Chapter 17
CCC Configuration

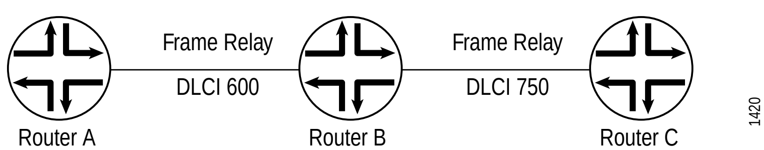
This chapter discusses the following cross-connect configuration tasks:

Configure Layer 2 Switching Cross-Connects

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 19 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. CCC allows you to configure Router B to act as a Frame Relay (Layer 2) switch. To do this, 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 19: 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, 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 19):

Define 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 19).

> **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, 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.

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

For ATM circuits, specify the encapsulation when configuring the Virtual Circuit (VC). For each VC, you configure whether it is a circuit or a regular logical interface.

```
[edit]
interfaces {
    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;
        }
    }
}
```

For Frame Relay circuits, 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.

```
[edit]
interfaces {
    interface-switch frame-relay-ccc;
    type-fpc/pic/port {
        unit logical-unit-number {
            point-to-point;        # Default interface type
            encapsulation frame-relay-ccc;
            dlci dlci-identifier;
        }
    }
}
```

Define the CCC Connection for Layer 2 Switching Cross-Connects

To configure Layer 2 switching cross-connects, define the connection between the two circuits. You configure this on the router that is acting as the switch (Router B in Figure 19). 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.

```
[edit]
protocols {
    connections {
        interface-switch connection-name {
            interface interface-name.unit-number;
            interface interface-name.unit-number;
        }
    }
}
```

Configure MPLS

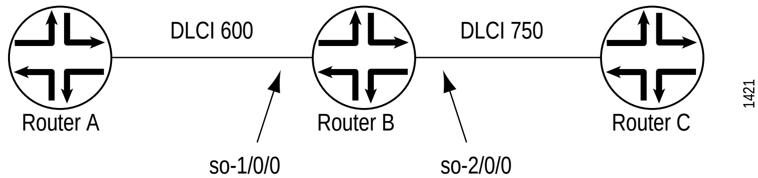
For Layer 2 switching cross-connects to work, you must configure MPLS. The following is a minimal MPLS configuration:

```
[edit]
protocols {
    mpls {
        interface (interface-name | all);
    }
}
```

Example: Configure Layer 2 Switching Cross-Connects

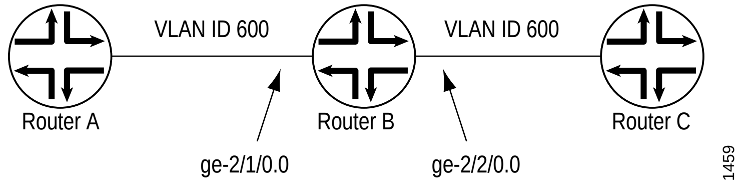
Configure a full-duplex Layer 2 switching cross-connect between Router A and Router C, using a Juniper router, Router B, as the virtual switch. See the topology in Figure 20 and Figure 21.

Figure 20: Example Topology of 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-router-c {
            interface so-1/0/0.1;
            interface so-2/0/0.2;
        }
    }
    mpls {
        interface all;
    }
```

Figure 21: Example Topology of a VLAN Layer 2 Switching Cross-Connect

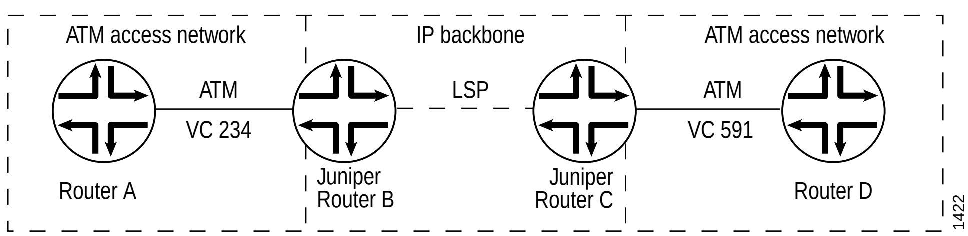


```
[edit]
interfaces {
    ge-2/1/0 {
        vlan-tagging;
        encapsulation vlan-ccc;
        unit 0 {
            encapsulation vlan-ccc;
            vlan-id 600;
        }
    }
    ge-2/2/0 {
        vlan-tagging;
        encapsulation vlan-ccc;
        unit 0 {
            encapsulation vlan-ccc;
            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;
        }
    }
}
```

Configure MPLS LSP Tunnel Cross-Connects

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 22 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 using an MPLS LSP.

Figure 22: MPLS LSP 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 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-connects on PPP, Cisco HDLC, Frame Relay, and ATM circuits. In a single cross-connect, only like interfaces can be connected.

To configure LSP tunnel cross-connects, you must configure the following on the interdomain router (Router B in Figure 24):

Define the CCC Encapsulation for LSP Tunnel Cross-Connects on page 166

Define the CCC Connection for LSP Tunnel Cross-Connects on page 168

When you use MPLS tunnel cross-connects, if you use the default MTU size, IS-IS does not form adjacencies across the tunnel. For the tunnel cross-connects to work, the MTU size on the edge routers (Routers A and D in Figure 22) must be smaller than the LSP's MTU. Use the following calculation to determine the maximum IS-IS MTU size:

IS-IS MTU ≤ MPLS MTU – 4 bytes – link-layer overhead

The link-layer overheads varies, depending on the encapsulation:

ATM—8 bytes

Frame Relay—2 bytes

HDLC—4 bytes

PPP—4 bytes

VLAN—4 bytes

We recommend that you simply set the MTU to 1497 bytes, which is small enough so that IS-IS works properly.

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.

Define 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 22).

> **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, 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.

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

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

```
[edit]
interfaces {
    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;
        }
    }
}
```

For Frame Relay circuits, 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.

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

Define the CCC Connection for LSP Tunnel Cross-Connects

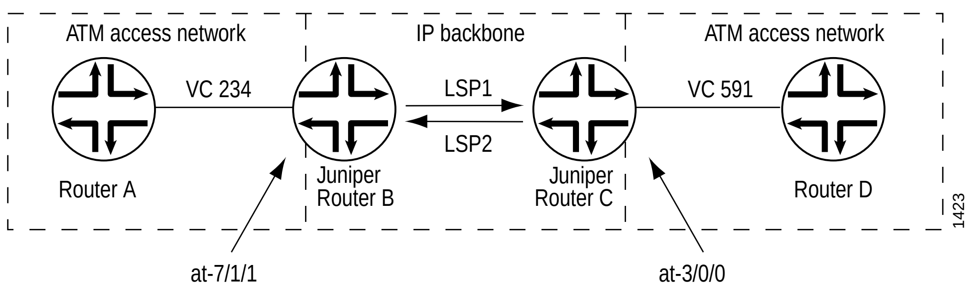
To configure LSP tunnel cross-connects, define the connection between the two circuits on the ingress and egress routers (Router B and Router C, respectively, in Figure 22). The connection joins the interface or LSP that comes from the circuit's source to the interface or LSP that leads to the circuit's 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.

```
[edit]
protocols {
    connections {
        remote-interface-switch connection-name {
            interface interface-name.unit-number;
            transmit-lsp label-switched-path;
            receive-lsp label-switched-path;
        }
    }
}
```

Example: Configure LSP Tunnel Cross-Connects

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 23.

Figure 23: 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;
        }
    }
}
```

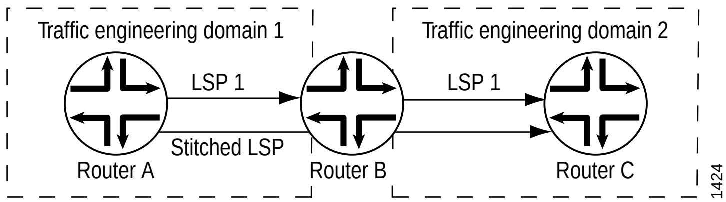
On Router C:

```
[edit]
interfaces {
    at-3/0/0 {
        atm-options {
            vpi 2 maximum-vcs 600;
        }
        unit 2 {
            point-to-point; # default interface type
            interface-switch atm-ccc-vc-mux;
            vci 2.591;
        }
    }
}
protocols {
    connections {
        remote-interface-switch router-b-to-router-c {
            interface at-3/0/0.1;
            transmit-lsp lsp2;
            receive-lsp lsp1;
        }
    }
}
```

Configure LSP Stitching Cross-Connects

LSP stitching cross-connects “stitch” together LSPs to join two LSPs. For example, they stitch together LSPs that fall in two different TED areas. The topology in Figure 24 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 24: LSP Stitching Cross-Connect



Without LSP stitching, a packet travelling from Router A to Router C is encapsulated on Router A (the ingress router for the first LSP), decapsulated on Router B (the egress router), and then re-encapsulated 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 decapsulated once (on Router C).

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

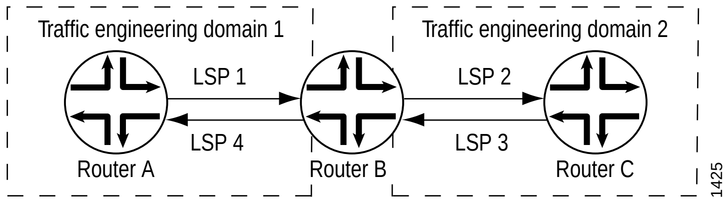
To configure LSP stitching cross-connects, you configure the two LSPs that you are stitching together on the two ingress routers. Then, on the interdomain router (Router B in Figure 24), you define the connection between the two LSPs. The connection joins the LSP that comes from the connection’s source to the LSP that leads to the connection’s destination.

```
[edit]
protocols {
    connections {
        lsp-switch connection-name {
            transmit-lsp label-switched-path;
            receive-lsp label-switched-path;
        }
    }
}
```

Example: Configure LSP Stitching Cross-Connects

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 25.

Figure 25: Example Topology of LSP Stitching Cross-Connect




```
[edit]
protocols {
    connections {
        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;
        }
    }
}
```