Table 3: QFX10000 MPLS Features *(continued)*

Feature	QFX10002	QFX10008	QFX10016
Traffic engineering (TE) Automatic bandwidth allocation and RSVP bandwidth Dynamic bandwidth management using ingress LSP splitting and merging	15.1X53-D10	15.1X53-D30	15.1X53-D60
Virtual routing and forwarding (VRF) label support	15.1X53-D10	15.1X53-D30	15.1X53-D60

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
QFX Series standalone switches as MPLS provider edge (PE) switches or provider switches	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Label edge router (LER)	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Label-switching router (LSR)	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Automatic bandwidth allocation on LSPs	Not supported	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
BGP labeled unicast	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features *(continued)*

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
BGP link state distribution	Not supported	17.1R1	17.1R1	18.3R1	17.1R1	18.1R1
BGP route reflector	15.1X53-D10	15.1X53-D30	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Carrier-to-carrier and interprovider BGP Layer 3 VPNs	14.1X53-D15	14.1X53-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Class of service (CoS or QoS) for MPLS traffic	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Dynamic label-switched path (LSP) count sizing: TE++	Not supported	17.2R1 VC/VCF 17.2R1	17.2R1 VC/VCF 17.2R1	18.3R1	17.2R1	18.1R1
Equal-cost multipath (ECMP) at LSRs: • SWAP • PHP • L3VPN • L2 Circuit	Not supported	14.1X53-D35 (Supported only on label stack. Not supported on flow label, entropy label, or ECMP label)	15.1X53-D210 (Supported only on label stack. Not supported on flow label, entropy label, or ECMP label)	18.3R1 (Supported only on label stack. Not supported on flow label, entropy label, or ECMP label)	15.1X53-D30	18.1R1
Entropy labels	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Ethernet-over-MPLS (L2 Circuit)	14.1X53-D10	14.1X53-D10 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features *(continued)*

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
Fast reroute (FRR), one-to-one local protection and many-to-one local protection	14.1X53-D10	14.1X53-D10	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
FRR using detours and secondary LSP	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
Firewall filters	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Flow-aware transport of pseudowires (FAT) flow labels	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
RSVP graceful restart for OSPF	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Traffic engineering extensions (OSPF-TE, IS-IS-TE)	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
IP-over-MPLS LSPs, both static and dynamic links	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features *(continued)*

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
IPv6 tunneling over an MPLS IPv4 network (6PE)	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
IPv6 over an MPLS core network	Not supported	Not supported	Not supported	Not supported	Not supported	Not supported
LDP tunneling over RSVP	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Layer 3 VPNs for both IPv4 and IPv6	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Loop-free alternate (LFA)	Not supported	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	18.1R1	18.1R1
MPLS over integrated bridging and routing (IRB) interfaces	Not supported	14.1X53-D40	18.1R1	18.3R1	18.1R1	18.1R1
MTU signaling in RSVP	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features *(continued)*

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
Operation, Administration, and Maintenance (OAM) including MPLS ping, traceroute, and BFD	12.3X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
OSPF TE	12.3X50-D10	13.2X51-D15	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
OSPFv2 as an interior gateway protocol	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Path Computation Element Protocol for RSVP-TE	Not supported	17.4R1	17.4R1	18.3R1	17.4R1	18.1R1
Redundant aggregated Ethernet interfaces (core-facing interface)	14.1X53-D10	14.1X53-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
RSVP automatic bandwidth	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1

Table 4: QFX3500, QFX5100, QFX5110, QFX5120, QFX5200, QFX5210 MPLS Features *(continued)*

Feature	QFX3500	QFX5100	QFX5110	QFX5120	QFX5200	QFX5210
RSVP fast reroute (FRR), including link-protection, node-link-protection, fast reroute using detours, and secondary LSP	14.1X53-D15	14.1X53-D15	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
RSVP-TE extensions (IS-IS and OSPF)	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
SNMP MIB support	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Static and dynamic LSPs	12.2X50-D10	13.2X51-D10 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Traffic engineering (TE) automatic bandwidth allocation on LSPs	13.1X51-D10	13.1X51-D10 VC/VCF (13.2X51-D10)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
Virtual routing and forwarding (VRF) label support	12.2X50-D10	13.2X51-D15 VC/VCF (14.1X53-D30)	15.1X53-D210	18.3R1	15.1X53-D30	18.1R1
VRF support in IRB Interfaces in a Layer 3 VPN	Not supported	17.3R1	17.3R1	18.3R1	17.3R1	18.1R1

Table 5: EX4600 and EX4650 MPLS Features

Feature	EX4600	EX4650
EX4600 and EX4650 standalone switches as MPLS provider edge (PE) switches or provider switches	14.1X53-D15	18.3R1
Label edge router (LER)	14.1X53-D15	18.3R1
Label-switching router (LSR)	14.1X53-D15	18.3R1
Automatic bandwidth allocation on LSPs	Not supported	18.3R1
BGP labeled unicast	14.1X53-D15	18.3R1
BGP link state distribution	Not supported	18.3R1
BGP route reflector	14.1X53-D15	18.3R1
Carrier-to-carrier and interprovider BGP Layer 3 VPNs	14.1X53-D15	18.3R1
Class of service (CoS or QoS) for MPLS traffic	14.1X53-D15	18.3R1
Dynamic label-switched path (LSP) count sizing: TE++	Not supported	18.3R1
Equal-cost multipath (ECMP) at LSRs: • SWAP • PHP • L3VPN • L2 Circuit	Not supported	18.3R1 (Supported only on label stack. Not supported on flow label, entropy label, or ECMP label)
Entropy labels	Not supported	Not supported
Ethernet-over-MPLS (L2 Circuit)	14.1X53-D15	18.3R1
Fast reroute (FRR), one-to-one local protection and many-to-one local protection	14.1X53-D15	18.3R1

Table 5: EX4600 and EX4650 MPLS Features *(continued)*

Feature	EX4600	EX4650
FRR using detours and secondary LSP	Not supported	Not supported
Firewall filters	14.1X53-D15	18.3R1
Flow-aware transport of pseudowires (FAT) flow labels	Not supported	Not supported
RSVP graceful restart for OSPF	13.2X51-D25	18.3R1
Traffic engineering extensions (OSPF-TE, IS-IS-TE)	14.1X53-D15	18.3R1
IP-over-MPLS LSPs, both static and dynamic links	14.1X53-D15	18.3R1
IPv6 tunneling over an MPLS IPv4 network (6PE)	14.1X53-D15	18.3R1
IPv6 over an MPLS core network	Not supported	Not supported
LDP tunneling over RSVP	14.1X53-D15	18.3R1
Layer 3 VPNs for both IPv4 and IPv6	14.1X53-D15	18.3R1
Loop-free alternate (LFA)	Not supported	Not supported
MPLS over integrated bridging and routing (IRB) interfaces	Not supported	18.3R1
MTU signaling in RSVP	14.1X53-D15	18.3R1
Operation, Administration, and Maintenance (OAM) including MPLS ping, traceroute, and BFD	14.1X53-D15	18.3R1
OSPF TE	14.1X53-D15	18.3R1
OSPFv2 as an interior gateway protocol	13.2X51-D25	18.3R1

Table 5: EX4600 and EX4650 MPLS Features *(continued)*

Feature	EX4600	EX4650
Path Computation Element Protocol for RSVP-TE	Not supported	18.3R1
Pseudowire-over-aggregated Ethernet interfaces (core-facing interface)	14.1X53-D15	18.3R1
RSVP automatic bandwidth	14.1X53-D15	18.3R1
RSVP fast reroute (FRR), including link-protection, node-link-protection, fast reroute using detours, and secondary LSP	14.1X53-D15	18.3R1
RSVP-TE extensions (IS-IS and OSPF)	14.1X53-D15	18.3R1
SNMP MIB support	14.1X53-D15	18.3R1
Static and dynamic LSPs	14.1X53-D15	18.3R1
Traffic engineering (TE)automatic bandwidth allocation on LSPs	14.1X53-D15	18.3R1
Virtual routing and forwarding (VRF) label support	14.1X53-D15	18.3R1
VRF support in IRB Interfaces in a Layer 3 VPN	Not supported	18.3R1

MPLS Limitations on QFX Series and EX4600 Switches

IN THIS SECTION

MPLS is a fully implemented protocol on routers, while switches support a subset of the MPLS features. The limitations of each switch are listed in a separate section here, although many of the limitations are duplicates that apply to more than one switch.

MPLS Limitations on QFX10000 Switches

- Configuring an MPLS firewall filter on a switch that is deployed as an egress provider edge (PE) switch has no effect.

- Configuring the **revert-timer** statement at the **[edit protocols mpls]** hierarchy level has no effect.

- These LDP features are not supported on the QFX10000 switches:

  - LDP multipoint

  - LDP link protection

  - LDP Bidirectional Forwarding Detection (BFD)

  - LDP Operation Administration and Management (OAM)

  - LDP multicast-only fast reroute (MoFRR)

- Pseudowire-over-aggregated Ethernet interfaces on UNI are not supported.

- MPLS-over-UDP tunnels are not supported on the following:

  - MPLS TTL propagation

  - IP fragmentation at the tunnel start point

  - CoS rewrite rules and priority propagation for RSVP LSP labels (ingress tunnels only)

  - Plain IPv6

  - Multicast traffic

  - Firewall filters on tunnel start and endpoints

  - CoS tunnel endpoints

    > **NOTE:** MPLS-over-UDP tunnels are created only if corresponding RSVP-TE, LDP, or BGP-LU tunnels are not available for the destination route.

MPLS Limitations on EX4600, EX4650, QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 Switches

- MPLS support differs on the various switches. EX4600 switches support only basic MPLS functionality while the QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches support some of the more advanced features. See "MPLS Feature Support on QFX Series and EX4600 Switches" on page 11 for details.

- On a QFX5100 switch, configuring integrated bridging and routing (IRB) interfaces on the MPLS core is implemented on the switch by using TCAM rules. This is the result of a chip limitation on the switch,

which only allows for a limited amount of TCAM space. There is 1K TCAM space is allocated for IRB. If multiple IRBs exist, make sure that you have enough available TCAM space on the switch. To check the TCAM space, see TCAM Filter Space Allocation and Verification in QFX Devices from Junos OS 12.2x50-D20 Onward.

- (QFX5100, QFX5110, QFX5120, QFX5200, QFX5210, EX4600) When VLAN bridge encapsulation is enabled on a CE connected interface, the switch drops packets if both flexible Ethernet services and VLAN CCC encapsulations are configured on the same logical interface. Only one can be configured, not both. For example:

  set interfaces xe-0/0/18 encapsulation flexible-ethernet-services, or **set interfaces xe-0/0/18 encapsulation vlan-ccc**.

- Layer 2 circuits on aggregated Ethernet (AE) interfaces are not supported on QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches.

- Layer 2 circuit local switching is not supported on the EX4600, EX4650, and QFX5100 switches.

- The QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches do not depend on the VRF match for loopback filters configured at different routing instances. Loopback filters per routing instance (such as lo0.100, lo0.103, lo0.105) are not supported and may cause unpredictable behavior. We recommend that you only apply the loopback filter (lo0.0) to the master routing instance

- On EX4600 and EX4650 switches, when loopback filters with both accept and deny terms for the same IP address are configured and if RSVP packets have that IP address in either source IP or destination IP, then those RSVP packets will be dropped even if accept terms have higher priority than deny terms. As per design, if the switch receives an RSVP packet with IP OPTION, the packet is copied to the CPU and then the original packet is dropped. Because RSVP packets are marked for drop, the accept term will not process these packets and the deny term will drop the packets.

- On a link-protected, fast reroute Layer 2 circuit, you might see a traffic convergence delay of 200 to 300 milliseconds.

- Layer 2 circuit local switching is not supported on the EX4600, EX4650, and QFX5100 switches.

- If you configure the BGP labeled unicast address family (using the **labeled-unicast** statement at the **[edit protocols bgp family inet]** hierarchy level) on a QFX Series switch or on an EX4600 switch deployed as a route reflector for BGP labeled routes, path selection will occur at the route reflector, and a single best path will be advertised. This will result in loss of BGP multipath informaton.

- Although fast reroute (FRR) on regular interfaces is supported, the **include-all** and **include-any** options for FRR are not supported. See "Fast Reroute Overview" on page 513.

- FRR is not supported on MPLS over IRB interfaces.

- MPLS-based circuit cross-connects (CCC) are not supported—only circuit-based pseudowires are supported.

- Configuring link aggregation groups (LAGs) on user-to-network interface (UNI) ports for L2 circuits is not supported.

- MTU signaling in RSVP and discovery is supported in the control plane. However, this cannot be enforced in the data plane.

- With L2 circuit-based pseudowires, if multiple equal-cost RSVP LSPs are available to reach an L2 circuit neighbor, one LSP is randomly used for forwarding. Use this feature to specify LSPs for specific L2 circuit traffic to load-share the traffic in the MPLS core.

- Configuring an MPLS firewall filter on a switch that is deployed as an egress provider edge (PE) switch has no effect.

- Firewall filters and policers on **family mpls** are only supported on QFX5100 switches that act as pure label-switching routers (LSRs) in an MPLS network. A pure LSR is a transit router that switches paths solely on the incoming label's instructions. Firewall filters and policers on **family mpls** are not supported on QFX5100 ingress and egress provider edge (PE) switches. This includes switches that perform penultimate hop popping (PHP).

- Configuring the **revert-timer** statement at the **[edit protocols mpls]** hierarchy level has no effect.

- These are the hardware limitations for EX4600, EX4650, QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches:

  - Push of a maximum of three labels is supported in the MPLS edge switch if label swap is not done.

  - Push of a maximum of two labels is supported in the MPLS edge switch if label swap is done.

  - Pop at line rate is supported for a maximum of two labels.

  - Global label space is supported but interface-specific label space is not supported.

  - MPLS ECMP on PHY node with BOS=1 is not supported for single labels.

  - QFX Series switches with Broadcom chips do not support separate next hops for the same label with different S bits (S-0 and S-1). This includes the QFX3500, QFX3600, EX4600, QFX5100, and QFX5200 switches.

  - On EX4600, EX4650, QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches, the MPLS MTU command can cause unexpected behavior—this is due to SDK chipset limitations on this platform.

- These LDP features are not supported on the EX4600, EX4650, QFX5100, QFX5110, QFX5120, QFX5200, and QFX5210 switches:

  - LDP multipoint

  - LDP link protection

  - LDP Bidirectional Forwarding Detection (BFD)

  - LDP Operation Administration and Management (OAM)

  - LDP multicast-only fast reroute (MoFRR)

- Configuring unit with **family mpls** and unit with **encapsulation vlan-bridge** on the same physical interface is not supported on EX4600, EX4650, QFX5100, QFX5110, or QFX5120.

MPLS Limitations on QFX5100 Virtual Chassis and Virtual Chassis Fabric Switches

The following MPLS features are not supported by the QFX5100 VC and QFX5100 VCF switches:

- Next-hop LSP

- BFD including BFD triggered FRR

- L2 VPN based on BGP (See RFC 6624)

- VPLS

- Extended VLAN CCC

- Pseudowire protection using Ethernet OAM

- Local switching of pseudo-wire

- Pseudowire fault detection based on VCCV

- QFX Series switches with Broadcom chipsets do not support separate next hops for the same label with different S bits (S-0 and S-1). This includes QFX3500, QFX3600, EX4600, QFX5100, and QFX5200 switches.

MPLS Limitations on QFX3500 Switches

- If you configure the BGP labeled unicast address family (using the **labeled-unicast** statement at the **[edit protocols bgp family inet]** hierarchy level) on a QFX Series switch or on an EX4600 switch deployed as a route reflector for BGP labeled routes, path selection will occur at the route reflector, and a single best path will be advertised. This will result in loss of BGP multipath information.

- Although fast reroute is supported, the **include-all** and **include-any** options for fast reroute are not supported. See "Fast Reroute Overview" on page 513 for details.

- MPLS-based circuit cross-connects (CCC) are not supported—only circuit-based pseudowires are supported.

- MTU signaling in RSVP and discovery is supported in the control plane. However, this cannot be enforced in the data plane.

- With Layer 2 (L2) circuit-based pseudowires, if multiple equal-cost RSVP label-switched paths (LSPs) are available to reach a L2 circuit neighbor, one LSP is randomly used for forwarding. Use this feature to specify LSPs for specific L2 circuit traffic to load-share the traffic in the MPLS core.

- Configuring an MPLS firewall filter on a switch that is deployed as an egress provider edge (PE) switch has no effect.

- Configuring the **revert-timer** statement at the **[edit protocols mpls]** hierarchy level has no effect.

RELATED DOCUMENTATION