Each LAG bundle contains up to 16 links.

By default, the hash key mechanism to load-balance frames across LAG interfaces is based on Layer 2 fields (such as frame source and destination address) as well as the input logical interface (unit). The default LAG algorithm is optimized for Layer 2 switching. You can also configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers using the **payload** statement, see "Configuring Load Balancing on a LAG Link" on page 39.In a Layer 2 switch, one link is overutilized and other links are underutilized.

Related Documentation

- Configuring Load Balancing on a LAG Link on page 39
- Load Balancing on a LAG Link on page 44
- *payload*

Layer 2 Learning and Forwarding in a Logical System Overview

You can partition a single physical router into multiple logical devices called *logical systems* that perform independent routing tasks. Logical systems perform a subset of the actions of a physical router and have their own unique routing tables, interfaces, policies, and routing instances. On MX Series routers only, you can enable Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances.

When enabling Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances, the following guidelines apply:

- You can only configure 16 logical systems.
- Logging is performed for the entire device and not per logical system.
- You cannot restart Layer 2 learning for an individual logical system.

Related Documentation

- Enabling Layer 2 Learning and Forwarding in a Logical System on page 40
- Layer 2 Learning and Forwarding and RSTP in a Logical System on page 44

CHAPTER 6

MX Series DPC Specifications

MX Series DPC Overview

A DPC provides multiple physical interfaces and Packet Forwarding Engines on a single board that installs into a slot within the MX240, MX480, and MX960 3D Universal Edge Routers. A DPC receives incoming packets from the network and sends outgoing packets to the network. The Packet Forwarding Engines on a DPC are equipped with purpose-built ASICs that perform packet processing and forwarding.

When a slot is not occupied by a DPC, you must insert a blank DPC to fill the empty slot and ensure proper cooling of the system. For complete information about installing and handling DPCs, see the hardware guide for your router.

Related Documentation

- DPCs Supported on MX240, MX480, and MX960 Routers on page 23
- *Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)*
- *Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)*
- *Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)*
- *Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)*
- *Protocols and Applications Supported by the Multiservices DPC (MS-DPC)*

DPCs Supported on MX240, MX480, and MX960 Routers

Table 4 on page 23 lists the DPCs supported by the MX240, MX480, and MX960 routers.

Table 4: DPCs Supported in MX240, MX480, and MX960 Routers

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Gigabit Ethernet				

Table 4: DPCs Supported in MX240, MX480, and MX960 Routers *(continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Gigabit Ethernet DPC with SFP	DPC-R-40GE-SFP EOL (see PSN-2009-06-400)	40	40 Gbps	8.2
Gigabit Ethernet Enhanced DPC with SFP	DPCE-R-40GE-SFP	40	40 Gbps	8.4
Gigabit Ethernet Enhanced Ethernet Services DPC with SFP	DPCE-X-40GE-SFP	40	40 Gbps	8.4
Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with SFP	DPCE-X-Q-40GE-SFP	40	40 Gbps	8.5
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-20GE-SFP	20	20 Gbps	9.1
Gigabit Ethernet Enhanced Queuing IP Services DPCs with SFP	DPCE-R-Q-40GE-SFP EOL (see PSN-2011-07-314)	40	40 Gbps	8.5
10-Gigabit Ethernet DPC with XFP	DPC-R-4XGE-XFP EOL (see PSN-2009-06-400)	4	40 Gbps	8.2
10-Gigabit Ethernet				
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-2XGE-XFP EOL (see PSN-2011-02-314)	2	20 Gbps	9.1
10-Gigabit Ethernet Enhanced DPCs with XFP	DPCE-R-4XGE-XFP	4	40 Gbps	8.4
10-Gigabit Ethernet Enhanced Ethernet Services DPC with XFP	DPCE-X-4XGE-XFP	4	40 Gbps	8.4
10-Gigabit Ethernet Enhanced Queuing Ethernet Services DPC with XFP	DPCE-X-Q-4XGE-XFP	4	40 Gbps	8.5
10-Gigabit Ethernet Enhanced Queuing IP Services DPC with XFP	DPCE-R-Q-4XGE-XFP EOL (see PSN-2011-02-314)	4	40 Gbps	8.5
Mulit-Rate Ethernet				
Multi-Rate Ethernet Enhanced DPC with SFP and XFP	DPCE-R-20GE-2XGE	22	40 Gbps	9.2

Table 4: DPCs Supported in MX240, MX480, and MX960 Routers *(continued)*

DPC Name	DPC Model Number	Ports	Maximum Throughput per DPC	First Junos OS Release
Multi-Rate Ethernet Enhanced Ethernet Services DPC with SFP and XFP	DPCE-X-20GE-2XGE EOL (see PSN-2011-02-314)	22	40 Gbps	9.2
Multi-Rate Ethernet Enhanced Queuing IP Services DPC with SFP and XFP	DPCE-R-Q-20GE-2XGE	22	40 Gbps	9.3
Tri-Rate Ethernet				
Tri-Rate Enhanced DPC	DPCE-R-40GE-TX	40	40 Gbps	9.1
Tri-Rate Enhanced Ethernet Services DPC	DPCE-X-40GE-TX EOL (see PSN-2011-07-315.)	40	40 Gbps	9.1
Services				
Multiservices DPC	MS-DPC	2 (Not supported)	–	9.3

Related Documentation

- MX Series DPC Overview on page 23
- *Protocols and Applications Supported by DPCs and Enhanced DPCs (DPC and DPCE-R)*
- *Protocols and Applications Supported by Enhanced Ethernet Services DPCs (DPCE-X)*
- *Protocols and Applications Supported by Enhanced Queuing IP Services DPCs (DPCE-R-Q)*
- *Protocols and Applications Supported by Enhanced Queuing Ethernet Services DPCs (DPCE-X-Q)*
- *Protocols and Applications Supported by the Multiservices DPC (MS-DPC)*

CHAPTER 7

MX Series PIC and FPC Specifications

MX Series PIC Overview

PICs provide the physical connection to various network media types. The PICs are inserted into a slot in a router. You can install PICs of different media types on the same router as long as the router supports those PICs.

PICs receive incoming packets from the network and transmit outgoing packets to the network. During this process, each PIC performs framing and high-speed signaling for its media type. Before transmitting outgoing data packets, the PICs encapsulate the packets received. Each PIC is equipped with a media-specific ASIC that performs control functions tailored to the PIC's media type.

Blank PICs resemble other PICs but do not provide any physical connection or activity. When a slot is not occupied by a PIC, you must insert a blank PIC to fill the empty slot and ensure proper cooling of the system.

MX240, MX480, and MX960 3D Universal Edge Routers support 2 PICs per Flexible PIC Concentrator (FPC). The maximum number of supported PICs varies per router:

- MX960 router—12 PICs
- MX480 router—6 PICs
- MX240 router—2 PICs

Related Documentation

- *High Availability Features*
- FPCs Supported by MX240, MX480, and MX960 Routers on page 28
- PICs Supported by MX240, MX480, and MX960 Routers on page 27

PICs Supported by MX240, MX480, and MX960 Routers

Table 5 on page 28 lists the PICs supported by MX240, MX480, and MX960 routers.

Table 5: PICs Supported by MX240, MX480, and MX960 Routers

PIC Name	PIC Model Number	Ports	Type	First Junos OS Release
Channelized IQ PICs				
Channelized OC12/STM4 Enhanced IQ (IQE) PIC with SFP	PB-4CHOC12-STM4-IQE-SFP	4	2	9.5
Channelized OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PB-1CHOC48-STM16-IQE	1	2	9.5
SONET/SDH PICs				
SONET/SDH OC3/STM1 (Multi-Rate) PIC with SFP	PB-4OC3-1OC12-SON2-SFP	4	2	9.5
SONET/SDH OC12/STM4 (Multi-Rate) PIC with SFP	PB-4OC3-4OC12-SON-SFP	4	2	9.5
SONET/SDH OC48/STM16 Enhanced IQ (IQE) PIC with SFP	PC-4OC48-STM16-IQE-SFP	4	3	10.4R2
SONET/SDH OC48/STM16 (Multi-Rate) PIC with SFP	PB-1OC48-SON-B-SFP	1	2	9.5
SONET/SDH OC48/STM16 PIC with SFP	PC-4OC48-SON-SFP	4	3	9.4
SONET/SDH OC192c/STM64 PIC	PC-1OC192-SON-VSR	1	3	9.4
SONET/SDH OC192c/STM64 PIC with XFP	PC-1OC192-SON-XFP	1	3	9.4

Related Documentation

- MX Series PIC Overview on page 27
- FPCs Supported by MX240, MX480, and MX960 Routers on page 28
- *High Availability Features*

FPCs Supported by MX240, MX480, and MX960 Routers

An FPC occupies two slots when installed in an MX240, MX480, or MX960 router. The maximum number of supported FPCs varies per router:

- MX960 router—6 FPCs
- MX480 router—3 FPCs
- MX240 router—1 FPC

Table 6 on page 29 lists FPCs supported by MX Series routers.

Table 6: FPCs Supported by MX Series Routers

FPC Type	FPC Name	FPC Model Number	Maximum Number of PICs Supported	Maximum Throughput per FPC (Full-duplex)	First Junos OS Release
3	FPC3	MX-FPC3	2	20 Gbps	9.4
2	FPC2	MX-FPC2	2	10 Gbps	9.5

Related Documentation

- MX Series PIC Overview on page 27
- PICs Supported by MX240, MX480, and MX960 Routers on page 27
- *High Availability Features*

PART 2

Configuration

CHAPTER 8

Configuration Tasks for Layer 2 Routing Instances

Configuring a VPLS Routing Instance

Use the **vpls** routing instance type for point-to-multipoint LAN implementations between a set of sites in a VPN.

To create a routing instance for VPLS, include at least the following statements in the configuration:

```
routing-instances {
   routing-instance-name {
      instance-type vpls;
      interface interface-name;
      route-distinguisher (as-number:number | ip-address:number);
      vrf-import [ policy-names ];
      vrf-export [ policy-names ];
      protocols {
         vpls {
            ... vpls configuration ...
         }
      }
   }
}
```

You can include these statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

For more information about configuring VPLS, see the *Junos OS VPNs Library for Routing Devices*. For a detailed VPLS example configuration, see the *Junos OS Feature Guides*.

Related Documentation

- Routing Instances Overview on page 15
- Layer 2 Routing Instance Types on page 16

- Layer 2 Routing Instances Configuration Hierarchy on page 17
- Configuring a Virtual Switch Routing Instance on page 34
- Configuring a Layer 2 Control Protocol Routing Instance on page 35

Configuring a Virtual Switch Routing Instance

On MX Series routers only, use the **virtual-switch** routing instance type to isolate a LAN segment with its spanning-tree instance and to separate its VLAN ID space. A bridge domain consists of a set of ports that share the same flooding or broadcast characteristics. Each virtual switch represents a Layer 2 network. You can optionally configure a virtual switch to support Integrated Routing and Bridging (IRB), which facilitates simultaneous Layer 2 bridging and Layer 3 IP routing on the same interface. You can also configure Layer 2 control protocols to provide loop resolution. Protocols supported include the Spanning-Tree Protocol (STP), Rapid Spanning-Tree Protocols (RSTP), Multiple Spanning-Tree Protocol (MSTP), and VLAN Spanning-Tree Protocol (VSTP).

To create a routing instance for a virtual switch, include at least the following statements in the configuration:

```
[edit]
routing-instances {
  routing-instance-name
    instance-type virtual-switch;
    bridge-domains {
      bridge-domain-name {
        domain-type bridge;
        interface interface-name;
        vlan-id (all | none | number);
        vlan-tags outer number inner number;
      }
    }
    protocols {
      (rstp | mstp | vstp) {
        ...stp-configuration ...
      }
    }
  }
}
```

For more information about configuring virtual switches, see *Configuring a Layer 2 Virtual Switch*.

Related Documentation

- Routing Instances Overview on page 15
- Layer 2 Routing Instance Types on page 16
- Layer 2 Routing Instances Configuration Hierarchy on page 17
- Configuring a VPLS Routing Instance on page 33
- Configuring a Layer 2 Control Protocol Routing Instance on page 35

Configuring a Layer 2 Control Protocol Routing Instance

On MX Series routers only, use the **layer2-control** routing instance type for Rapid Spanning-Tree Protocol (RSTP) or Multiple Spanning-Tree Protocol (MSTP) in customer edge interfaces of a VPLS routing instance. Layer 2 control protocols enable features such as Layer 2 protocol tunneling or nonstop bridging. This instance type cannot be used if the customer edge interface is multihomed to two provider edge interfaces. If the customer edge interface is multihomed to two provider edge interfaces, use the default bridge protocol data unit (BPDU) tunneling.

To create a routing instance for Layer 2 control protocols, include at least the following statements in the configuration:

```
routing-instances {
  routing-instance-name {
    instance-type layer2-control;
    interface interface-name;
    route-distinguisher (as-number:number | ip-address:number);
    vrf-import [ policy-names ];
    vrf-export [ policy-names ];
    protocols {
      mstp {
        ... interface options ...
        msti msti-id {
          ... MSTP MSTI configuration ...
        }
      }
    }
  }
}
```

You can include these statements at the following hierarchy levels:

- **[edit]**
- **[edit logical-systems *logical-system-name*]**

Related Documentation

- Routing Instances Overview on page 15
- Layer 2 Routing Instance Types on page 16
- Layer 2 Routing Instances Configuration Hierarchy on page 17
- Configuring a VPLS Routing Instance on page 33
- Configuring a Virtual Switch Routing Instance on page 34

CHAPTER 9

Configuration Tasks for Basic Layer 2 Services

Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages

You can configure the multicast snooping process for a virtual switch to ignore VPLS root protection topology change messages.

Before you begin, complete the following tasks:

1. Configure the spanning-tree protocol. For configuration details, see one of the following topics:
   - *Configuring Rapid Spanning-Tree Protocol*
   - *Configuring Multiple Spanning-Tree Protocol*
   - *Configuring VLAN Spanning-Tree Protocol*
2. Configure VPLS root protection. For configuration details, see one of the following topics:
   - *Configuring VPLS Root Protection Topology Change Actions to Control Global Spanning Tree Behavior*
   - *Configuring VPLS Root Protection Topology Change Actions to Control VLAN Spanning Tree Behavior*

To configure multicast snooping to ignore spanning tree topology change messages:

1. Configure a **virtual-switch** routing instance to isolate a LAN segment with its VSTP instance.
   a. Enable configuration of a virtual switch routing instance:

      ```
      [edit]
      user@host# edit routing-instances routing-instance-name
      user@host# set instance-type virtual-switch
      ```

      You can configure multicast snooping to ignore messages about spanning tree topology changes for the **virtual-switch** routing-instance type only.

   b. Enable configuration of a bridge domain:

      ```
      [edit routing-instances routing-instance-name]
      user@host# edit bridge-domains bridge-domain-name
      user@host# set domain-type bridge
      ```

   c. Configure the logical interfaces for the bridge domain in the virtual switch:

      ```
      [edit routing-instances routing-instance-name bridge-domains bridge-domain-name]
      user@host# set interface interface-name
      ```

   d. Configure the VLAN identifiers for the bridge domain in the virtual switch. For detailed information, see "Configuring a Virtual Switch Routing Instance" on page 34.

2. Configure the multicast snooping process to ignore any spanning tree topology change messages sent to the virtual switch routing instance:

   [edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]
   user@host# **set multicast-snooping-options ignore-stp-topology-change**

3. Verify the configuration of multicast snooping for the virtual-switch routing instance to ignore spanning tree topology change messages:

   [edit routing-instances *routing-instance-name* bridge-domains *bridge-domain-name*]
   user@host# **top**
   user@host# **show routing-instances**

```
routing-instance-name {
    instance-type virtual-switch;
    bridge-domains {
        bridge-domain-name {
            domain-type bridge {
            interface interface-name;
            ...VLAN-identifiers-configuration...
            multicast-snooping-options {
                ignore-stp-topology-change;
            }
        }
    }
}
```

Related Documentation

- Multicast Snooping on MX Series Routers on page 9
- Understanding Multicast Snooping and VPLS Root Protection on page 19
- Example: Configuring Multicast Snooping for a Bridge Domain on page 43

Configuring Load Balancing on a LAG Link

You can configure the load balancing hash key for Layer 2 traffic to use fields in the Layer 3 and Layer 4 headers inside the frame payload for load-balancing purposes using the **payload** statement. You can configure the statement to look at **layer-3** (and **source-ip-only** or **destination-ip-only** packet header fields) or **layer-4** fields. You configure this statement at the **[edit forwarding-options hash-key family multiservice]** hierarchy level.

You can configure Layer 3 or Layer 4 options, or both. The **source-ip-only** or **destination-ip-only** options are mutually exclusive. The **layer-3-only** statement is not available on MX Series routers.

NOTE: For Dense Port Concentrators (DPC), any change in the hash key configuration requires a reboot for the changes to take effect. For Modular Port Concentrators (MPC) the reboot is not required.

For more information about link aggregation group (LAG) configuration, see the *Junos OS Network Interfaces Library for Routing Devices*.

Related Documentation

- Load Balancing and Ethernet Link Aggregation on page 20
- Load Balancing on a LAG Link on page 44

Enabling Layer 2 Learning and Forwarding in a Logical System

On MX Series router, you can enable Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances.

Before you begin, configure the interfaces for the logical system.

To configure Layer 2 learning and forwarding in a logical system for bridge domains or other virtual-switch routing instances:

1. Enable configuration of a logical system:

   ```
   [edit]
   user@host# edit logical-systems logical-system-name
   ```

   For detailed information about logical systems, see the *Logical Systems Feature Guide for Routing Devices*.

2. Enable configuration of a virtual-switch routing instance:

   ```
   [edit logical-systems logical-system-name]
   user@host# edit routing-instances routing-instance-name
   user@host# set instance-type virtual-switch
   ```

3. Configure the set of bridge-domains or other virtual-switch routing instances.
4. Configure Layer 2 learning and forwarding properties for a set of bridge domains:

   a. Enable configuration of Layer 2 learning and forwarding properties:

      ```
      [edit logical-systems logical-system-name]
      user@host# edit switch-options
      ```

   b. Configure Layer 2 learning and forwarding properties. For more information, see *Layer 2 Learning and Forwarding for Bridge Domains Overview*.

5. Verify the configuration:

   ```
   [edit logical-systems logical-system-name switch-options]
   user@host# top
   user@host# show logical-systems

   logical-system-name {
     interfaces {
       ...interface-configurations...
     }
     routing-instances {
       instance-type virtual-switch;
     }
     bridge-domains{
       ...bridge-domain-configuration...
     }
   ```

```
switch-options {
   interface logical-interface-name {
      ...layer-2-learning-and-forwarding-configuration...
   }
}
protocols {
   (rstp | mstp | vstp) {
      interface interface-name;
      ...spanning-tree-protocol-configuration...
   }
}
```

Related Documentation

- Layer 2 Learning and Forwarding in a Logical System on page 21
- Layer 2 Learning and Forwarding and RSTP in a Logical System on page 44

CHAPTER 10

Basic Layer 2 Services Examples

Example: Configuring Multicast Snooping for a Bridge Domain

This example configures the multicast snooping option for a bridge domain named **Ignore-STP** in a virtual switch routing instance named **vs_routing_instance_multihomed_CEs**:

```
[edit]
routing-instances {
   vs_routing_instance_multihomed_CEs {
      instance-type virtual-switch;
      bridge-domains {
         bd_ignore_STP {
            multicast-snooping-options {
               ignore-stp-topology-change;
            }
         }
      }
   }
}
```

NOTE: This is not a complete router configuration.

Related Documentation

- Multicast Snooping on MX Series Routers on page 9
- Understanding Multicast Snooping and VPLS Root Protection on page 19
- Configuring Multicast Snooping to Ignore Spanning Tree Topology Change Messages on page 38

Example: Configuring Load Balancing on a LAG Link

This example configures the load-balancing hash key to use the source Layer 3 IP address option and Layer 4 header fields as well as the source and destination MAC addresses for load balancing on a link aggregation group (LAG) link:

```
[edit]
forwarding-options {
  hash-key {
    family multiservice {
      source-mac;
      destination-mac;
      payload {
        ip {
          layer-3 {
            source-ip-only;
          }
          layer-4;
        }
      }
    }
  }
}
```

NOTE: Any change in the hash key configuration requires a reboot of the FPC for the changes to take effect.

Related Documentation

- Load Balancing and Ethernet Link Aggregation on page 20
- Configuring Load Balancing on a LAG Link on page 39

Example: Configuring Layer 2 Learning and Forwarding and RSTP in a Logical System

The following example configures a logical system and routing instance with its own bridge domain (**bd1**), switch options, and spanning- tree protocol (**rstp**).

```
[edit]
interfaces {
  ge-5/0/1 {
    flexible-vlan-tagging;
  }
}
logical-systems {
  logical-sys1 {
    interfaces {
      ge-5/0/1 {
        unit 0 {
          family bridge {
            interface-mode trunk;
            vlan-id-list 1–5;
          }
```

```
        }
        unit 3 {
          family bridge {
            interface-mode trunk;
            vlan-id-list 11–15;
          }
        }
      }
      ge-5/0/2 {
        unit 0 {
          family bridge {
            interface-mode trunk;
            vlan-id-list 1–5;
          }
        }
      }
    }
    routing-instances {
      routing-inst-1 {
        interface ge-5/0/2;
        instance-type virtual-switch;
        bridge-domains {
          vlan-id 1;
        }
        protocols {
          rstp {
            interface ge-5/0/2;
          }
        }
      }
    }
    bridge-domains {
      bd-1 {
        vlan-id 1;
      }
    }
    switch-options {
      interface ge-5/0/1.3 {
        interface-mac-limit {
          1400;
          packet-action drop;
        }
      }
    }
    protocols {
      rstp {
        interface ge-5/0/1;
      }
    }
  }
}
```

NOTE: This is not a complete router configuration.

Related Documentation

- Layer 2 Learning and Forwarding in a Logical System on page 21
- Enabling Layer 2 Learning and Forwarding in a Logical System on page 40

PART 3

Index

Index

Symbols

A

B

C

D

E

F

H

I

L

M

P

R

S

T

V