JUNIPER NETWORKS

Junos® OS

CCC and TCC Configuration Guide

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Junos® OS CCC and TCC Configuration Guide
12.1

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.

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Table of Contents

List of Figures

List of Tables

About the Documentation

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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 *Junos OS 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`
Italic text like this	• Introduces 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*

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

Convention	Description	Examples
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; interface names; 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.	
J-Web GUI Conventions		
Bold text like this	Represents J-Web 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 J-Web selections.	In the configuration editor hierarchy, select **Protocols>Ospf**.

Documentation Feedback

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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)

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- 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 .
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- 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

Introduction to CCC and TCC

CCC Overview

Circuit cross-connect (CCC) allows you to configure transparent connections between two circuits, where a circuit can be a Frame Relay data-link connection identifier (DLCI), an Asynchronous Transfer Mode (ATM) virtual circuit (VC), a Point-to-Point Protocol (PPP) interface, a Cisco High-Level Data Link Control (HDLC) interface, or an MPLS label-switched path (LSP). Using CCC, packets from the source circuit are delivered to the destination circuit with, at most, the Layer 2 address being changed. No other processing—such as header checksums, time-to-live (TTL) decrementing, or protocol processing—is done.

CCC circuits fall into two categories: logical interfaces, which include DLCIs, VCs, virtual local area network (VLAN) IDs, PPP and Cisco HDLC interfaces, and LSPs. The two circuit categories provide three types of cross-connect:

- Layer 2 switching—Cross-connects between logical interfaces provide what is essentially Layer 2 switching. The interfaces that you connect must be of the same type.
- MPLS tunneling—Cross-connects between interfaces and LSPs allow you to connect two distant interface circuits of the same type by creating MPLS tunnels that use LSPs as the conduit.
- LSP stitching—Cross-connects between LSPs provide a way to “stitch” together two label-switched paths, including paths that fall in two different traffic engineering database areas.

For Layer 2 switching and MPLS tunneling, the cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first. For LSP stitching, the cross-connect is unidirectional.

You can police (control) the amount of traffic flowing over CCC circuits. For more information, see the *Junos OS VPNs Configuration Guide*.

It is also possible to use the **ping** command to check the integrity of CCC LSPs. See Pinging CCC LSPs for more information.

Transmitting Nonstandard BPDUs

CCC protocol (and Layer 2 Circuit and Layer 2 VPN) configurations can transmit nonstandard bridge protocol data units (BPDUs) generated by other vendors' equipment. This is the default behavior on all supported PICs and requires no additional configuration.

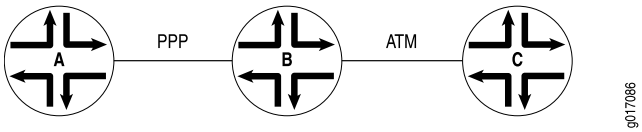
The following PICs are supported on M320 and T Series routers:

- 1-port Gigabit Ethernet PIC
- 2-port Gigabit Ethernet PIC
- 4-port Gigabit Ethernet PIC
- 10-port Gigabit Ethernet PIC

TCC Overview

Translational cross-connect (TCC) is a switching concept that enables you to establish interconnections between a variety of Layer 2 protocols or circuits. It is similar to CCC. However, whereas CCC requires the same Layer 2 encapsulations on each side of a Juniper Networks router (such as PPP-to-PPP or Frame Relay-to-Frame Relay), TCC enables you to connect different types of Layer 2 protocols interchangeably. When you use TCC, combinations such as PPP-to-ATM (see Figure 1 on page 4) and Ethernet-to-Frame Relay connections are possible.

Figure 1: TCC Example



The Layer 2 circuits and encapsulation types that can be interconnected by TCC are:

- Ethernet
- Extended VLANs
- PPP
- HDLC
- ATM
- Frame Relay

TCC works by removing the Layer 2 header when frames enter the router and adding a different Layer 2 header on the frames before they leave the router. In Figure 1 on page 4, the PPP encapsulation is stripped from the frames arriving at Router B, and the ATM encapsulation is added before the frames are sent to Router C.

Note that all control traffic is terminated at the interconnecting router (Router B). Examples of traffic controllers include the Link Control Protocol (LCP) and the Network Control Protocol (NCP) for PPP, keepalives for HDLC, and Local Management Interface (LMI) for Frame Relay.

TCC functionality is different from standard Layer 2 switching. TCC only swaps Layer 2 headers. No other processing, such as header checksums, TTL decrementing, or protocol handling is performed. TCC is supported for IPv4 only.

Address Resolution Protocol (APR) packet policing on TCC Ethernet interfaces is effective for releases 10.4 and onwards.

You can configure TCC for interface switching and for Layer 2 VPNs. For more information about using TCC for virtual private networks (VPNs), see the *Junos OS VPNs Configuration Guide*.

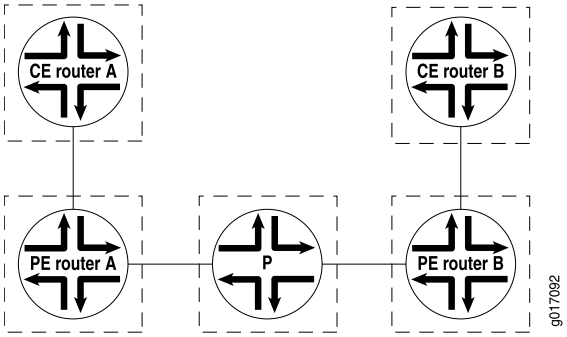
CCC and TCC Graceful Restart

CCC and TCC graceful restart allows Layer 2 connections between customer edge (CE) routers to restart gracefully. These Layer 2 connections are configured with the **remote-interface-switch** or **lsp-switch** statements. Because these CCC and TCC connections have an implicit dependency on RSVP LSPs, graceful restart for CCC and TCC uses the RSVP graceful restart capabilities.

RSVP graceful restart must be enabled on the PE routers and P routers to enable graceful restart for CCC and TCC. Also, because RSVP is used as the signaling protocol for signaling label information, the neighboring router must use helper mode to assist with the RSVP restart procedures.

Figure 2 on page 5 illustrates how graceful restart might work on a CCC connection between two CE routers.

Figure 2: Remote Interface Switch Connecting Two CE Routers Using CCC



PE Router A is the ingress for the transmit LSP from PE Router A to PE Router B and the egress for the receive LSP from PE Router B to PE Router A. With RSVP graceful restart enabled on all the PE and P routers, the following occurs when PE router A restarts:

- PE Router A preserves the forwarding state associated with the CCC routes (those from CCC to MPLS and from MPLS to CCC).

- Traffic flows without disruption from CE router to CE router.
- After the restart, PE Router A preserves the label for the LSP for which PE Router A is the egress (the receive LSP, for example). The transmit LSP from PE Router A to PE Router B can derive new label mappings, but should not cause any traffic disruption.

PART 2

Configuration

CHAPTER 2

CCC and TCC Configuration Guidelines

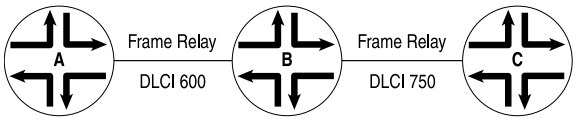
Configuring Layer 2 Switching Cross-Connects Using CCC

Layer 2 switching cross-connects join logical interfaces to form what is essentially Layer 2 switching. The interfaces that you connect must be of the same type.

Figure 3 on page 9 illustrates a Layer 2 switching cross-connect. In this topology, Router A and Router C have Frame Relay connections to Router B, which is a Juniper Networks router. Circuit cross-connect (CCC) allows you to configure Router B to act as a Frame Relay (Layer 2) switch.

To configure Router B to act as a Frame Relay switch, you configure a circuit from Router A to Router C that passes through Router B, effectively configuring Router B as a Frame Relay switch with respect to these routers. This configuration allows Router B to transparently switch packets (frames) between Router A and Router C without regard to the packets' contents or the Layer 3 protocols. The only processing that Router B performs is to translate DLCI 600 to 750.

Figure 3: Layer 2 Switching Cross-Connect



If the Router A–to–Router B and Router B–to–Router C circuits were PPP, for example, the Link Control Protocol and Network Control Protocol exchanges occur between Router A and Router C. These messages are handled transparently by Router B, allowing Router A and Router C to use various PPP options (such as header or address compression and authentication) that Router B might not support. Similarly, Router A and Router C exchange keepalives, providing circuit-to-circuit connectivity status.

You can configure Layer 2 switching cross-connects on PPP, Cisco HDLC, Frame Relay, Ethernet, and ATM circuits. In a single cross-connect, only like interfaces can be connected.

To configure Layer 2 switching cross-connects, you must configure the following on the router that is acting as the switch (Router B in Figure 3 on page 9):

Configuring the CCC Encapsulation for Layer 2 Switching Cross-Connects

To configure Layer 2 switching cross-connects, configure the CCC encapsulation on the router that is acting as the switch (Router B in Figure 3 on page 9).

NOTE: You cannot configure families on CCC interfaces; that is, you cannot include the family statement at the **[edit interfaces *interface-name* unit *logical-unit-number*]** hierarchy level.

For instructions for configuring the encapsulation for Layer 2 switching cross-connects, see the following sections:

Configuring ATM Encapsulation for Layer 2 Switching Cross-Connects

For ATM circuits, specify the encapsulation when configuring the virtual circuit (VC). Configure each VC as a circuit or a regular logical interface by including the following statements:

```
at-fpc/pic/port {
  atm-options {
    vpi vpi-identifier maximum-vcs maximum-vcs;
  }
  unit logical-unit-number {
    point-to-point; # Default interface type
    encapsulation encapsulation-type;
    vci vpi-identifier.vci-identifier;
```

```
    }
}
```

You can include these statements at the following hierarchy levels:

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

Configuring Ethernet Encapsulation for Layer 2 Switching Cross-Connects

For Ethernet circuits, specify **ethernet-ccc** in the **encapsulation** statement. This statement configures the entire physical device. For these circuits to work, you must also configure a logical interface (unit 0).

Ethernet interfaces with standard Tag Protocol Identifier (TPID) tagging can use Ethernet CCC encapsulation. On M Series Multiservice Edge Routers, except the M320, one-port Gigabit Ethernet, two-port Gigabit Ethernet, four-port Gigabit Ethernet, and four-port Fast Ethernet PICs can use Ethernet CCC encapsulation. On T Series Core Routers and M320 routers, one-port Gigabit Ethernet and two-port Gigabit Ethernet PICs installed in FPC2 can use Ethernet CCC encapsulation. When you use this encapsulation type, you can configure the **ccc** family only.

```
fe-fpc/pic/port {
    encapsulation ethernet-ccc;
    unit 0;
}
```

You can include these statements at the following hierarchy levels:

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

Configuring Ethernet VLAN Encapsulation for Layer 2 Switching Cross-Connects

An Ethernet virtual LAN (VLAN) circuit can be configured using either the **vlan-ccc** or **extended-vlan-ccc** encapsulation. If you configure the **extended-vlan-ccc** encapsulation on the physical interface, you cannot configure the **inet** family on the logical interfaces. Only the **ccc** family is allowed. If you configure the **vlan-ccc** encapsulation on the physical interface, both the **inet** and **ccc** families are supported on the logical interfaces. Ethernet interfaces in VLAN mode can have multiple logical interfaces.

For encapsulation type **vlan-ccc**, VLAN IDs from 512 through 4094 are reserved for CCC VLANs. For the **extended-vlan-ccc** encapsulation type, all VLAN IDs 1 and higher are valid. VLAN ID 0 is reserved for tagging the priority of frames.

NOTE: Some vendors use the proprietary TPIDs 0x9100 and 0x9901 to encapsulate a VLAN-tagged packet into a VLAN-CCC tunnel to interconnect a geographically separated metro Ethernet network. By configuring the extended-vlan-ccc encapsulation type, a Juniper Networks router can accept all three TPIDs (0x8100, 0x9100, and 0x9901).

Configure an Ethernet VLAN circuit with the **vlan-ccc** encapsulation as follows:

```
interfaces {
  type-fpc/pic/port {
    vlan-tagging;
    encapsulation vlan-ccc;
    unit logical-unit-number {
      encapsulation vlan-ccc;
      vlan-id vlan-id;
    }
  }
}
```

You can configure these statements at the following hierarchy levels:

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

Configure an Ethernet VLAN circuit with the **extended-vlan-ccc** encapsulation statement as follows:

```
interfaces {
  type-fpc/pic/port {
    vlan-tagging;
    encapsulation extended-vlan-ccc;
    unit logical-unit-number {
      vlan-id vlan-id;
      family ccc;
    }
  }
}
```

You can configure these statements at the following hierarchy levels:

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

Whether you configure the encapsulation as **vlan-ccc** or **extended-vlan-ccc**, you must enable VLAN tagging by including the **vlan-tagging** statement.

Configuring Aggregated Ethernet Encapsulation for Layer 2 Switching Cross-Connects

You can configure aggregated Ethernet interfaces for CCC connections and for Layer 2 virtual private networks (VPNs).

Aggregated Ethernet interfaces configured with VLAN tagging can be configured with multiple logical interfaces. The only encapsulation available for aggregated Ethernet logical interfaces is **vlan-ccc**. When you configure the **vlan-id** statement, you are limited to VLAN IDs 512 through 4094.

Aggregated Ethernet interfaces configured without VLAN tagging can be configured only with the **ethernet-ccc** encapsulation. All untagged Ethernet packets received are forwarded based on the CCC parameters.

To configure aggregated Ethernet interfaces for CCC connections, include the **ae0** statement at the **[edit interfaces]** hierarchy level:

```
[edit interfaces]
ae0 {
  encapsulation (ethernet-ccc | extended-vlan-ccc | vlan-ccc);
  vlan-tagging;
  aggregated-ether-options {
    minimum-links links;
    link-speed speed;
  }
  unit logical-unit-number {
    encapsulation vlan-ccc;
    vlan-id identifier;
    family ccc;
  }
}
```

Be aware of the following limitations when configuring CCC connections over aggregated Ethernet interfaces:

- If you configured load balancing between child links, be aware that a different hash key is used to distribute packets among the child links. Standard aggregated interfaces have family inet configured. An IP version 4 (IPv4) hash key (based on the Layer 3 information) is used to distribute packets among the child links. A CCC connection over an aggregated Ethernet interface has family ccc configured instead. Instead of an IPv4 hash key, an MPLS hash key (based on the destination media access control [MAC] address) is used to distributed packets among the child links.
- The extended-vlan-ccc encapsulation is not supported on the 12-port Fast Ethernet PIC and the 48-port Fast Ethernet PIC.
- The Junos OS does not support the Link Aggregation Control Protocol (LACP) when an aggregated interface is configured as a VLAN (with vlan-ccc encapsulation). LACP can be configured only when the aggregated interface is configured with the ethernet-ccc encapsulation.

For more information about how to configure aggregated Ethernet interfaces, see the *Junos OS Network Interfaces Configuration Guide*.

Configuring Frame Relay Encapsulation for Layer 2 Switching Cross-Connects

For Frame Relay circuits, specify the encapsulation when configuring the DLCI. Configure each DLCI as a circuit or a regular logical interface. The DLCI for regular interfaces must be from 1 through 511. For CCC interfaces, it must be from 512 through 4094.

```
interfaces {
  type-fpc/pic/port {
    unit logical-unit-number {
      point-to-point; # Default interface type
      encapsulation encapsulation-type;
      dlci dlci-identifier;
    }
  }
}
```

You can configure these statements at the following hierarchy levels:

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

Configuring PPP and Cisco HDLC Encapsulation for Layer 2 Switching Cross-Connects

For PPP and Cisco HDLC circuits, specify the encapsulation in the **encapsulation** statement. This statement configures the entire physical device. For these circuits to work, you must configure a logical interface (unit 0).

```
interfaces type-fpc/pic/port {
  encapsulation encapsulation-type;
  unit 0;
}
```

You can configure these statements at the following hierarchy levels:

- **[edit interfaces *type-fpc/pic/port*]**
- **[edit logical-systems *logical-system-name* interfaces *type-fpc/pic/port*]**

Configuring the CCC Connection for Layer 2 Switching Cross-Connects

To configure Layer 2 switching cross-connects, define the connection between the two circuits by including the **interface-switch** statement. You configure this connection on the router that is acting as the switch (Router B in Figure 3 on page 9). The connection joins the interface that comes from the circuit's source to the interface that leads to the circuit's destination. When you specify the interface names, include the logical portion of the name, which corresponds to the logical unit number. The cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first.

```
interface-switch connection-name {
  interface interface-name.unit-number;
  interface interface-name.unit-number;
}
```

You can include this statement at the following hierarchy levels:

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

Configuring MPLS for Layer 2 Switching Cross-Connects

For Layer 2 switching cross-connects to work, you must enable MPLS on the router by including at least the following statements. This minimum configuration enables MPLS on a logical interface for the switching cross-connect.

Include the **family mpls** statement:

```
family mpls;
```

You can configure this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]**

You can then specify this logical interface in the MPLS protocol configuration:

```
mpls {
  interface interface-name; # Required to enable MPLS on the interface
}
```

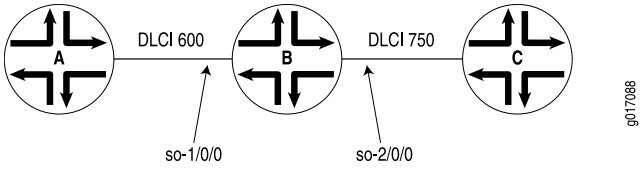
You can configure these statements at the following hierarchy levels:

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

Example: Configuring a Layer 2 Switching Cross-Connect

Configure a full-duplex Layer 2 switching cross-connect between Router A and Router C, using a Juniper Networks router, Router B, as the virtual switch. See the topology in Figure 4 on page 15 and Figure 5 on page 16.

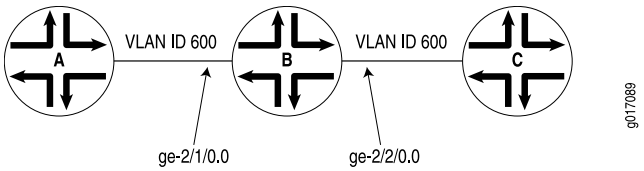
Figure 4: Topology of a Frame Relay Layer 2 Switching Cross-Connect




```
[edit]
interfaces {
  so-1/0/0 {
    encapsulation frame-relay-ccc;
    unit 1 {
      point-to-point;
      encapsulation frame-relay-ccc;
      dlci 600;
    }
  }
  so-2/0/0 {
    encapsulation frame-relay-ccc;
    unit 2 {
      point-to-point;
      encapsulation frame-relay-ccc;
      dlci 750;
    }
  }
}
protocols {
  connections {
    interface-switch router-a-to-router-c {
      interface so-1/0/0.1;
```

```
        interface so-2/0/0.2;
      }
    }
    mpls {
      interface all;
    }
}
```

Figure 5: Sample Topology of a VLAN Layer 2 Switching Cross-Connect

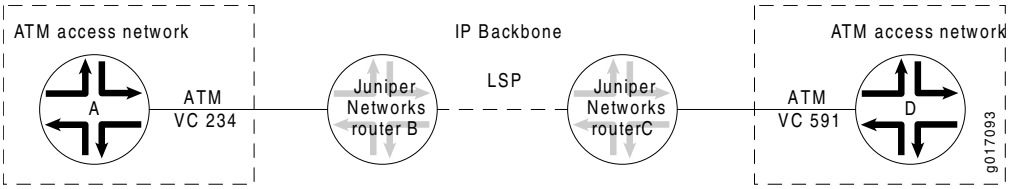



```
[edit]
interfaces {
  ge-2/1/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    unit 0 {
      encapsulation vlan-ccc;
      vlan-id 600;
    }
  }
  ge-2/2/0 {
    vlan-tagging;
    encapsulation vlan-ccc;
    unit 0 {
      encapsulation vlan-ccc;
      vlan-id 600;
    }
    unit 1 {
      family inet {
        vlan-id 1;
        address 10.9.200.1/24;
      }
    }
  }
}
protocols {
  mpls {
    interface all;
  }
  connections {
    interface-switch layer2-sw {
      interface ge-2/1/0.0;
      interface ge-2/2/0.0;
    }
  }
}
```

Configuring MPLS LSP Tunnel Cross-Connects Using CCC

MPLS tunnel cross-connects between interfaces and LSPs allow you to connect two distant interface circuits of the same type by creating MPLS tunnels that use LSPs as the conduit. The topology in Figure 6 on page 17 illustrates an MPLS LSP tunnel cross-connect. In this topology, two separate networks, in this case ATM access networks, are connected through an IP backbone. CCC allows you to establish an LSP tunnel between the two domains. With LSP tunneling, you tunnel the ATM traffic from one network across a SONET backbone to the second network by using an MPLS LSP.

Figure 6: MPLS Tunnel Cross-Connect



When traffic from Router A (VC 234) reaches Router B, it is encapsulated and placed into an LSP, which is sent through the backbone to Router C. At Router C, the label is removed, and the packets are placed onto the ATM permanent virtual circuit (PVC) (VC 591) and sent to Router D. Similarly, traffic from Router D (VC 591) is sent over an LSP to Router B, then placed on VC 234 to Router A.

You can configure LSP tunnel cross-connect on PPP, Cisco HDLC, Frame Relay, and ATM circuits. In a single cross-connect, only like interfaces can be connected.

When you use MPLS tunnel cross-connects to support IS-IS, you must ensure that the LSP's maximum transmission unit (MTU) can, at a minimum, accommodate a 1492-octet IS-IS protocol data unit (PDU) in addition to the link-level overhead associated with the technology being connected.

For the tunnel cross-connects to work, the IS-IS frame size on the edge routers (Routers A and D in Figure 7 on page 20) must be smaller than the LSP's MTU.

NOTE: **Frame size values do not include the frame check sequence (FCS) or delimiting flags.**

To determine the LSP MTU required to support IS-IS, use the following calculation:

IS-IS MTU (minimum 1492, default 1497) + frame overhead + 4 (MPLS shim header) = Minimum LSP MTU

The framing overhead varies based on the encapsulation being used. The following lists the IS-IS encapsulation overhead values for various encapsulations:

- ATM
  - AAL5 multiplex—8 bytes (RFC 1483)

    - VC multiplex—0 bytes
- Frame Relay
    - Multiprotocol—2 bytes (RFCs 1490 and 2427)
    - VC multiplex—0 bytes
- HDLC—4 bytes
- PPP—4 bytes
- VLAN—21 bytes (802.3/LLC)

For IS-IS to work over VLAN-CCC, the LSP's MTU must be at least 1513 bytes (or 1518 for 1497-byte PDUs). If you increase the size of a Fast Ethernet MTU above the default of 1500 bytes, you might need to explicitly configure jumbo frames on intervening equipment.

To modify the MTU, include the **mtu** statement when configuring the logical interface family at the **[edit interfaces** *interface-name* **unit** *logical-unit-number* **encapsulation** *family***]** hierarchy level. For more information about setting the MTU, see the *Junos OS Network Interfaces Configuration Guide*.

To configure an LSP tunnel cross-connect, you must configure the following on the interdomain router (Router B in Figure 7 on page 20):

- Configuring the CCC Encapsulation for LSP Tunnel Cross-Connects on page 18
- Configuring the CCC Connection for LSP Tunnel Cross-Connects on page 19
- Example: Configuring an LSP Tunnel Cross-Connect on page 20

Configuring the CCC Encapsulation for LSP Tunnel Cross-Connects

To configure LSP tunnel cross-connects, you must configure the CCC encapsulation on the ingress and egress routers (Router B and Router C, respectively, in Figure 7 on page 20).

NOTE: You cannot configure families on CCC interfaces; that is, you cannot include the family statement at the **[edit interfaces** *interface-name* **unit** *logical-unit-number***]** hierarchy level.

For PPP or Cisco HDLC circuits, include the **encapsulation** statement to configure the entire physical device. For these circuits to work, you must configure logical unit **0** on the interface.

```
type-fpc/pic/port {
  encapsulation (ppp-ccc | cisco-hdlc-ccc);
  unit 0;
}
```

You can include these statements at the following hierarchy levels:

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

For ATM circuits, specify the encapsulation when configuring the VC by including the following statements. For each VC, you configure whether it is a circuit or a regular logical interface.

```
at-fpc/pic/port {
    atm-options {
        vpi vpi-identifier maximum-vcs maximum-vcs;
    }
    unit logical-unit-number {
        point-to-point; # Default interface type
        encapsulation atm-ccc-vc-mux;
        vci vpi-identifier.vci-identifier;
    }
}
```

You can include these statements at the following hierarchy levels:

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

For Frame Relay circuits, include the following statements to specify the encapsulation when configuring the DLCI. For each DLCI, you configure whether it is a circuit or a regular logical interface. The DLCI for regular interfaces must be in the range 1 through 511. For CCC interfaces, it must be in the range 512 through 1022.

```
type-fpc/pic/port {
    encapsulation frame-relay-ccc;
    unit logical-unit-number {
        point-to-point; # default interface type
        encapsulation frame-relay-ccc;
        dlci dlci-identifier;
    }
}
```

You can include these statements at the following hierarchy levels:

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

For more information about the **encapsulation** statement, see the *Junos OS Network Interfaces Configuration Guide*.

Configuring the CCC Connection for LSP Tunnel Cross-Connects

To configure LSP tunnel cross-connects, include the **remote-interface-switch** statement to define the connection between the two circuits on the ingress and egress routers (Router B and Router C, respectively, in Figure 7 on page 20). The connection joins the interface or LSP that comes from the circuit's source to the interface or LSP that leads to the circuit's destination. When you specify the interface name, include the logical portion of the name, which corresponds to the logical unit number. For the cross-connect to be bidirectional, you must configure cross-connects on two routers.

```
remote-interface-switch connection-name {
    interface interface-name.unit-number;
```

```
    transmit-lsp label-switched-path;
    receive-lsp label-switched-path;
}
```

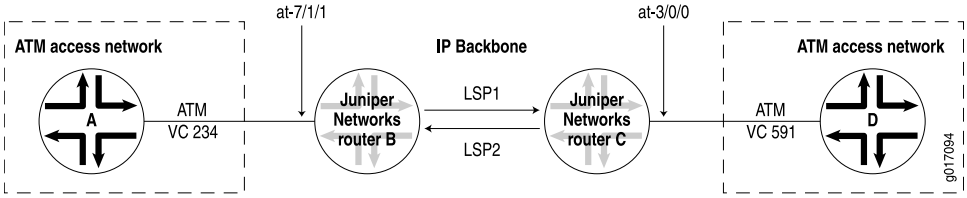
You can include these statements at the following hierarchy levels:

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

Example: Configuring an LSP Tunnel Cross-Connect

Configure a full-duplex MPLS LSP tunnel cross-connect from Router A to Router D, passing through Router B and Router C. See the topology in Figure 7 on page 20.

Figure 7: Example Topology of MPLS LSP Tunnel Cross-Connect



On Router B:

```
[edit]
interfaces {
    at-7/1/1 {
        atm-options {
            vpi 1 maximum-vcs 600;
        }
        unit 1 {
            point-to-point; # default interface type
            encapsulation atm-ccc-vc-mux;
            vci 1.234;
        }
    }
}
protocols {
    connections {
        remote-interface-switch router-b-to-router-c {
            interface at-7/1/1.1;
            transmit-lsp lsp1;
            receive-lsp lsp2;
        }
    }
}
```

On Router C:

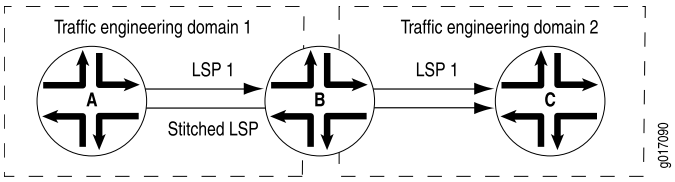
```
[edit]
interfaces {
    at-3/0/0 {
        atm-options {
            vpi 2 maximum-vcs 600;
        }
```

```
      unit 2 {
        point-to-point; # default interface type
        encapsulation atm-ccc-vc-mux;
        vci 2.591;
      }
    }
  }
  protocols {
    connections {
      remote-interface-switch router-b-to-router-c {
        interface at-3/0/0.2;
        transmit-lsp lsp2;
        receive-lsp lsp1;
      }
    }
  }
```

Configuring LSP Stitching Cross-Connects Using CCC

LSP stitching cross-connects "stitch" together LSPs to join two LSPs. For example, they stitch together LSPs that fall in two different traffic engineering database areas. The topology in Figure 8 on page 21 illustrates an LSP stitching cross-connect. In this topology, the network is divided into two traffic engineering domains. CCC allows you to establish an LSP between the two domains by stitching together LSPs from the two domains. For LSP stitching to work, the LSPs must be dynamic LSPs, not static.

Figure 8: LSP Stitching Cross-Connect



Without LSP stitching, a packet traveling from Router A to Router C is encapsulated on Router A (the ingress router for the first LSP), de-encapsulated on Router B (the egress router), and then reencapsulated on Router B (the ingress router for the second LSP). With LSP stitching, you connect LSP1 and LSP2 into a single, stitched LSP, which means that the packet is encapsulated once (on Router A) and de-encapsulated once (on Router C).

You can use LSP stitching to create a seamless LSP for LSPs carrying any kind of traffic.

To configure LSP stitching cross-connects, configure the two LSPs that you are stitching together on the two ingress routers. Then on the interdomain router (Router B in Figure 8 on page 21), you define the connection between the two LSPs. The connection joins the LSP that comes from the connection's source to the LSP that leads to the connection's destination.

```
protocols {
  connections {
    lsp-switch connection-name {
      transmit-lsp label-switched-path;
```

```
        receive-lsp label-switched-path;
      }
    }
  }
```

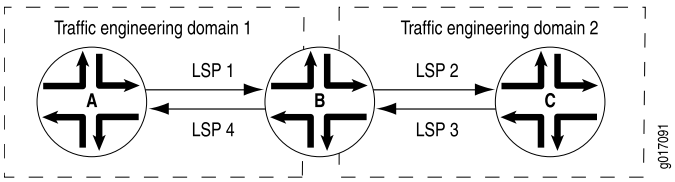
You can configure these statements at the following hierarchy levels:

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

Example: Configuring an LSP Stitching Cross-Connect

Configure a full-duplex LSP stitching cross-connect between Router A and Router C. To do this, you configure Router B, which is the interdomain router. See the topology in Figure 9 on page 22.

Figure 9: Example Topology of LSP Stitching Cross-Connect




```
[edit]
protocols {
  connections interface-switch {
    lsp-switch router-a-to-router-c {
      transmit-lsp lsp2;
      receive-lsp lsp1;
    }
  }
  connections {
    lsp-switch router-c-to-router-a {
      receive-lsp lsp3;
      transmit-lsp lsp4;
    }
  }
}
```

Configuring TCC

This section describes how to configure translational cross-connect (TCC). Extensive examples on how to configure TCC for interface switching and for Layer 2.5 VPNs are available in the *Junos OS Feature Guides*.

To configure TCC, you must perform the following tasks on the router that is acting as the switch:

- Configuring the Encapsulation for Layer 2 Switching TCCs on page 23
- Configuring the Connection for Layer 2 Switching TCCs on page 26
- Configuring MPLS for Layer 2 Switching TCCs on page 27

Configuring the Encapsulation for Layer 2 Switching TCCs

To configure a Layer 2 switching TCC, specify the TCC encapsulation on the desired interfaces of the router that is acting as the switch.

NOTE: You cannot configure standard protocol families on TCC or CCC interfaces. Only the CCC family is allowed on CCC interfaces, and only the TCC family is allowed on TCC interfaces.

For Ethernet circuits and Ethernet extended VLAN circuits, you must also configure the Address Resolution Protocol (ARP). See "Configuring ARP for Ethernet and Ethernet Extended VLAN Encapsulations" on page 26.

Configuring PPP and Cisco HDLC Encapsulation for Layer 2 Switching TCCs

For PPP and Cisco HDLC circuits, configure the encapsulation type for the entire physical device by specifying the appropriate value for the **encapsulation** statement. For these circuits to work, you must also configure the logical interface **unit 0**.

```
encapsulation (ppp-tcc | cisco-hdlc-tcc);
unit 0;
}
```

You can include these statements at the following hierarchy levels:

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

Configuring ATM Encapsulation for Layer 2 Switching TCCs

For ATM circuits, configure the encapsulation type by specifying the appropriate value for the **encapsulation** statement in the virtual circuit (VC) configuration. Specify whether each VC is a circuit or a regular logical interface.

```
atm-options {
   vpi vpi-identifier maximum-vcs maximum-vcs;
}
unit logical-unit-number {
   encapsulation (atm-tcc-vc-mux | atm-tcc-snap);
   point-to-point;
   vci vpi-identifier.vci-identifier;
}
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces at-*fpc/pic/port*]**
- **[edit logical-systems *logical-system-name* interfaces at-*fpc/pic/port*]**

Configuring Frame Relay Encapsulation for Layer 2 Switching TCCs

For Frame Relay circuits, configure the encapsulation type by specifying the value **frame-relay-tcc** for the **encapsulation** statement when configuring the data-link connection identifier (DLCI). You configure each DLCI as a circuit or a regular logical interface. The DLCI for regular interfaces must be in the range from 1 through 511, but for TCC and CCC interfaces it must be in the range from 512 through 1022.

```
encapsulation frame-relay-tcc;
unit logical-unit-number {
   point-to-point;
   encapsulation frame-relay-tcc;
   dlci dlci-identifier;
}
```

You can include these statements at the following hierarchy levels:

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

Configuring Ethernet Encapsulation for Layer 2 Switching TCCs

For Ethernet TCC circuits, configuring the encapsulation type for the entire physical device by specifying the value **ethernet-tcc** for the **encapsulation** statement.

You must also specify static values for a remote address and a proxy address at the **[edit interfaces *interface-name* unit *unit-number* family tcc]** or **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family tcc]** hierarchy level.

The remote address is associated with the TCC switching router's Ethernet neighbor; in the **remote** statement you must specify both the IP address and the media access control (MAC) address of the Ethernet neighbor. The proxy address is associated with the TCC router's other neighbor connected by the unlike link; in the **proxy** statement you must specify the IP address of the non-Ethernet neighbor.

You can configure Ethernet TCC encapsulation for the interfaces on 1-port Gigabit Ethernet, 2-port Gigabit Ethernet, 4-port Fast Ethernet, and 4-port Gigabit Ethernet PICs.

```
encapsulation ethernet-tcc;
unit logical-unit-number {
   family tcc {
      proxy {
         inet-address ip-address;
      }
      remote {
         inet-address ip-address;
         mac-address mac-address;
      }
```

```
    }
  }
```

You can include these statements at the following hierarchy levels:

- **[edit interfaces (fe | ge)-*fpc/pic/port*]**
- **[edit logical-systems *logical-system-name* interfaces (fe | ge)-*fpc/pic/port*]**

NOTE: For Ethernet circuits, you must also configure the Address Resolution Protocol (ARP). See "Configuring ARP for Ethernet and Ethernet Extended VLAN Encapsulations" on page 26.

Configuring Ethernet Extended VLAN Encapsulation for Layer 2 Switching TCCs

For Ethernet extended VLAN circuits, configure the encapsulation type for the entire physical device by specifying the value **extended-vlan-tcc** for the **encapsulation** statement.

You must also enable VLAN tagging. Ethernet interfaces in VLAN mode can have multiple logical interfaces. With encapsulation type **extended-vlan-tcc**, all VLAN IDs from 0 through 4094 are valid, up to a maximum of 1024 VLANs. As with Ethernet circuits, you must also specify a proxy address and a remote address at the **[edit interfaces *interface-name* unit *logical-unit-number* family tcc]** or **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *unit-number* family tcc]** hierarchy level (see "Configuring Ethernet Encapsulation for Layer 2 Switching TCCs" on page 24).

```
encapsulation extended-vlan-tcc;
vlan-tagging;
unit logical-unit-number {
  vlan-id identifier;
  family tcc;
  proxy {
    inet-address ip-address;
  }
  remote {
    inet-address ip-address;
    mac-address mac-address;
  }
}
```

You can configure these statements at the following hierarchy levels:

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

NOTE: For Ethernet extended VLAN circuits, you must also configure the Address Resolution Protocol (ARP). See "Configuring ARP for Ethernet and Ethernet Extended VLAN Encapsulations" on page 26.

Configuring ARP for Ethernet and Ethernet Extended VLAN Encapsulations

For Ethernet and Ethernet extended VLAN circuits with TCC encapsulation, you must also configure ARP. Because TCC simply removes one Layer 2 header and adds another, the default form of dynamic ARP is not supported; you must configure static ARP.

Because remote and proxy addresses are specified on the router performing TCC switching, you must apply the static ARP statement to the Ethernet-type interfaces of the routers that connect to the TCC-switched router. The **arp** statement must specify the IP address and the MAC address of the remotely connected neighbor by use of the unlike Layer 2 protocol on the far side of the TCC switching router.

arp *ip-address* mac *mac-address*;

You can include this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number* family inet address *ip-address*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number* family inet address *ip-address*]**

Configuring the Connection for Layer 2 Switching TCCs

You must configure the connection between the two circuits of the Layer 2 switching TCC on the router acting as the switch. The connection joins the interface coming from the circuit's source to the interface leading to the circuit's destination. When you specify the interface names, include the logical portion of the name, which corresponds to the logical unit number. The cross-connect is bidirectional, so packets received on the first interface are transmitted from the second interface, and those received on the second interface are transmitted from the first.

To configure a connection for a local interface switch, include the following statements:

```
interface-switch connection-name {
    interface interface-name.unit-number;
}
lsp-switch connection-name {
    transmit-lsp lsp-number;
    receive-lsp lsp-number;
}
```

You can include these statements at the following hierarchy levels:

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

To configure a connection for a remote interface switch, include the following statements:

```
remote-interface-switch connection-name {
    interface interface-name.unit-number;
    interface interface-name.unit-number;
    transmit-lsp lsp-number;
    receive-lsp lsp-number;
}
```

You can include these statements at the following hierarchy levels:

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

Configuring MPLS for Layer 2 Switching TCCs

For a Layer 2 switching TCC to work, you must enable MPLS on the router by including at least the following statements. This minimum configuration enables MPLS on a logical interface for the switching cross-connect.

Include the **family mpls** statement:

```
family mpls;
```

You can configure this statement at the following hierarchy levels:

- **[edit interfaces *interface-name* unit *logical-unit-number*]**
- **[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]**

You can then specify this logical interface in the MPLS protocol configuration:

```
mpls {
   interface interface-name; # Required to enable MPLS on the interface
}
```

You can configure these statements at the following hierarchy levels:

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

NOTE: MPLS LSP link protection does not support TCC.

Configuring CCC and TCC Graceful Restart

To enable CCC and TCC graceful restart, include the **graceful-restart** statement:

```
graceful-restart;
```

You can include this statement at the following hierarchy levels:

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

The **graceful-restart** statement enables graceful restart for all protocols supporting this feature on the router. For more information about graceful restart, see the *Junos OS Routing Protocols Configuration Guide*.

CCC and TCC graceful restart depend on RSVP graceful restart. If you disable RSVP graceful restart, CCC and TCC graceful restart will not work. For more information about RSVP graceful restart, see RSVP Graceful Restart and Configuring RSVP Graceful Restart.

Configuring CCC Switching for Point-to-Multipoint LSPs

You can configure CCC to switch traffic from interfaces to point-to-multipoint LSPs. This feature is useful for handling multicast or broadcast traffic (for example, a digital video stream).

To configure CCC switching for point-to-multipoint LSPs, you do the following:

- On the ingress provider edge (PE) router, you configure CCC to switch traffic from an incoming interface to a point-to-multipoint LSP.
- On the egress PE, you configure CCC to switch traffic from an incoming point-to-multipoint LSP to an outgoing interface.

The CCC connection for point-to-multipoint LSPs is unidirectional.

For more information on point-to-multipoint LSPs, see Point-to-Multipoint LSPs Overview.

To configure a CCC connection for a point-to-multipoint LSP, complete the steps in the following sections:

- Configuring the Point-to-Multipoint LSP Switch on Ingress PE Routers on page 28
- Configuring the Point-to-Multipoint LSP Switch on Egress PE Routers on page 29

Configuring the Point-to-Multipoint LSP Switch on Ingress PE Routers

To configure the ingress PE router with a CCC switch for a point-to-multipoint LSP, include the **p2mp-transmit-switch** statement:

```
p2mp-transmit-switch switch-name {
    input-interface input-interface-name.unit-number;
    transmit-p2mp-lsp transmitting-lsp;
}
```

You can include the **p2mp-transmit-switch** statement at the following hierarchy levels:

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

switch-name specifies the name of the ingress CCC switch.

input-interface *input-interface-name.unit-number* specifies the name of the ingress interface.

transmit-p2mp-lsp *transmitting-lsp* specifies the name of the transmitting point-to-multipoint LSP.

Configuring the Point-to-Multipoint LSP Switch on Egress PE Routers

To configure the CCC switch for a point-to-multipoint LSP on the egress PE router, include the **p2mp-receive-switch** statement.

```
p2mp-receive-switch switch-name {
    output-interface [ output-interface-name.unit-number ];
    receive-p2mp-lsp receptive-lsp;
}
```

You can include this statement at the following hierarchy levels:

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

switch-name specifies the name of the egress CCC switch.

output-interface [*output-interface-name.unit-number*] specifies the name or one or more egress interfaces.

receive-p2mp-lsp *receptive-lsp* specifies the name of the receptive point-to-multipoint LSP.

PART 3

Administration

CHAPTER 3

Summary of CCC and TCC Configuration Statements

connections

Syntax

```
connections {
  interface-switch connection-name {
    interface interface-name.unit-number;
  }
  lsp-switch connection-name {
    transmit-lsp label-switched-path;
    receive-lsp label-switched-path;
  }
  p2mp-receive-switch {
    output-interface [ interface-name.unit-number ];
    receive-p2mp-lsp receiving-point-to-multipoint-lsp;
  }
  p2mp-transmit-switch {
    input-interface interface-name.unit-number;
    transmit-p2mp-lsp transmitting-point-to-multipoint-lsp;
  }
  remote-interface-switch connection-name {
    interface interface-name.unit-number;
    receive-lsp label-switched-path;
    transmit-lsp label-switched-path;
  }
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols],
[edit protocols]

Release Information Statement introduced before Junos OS Release 7.4.

Description Define the connection between two circuits in a CCC connection.

Options The statements are explained separately.

NOTE: The edit logical-systems hierarchy is not available on QFabric switches.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring Layer 2 Switching Cross-Connects Using CCC on page 9
- Configuring MPLS LSP Tunnel Cross-Connects Using CCC on page 17
- Configuring LSP Stitching Cross-Connects Using CCC on page 21
- Configuring TCC on page 22
- Configuring CCC Switching for Point-to-Multipoint LSPs on page 28

encapsulation (Logical Interface)

Syntax encapsulation (atm-ccc-cell-relay | atm-ccc-vc-mux | atm-tcc-vc-mux | atm-cisco-nlpid | tm-mlppp-llc | atm-nlpid | atm-ppp-llc | atm-ppp-vc-mux | atm-snap | atm-tcc-snap | atm-vc-mux | ether-over-atm-llc | ether-vpls-over-atm-llc | frame-relay-ccc | frame-relay-ppp | frame-relay-tcc | gre-fragmentation | multilink-frame-relay-end-to-end | multilink-ppp | vlan-ccc | vlan-ccc | vlan-vpls);

Hierarchy Level [edit interfaces *interface-name* unit *logical-unit-number*],
[edit logical-systems *logical-system-name* interfaces *interface-name* unit *logical-unit-number*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Logical link-layer encapsulation type.

Options **atm-ccc-cell-relay**—Use ATM cell-relay encapsulation.

atm-ccc-vc-mux—Use ATM VC multiplex encapsulation on circuit cross-connect (CCC) circuits. When you use this encapsulation type, you can configure the family **ccc** only.

atm-cisco-nlpid—Use Cisco ATM NLPID encapsulation. When you use this encapsulation type, you can configure the family **inet** only.

atm-mlppp-llc—For ATM2 IQ interfaces only, use Multilink PPP over ATM adaptation layer 5 (AAL5) logical link control (LLC). For this encapsulation type, your router must be equipped with a Link Services PIC.

atm-nlpid—Use ATM NLPID encapsulation. When you use this encapsulation type, you can configure the family **inet** only.

atm-ppp-llc—For ATM2 IQ interfaces only, use PPP over ATM adaptation layer 5 (AAL5) logical link control (LLC) encapsulation.

atm-ppp-vc-mux—For ATM2 IQ interfaces only, use PPP over ATM adaptation layer 5 (AAL5) multiplex encapsulation.

atm-snap—Use ATM SNAP encapsulation.

atm-tcc-snap—Use ATM SNAP encapsulation on translational cross-connect (TCC) circuits.

atm-tcc-vc-mux—Use ATM VC multiplex encapsulation on translational cross-connect (TCC) circuits. When you use this encapsulation type, you can configure the family **tcc** only.

atm-vc-mux—Use ATM VC multiplex encapsulation. When you use this encapsulation type, you can configure the family **inet** only.

ether-over-atm-llc—For interfaces that carry IPv4 traffic, use Ethernet over ATM LLC encapsulation. When you use this encapsulation type, you cannot configure multipoint interfaces.

ether-vpls-over-atm-llc—For ATM intelligent queuing interfaces only, use the Ethernet VPLS over ATM LLC encapsulation to bridge Ethernet interfaces and ATM interfaces over a VPLS routing instance (as described in RFC 2684). Packets from the ATM interfaces are converted to standard ENET2/802.3 encapsulated Ethernet frames with the FCS field removed.

frame-relay-ccc—Use Frame Relay encapsulation on CCC circuits. When you use this encapsulation type, you can configure the family **ccc** only.

frame-relay-ppp—Use Frame Relay encapsulation on PPP circuits.

frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits for connecting unlike media. When you use this encapsulation type, you can configure the family **tcc** only.

gre-fragmentation—For adaptive services interfaces only, use GRE fragmentation encapsulation to enable fragmentation of IPv4 packets in GRE tunnels. This encapsulation clears the don't fragment (DF) bit in the packet header. If the packet's size exceeds the tunnel's maximum transmission unit (MTU) value, the packet is fragmented before encapsulation.

multilink-frame-relay-end-to-end—Use Multilink Frame Relay (MLFR) FRF.15 encapsulation. This encapsulation is used only on multilink and link services interfaces and their constituent T1 or E1 interfaces.

multilink-ppp—Use Multilink Point-to-Point Protocol (MLPPP) encapsulation. This encapsulation is used only on multilink and link services interfaces and their constituent T1 or E1 interfaces.

vlan-ccc—Use Ethernet virtual local area network (VLAN) encapsulation on CCC circuits. When you use this encapsulation type, you can configure the family **ccc** only.

vlan-tcc—Use Ethernet VLAN encapsulation on TCC circuits. When you use this encapsulation type, you can configure the **family tcc** only.

vlan-vpls—Use Ethernet VLAN encapsulation on virtual private LAN service (VPLS) circuits.

Required Privilege Level

interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation

- Configuring the CCC Encapsulation for Layer 2 Switching Cross-Connects on page 10
- Configuring the CCC Encapsulation for LSP Tunnel Cross-Connects on page 18
- Configuring the Encapsulation for Layer 2 Switching TCCs on page 23
- *Junos OS Network Interfaces Configuration Guide*

encapsulation (Physical Interface)

Syntax encapsulation (atm-ccc-cell-relay | atm-pvc | cisco-hdlc | cisco-hdlc-ccc | cisco-hdlc-tcc | ethernet-ccc | ethernet-over-atm | ethernet-tcc | ethernet-vpls | extended-frame-relay-ccc | extended-frame-relay-tcc | extended-vlan-ccc | extended-vlan-tcc | extended-vlan-vpls | flexible-ethernet-services | flexible-frame-relay | frame-relay | frame-relay-ccc | frame-relay-tcc | frame-relay-port-ccc | multilink-frame-relay-uni-nni | ppp | ppp-ccc | ppp-tcc | vlan-ccc | vlan-vpls);

Hierarchy Level [edit interfaces *interface-name*]

Release Information Statement introduced before Junos OS Release 7.4.

Description Physical link-layer encapsulation type.

Default PPP encapsulation.

Options **atm-ccc-cell-relay**—Use ATM cell-relay encapsulation.

atm-pvc—Use ATM PVC encapsulation.

cisco-hdlc—Use Cisco-compatible HDLC framing.

cisco-hdlc-ccc—Use Cisco-compatible HDLC framing on CCC circuits.

cisco-hdlc-tcc—Use Cisco-compatible HDLC framing on TCC circuits for connecting unlike media.

ethernet-ccc—Use Ethernet CCC encapsulation on Ethernet interfaces that must accept packets carrying standard TPID values.

ethernet-over-atm—As defined in RFC 1483, this encapsulation type allows ATM interfaces to connect to devices that support only bridged-mode protocol data units (PDUs). The Junos OS does not completely support bridging, but accepts BPDU packets as a default gateway. If you use the router as an edge device, then the router acts as a default gateway. It accepts Ethernet LLC/SNAP frames with IP or ARP in the payload and drops the rest. For packets destined the Ethernet LAN, a route lookup is done by use of the destination IP address. If the route lookup yields a full address match, the packet is encapsulated with an LLC/SNAP and MAC header, and the packet is forwarded to the ATM interface.

ethernet-tcc—For interfaces that carry IPv4 traffic, use Ethernet TCC encapsulation on interfaces that must accept packets carrying standard Tag Protocol Identifier (TPID) values. Ethernet TCC is not currently supported on Fast Ethernet 48-port PICs.

ethernet-vpls—Use Ethernet VPLS encapsulation on Ethernet interfaces that have VPLS enabled and that must accept packets carrying standard TPID values.

extended-frame-relay-ccc—Use Frame Relay encapsulation on CCC circuits. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to CCC.

extended-frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits to connect unlike media. This encapsulation type allows you to dedicate DLCIs 1 through 1022 to TCC.

extended-vlan-ccc—Use extended VLAN encapsulation on CCC circuits with Gigabit Ethernet and 4-port Fast Ethernet interfaces that must accept packets carrying 802.1Q values.

extended-vlan-tcc—For interfaces that carry IPv4 traffic, use extended VLAN encapsulation on TCC circuits with Gigabit Ethernet interfaces on which you want to use 802.1Q tagging. Extended Ethernet TCC is not currently supported on Fast Ethernet 48-port PICs.

extended-vlan-vpls—Use extended VLAN VPLS encapsulation on Ethernet interfaces that have VLAN 802.1Q tagging and VPLS enabled and that must accept packets carrying TPIDs 0x8100, 0x9100, and 0x9901.

flexible-ethernet-services—For Gigabit Ethernet intelligent queuing interfaces only, use flexible Ethernet services encapsulation when you want to configure multiple per-unit Ethernet encapsulations. This encapsulation type allows you to configure any combination of routed, TCC, CCC, and VPLS encapsulations on a single physical port.

flexible-frame-relay—For intelligent queuing interfaces only, use flexible Frame Relay encapsulation when you want to configure multiple per-unit Frame Relay encapsulations. This encapsulation type allows you to configure any combination of TCC, CCC, or standard Frame Relay encapsulations on a single physical port. Also, each logical interface can have any DLCI value in the range 1 through 1022.

frame-relay—Use Frame Relay encapsulation.

frame-relay-ccc—Use plain Frame Relay encapsulation or Frame Relay encapsulation on circuit cross-connect (CCC) circuits.

frame-relay-port-ccc—Use Frame Relay port CCC encapsulation to transparently carry all the DLCIs between two CE routers without explicitly configuring each DLCI on the two PE routers with Frame Relay transport. When you use this encapsulation type, you can configure the **family ccc** only.

frame-relay-tcc—Use Frame Relay encapsulation on TCC circuits to connect unlike media.

multilink-frame-relay-uni-nni—Use MLFR user-to-network (UNI) network-to-network (NNI) encapsulation. This encapsulation is used only on link services interfaces functioning as FRF.16 bundles and their constituent T1 or E1 interfaces.

ppp—Use serial PPP encapsulation.

ppp-ccc—Use serial PPP encapsulation on CCC circuits. When you use this encapsulation type, you can configure the family **ccc** only.

ppp-tcc—Use serial PPP encapsulation on TCC circuits for connecting unlike media. When you use this encapsulation type, you can configure the family **tcc** only.

vlan-ccc—Use Ethernet VLAN encapsulation on CCC circuits.

vlan-vpls—Use VLAN VPLS encapsulation on Ethernet interfaces with VLAN tagging and VPLS enabled. Interfaces with VLAN VPLS encapsulation accept packets carrying standard TPID values only.

Required Privilege Level
interface—To view this statement in the configuration.
interface-control—To add this statement to the configuration.

Related Documentation
- Configuring the CCC Encapsulation for Layer 2 Switching Cross-Connects on page 10
- Configuring the CCC Encapsulation for LSP Tunnel Cross-Connects on page 18
- Configuring the Encapsulation for Layer 2 Switching TCCs on page 23
- *Junos OS Network Interfaces Configuration Guide*

interface-switch

Syntax
```
interface-switch connection-name {
    interface interface-name.unit-number;
}
```

Hierarchy Level
[edit logical-systems *logical-system-name* protocols connections],
[edit protocols connections]

Release Information
Statement introduced before Junos OS Release 7.4.

Description
Configure Layer 2 switching cross-connects. The cross-connect is bidirectional, so packets received on the first interface are transmitted out the second interface, and those received on the second interface are transmitted out the first.

For Layer 2 switching cross-connects to work, you must also configure MPLS.

Options
connection-name—Connection name.

interface *interface-name.unit-number*—Interface name. Include the logical portion of the name, which corresponds to the logical unit number.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration

Related Documentation
- Configuring the CCC Connection for Layer 2 Switching Cross-Connects on page 14

lsp-switch

Syntax

```
lsp-switch connection-name {
    transmit-lsp label-switched-path;
    receive-lsp label-switched-path;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols connections],
[edit protocols connections]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure Layer 2 switching cross-connects.

Options ***connection-name***—Connection name.

receive-lsp *label-switched-path*—Name of the LSP from the connection's source.

transmit-lsp *label-switched-path*—Name of the LSP to the connection's destination.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring LSP Stitching Cross-Connects Using CCC on page 21
- Configuring the Connection for Layer 2 Switching TCCs on page 26

p2mp-receive-switch

Syntax

```
p2mp-receive-switch point-to-multipoint-switch-name {
    output-interface [ interface-name.unit-number ];
    receive-p2mp-lsp receiving-point-to-multipoint-lsp;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols connections],
[edit protocols connections]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure the CCC switch for a point-to-multipoint LSP on the egress PE router.

Options

point-to-multipoint-switch-name—Point-to-multipoint CCC receive switch name.

output-interface ***interface-name.unit-number***—Name of the egress interfaces for the point-to-multipoint LSP traffic. You can configure multiple output interfaces.

receive-p2mp-lsp ***receiving-point-to-multipoint-lsp***—Name of the point-to-multipoint LSP that is switched to the output interface.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Point-to-Multipoint LSP Switch on Egress PE Routers on page 29

p2mp-transmit-switch

Syntax

```
p2mp-transmit-switch point-to-multipoint-transmit-switch-name {
    input-interface interface-name.unit-number;
    transmit-p2mp-lsp transmitting-point-to-multipoint-lsp;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols connections],
[edit protocols connections]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure the CCC switch for the point-to-multipoint LSP on the ingress PE router.

Options

point-to-multipoint-transmit-switch-name—Point-to-multipoint CCC transmit switch name.

input-interface *input-interface-name.unit-number*—Specify the name of the interface carrying incoming traffic to be switched to the point-to-multipoint LSP.

transmit-p2mp-lsp *transmitting-point-to-multipoint-lsp*—Specify the name of the point-to-multipoint LSP carrying traffic to the CCC switch on the egress PE router.

Required Privilege Level
routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring the Point-to-Multipoint LSP Switch on Ingress PE Routers on page 28

remote-interface-switch

Syntax

```
remote-interface-switch connection-name {
    interface interface-name.unit-number;
    transmit-lsp label-switched-path;
    receive-lsp label-switched-path;
}
```

Hierarchy Level [edit logical-systems *logical-system-name* protocols connections], [edit protocols connections]

Release Information Statement introduced before Junos OS Release 7.4.

Description Configure MPLS LSP tunnel cross-connects.

Options

connection-name—Connection name.

interface *interface-name.unit-number*—Interface name. Include the logical portion of the name, which corresponds to the logical unit number.

receive-lsp *label-switched-path*—Name of the LSP from the connection's source.

transmit-lsp *label-switched-path*—Name of the LSP to the connection's destination.

Required Privilege Level routing—To view this statement in the configuration.
routing-control—To add this statement to the configuration.

Related Documentation

- Configuring MPLS LSP Tunnel Cross-Connects Using CCC on page 17

PART 4

Index

Index