Network Configuration Example

Configuring the Broadband Edge as a Service Node Within Seamless MPLS Network Designs
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CHAPTER 1

Configuring Broadband Edge as a Service Node Within Seamless MPLS Network Designs

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About This Network Configuration Example

This network configuration example focuses specifically on the use case in which the MX Series 3D Universal Edge Router-based broadband edge is deployed as an IP/MPLS service node within a seamless MPLS network architecture. A tested, step-by-step configuration example is provided, showing how the technologies featured in this use case can be leveraged to support residential subscriber management. Configuration and verification steps are included, as are troubleshooting strategies to employ if the configuration is not working properly.

Customer Use Case for Deploying an MX Series Broadband Edge as an IP/MPLS Service Node Within a Seamless MPLS Network Architecture

Seamless MPLS and pseudowire head-end termination provide a simplified network architecture enabling efficient backhaul of broadband residential and business services to an MPLS service node activated for broadband network gateway (BNG) functionality. All forwarding of packets within a seamless MPLS network is based on IP/MPLS; it is MPLS end to end, without boundaries. Because the number of service provisioning points is minimized, the model of service delivery is quite flexible, allowing centralized or distributed delivery, depending on what is most effective for the type of service. The topological placement of service delivery points can be customized. The seamlessness,
as well as the decoupling of the network infrastructure and service architectures, allows for the simplified addition of new services.

This approach extends a single IP/MPLS network from core and edge, into aggregation and access, creating a single end-to-end label-switched path (LSP) without VLAN stitching and provisioning. In addition, the subscribers on the pseudowire interfaces can leverage the benefits of MPLS network resiliency for service restoration after node, link, or route failure.

This is a single converged packet network with no service dependencies, supporting residential, wholesale, mobile, and business subscribers.

The benefits can be summarized as follows:

- A single IP/MPLS network from core and edge can be extended into aggregation and access, resulting in the ability to signal a single end-to-end LSP without stitching.
- Service delivery and operations are greatly simplified, minimizing the number of service provisioning points, and making the topological placement of service delivery points highly flexible.
- With the single converged packet network, there are no service dependencies to hamper support of residential, wholesale, mobile, and business customers.
- “Dumb” access devices can be utilized in the network where devices with low compute power, low cost, and limited IP/MPLS functionality are appropriate, and where dynamic IP routing is not needed.
- Infrastructure and service architectures are decoupled:
  - Network infrastructure and service architectures can be as independent as feasible.
  - Flexible topological service placement based on end-to-end LSP reachability is enabled.
  - Access pseudowires can be used instead of VLANs or dedicated links for access to Layer 3 (L3) and L4-7 services (MPLS-based transport).
  - Service delivery is simplified by minimizing the number of provisioning points.
- Fast end-to-end service restoration covers all IP/MPLS infrastructure failures, links, and nodes, and the deterministic service restoration time is independent of network and service scale.
Technical Overview—Broadband Edge as a Service Node Within Seamless MPLS Network Designs

The Juniper Networks Broadband Edge solution enables providers to deliver traditional multiplay residential services over a simpler, collapsed network design that consolidates management and service activation points. This approach enables faster service rollouts and differentiated service offerings with greater operational efficiency, along with service velocity, service agility, and faster time to revenue for new subscribers and services.

The architectural elements of the broadband edge IP/MPLS service node design that enable consolidation of services at the edge include network topology, access protocols, IP/MPLS overlay, and interoperability with the metro/aggregation network.

This Network Configuration Example document focuses specifically on the use case in which MX Series broadband edge is deployed as an IP/MPLS service node within a seamless MPLS network architecture. The following sections provide an overview of this broadband edge solution:

- The Challenges Faced by Service Providers in Today’s Market on page 7
- Seamless MPLS on page 8
- Building Seamless MPLS Networks on page 9
- Seamless MPLS with Pseudowire Head-End Termination on page 10

The Challenges Faced by Service Providers in Today’s Market

The telecommunications market is increasingly dominated by IP packet services. The developments in this area are occurring so fast, it is difficult for service providers to keep up while staying profitable and retaining a strong client base. Their business and operational models are challenged as they struggle to manage the customer bandwidth demands brought on by increasing data services, and especially video. Broadband developments with wireline and 4G/LTE access offer much higher bandwidths to end users, and are quickly becoming key drivers for new service developments and network designs. Future bandwidth requirements and service mix uncertainties make the choice of network and service architecture even more complicated.

Network and operational complexity do not lend themselves easily to change, yet the ability to change rapidly is critical to service provider success, and it represents a significant competitive advantage. A streamlined network architecture is needed—one that reduces CapEx (by eliminating multiple service-specific elements) and OpEx (by significantly reducing the number of service provisioning points). A streamlined network architecture that converges residential, business, and mobile network infrastructures, and provides the agility to adapt to changing requirements is underway.

Seamless MPLS with pseudowire head-end termination provides a converged packet network and service architecture based on IP/MPLS. This architecture allows service providers to manage rapidly evolving service mix and bandwidth growth. It is based on a simple principle of expanding the dynamic IP/MPLS network to reach across core, metro, and access network infrastructure, enabling any-to-any packet connectivity and flexible service overlay.
This use case is a simplified backhaul architecture in which a Juniper Networks MX Series service edge provides a combination of residential and business provider edge services.

**Seamless MPLS**

Seamless (no boundaries) MPLS is a network architecture in which all forwarding of packets within a network, from the time a packet enters the network until it leaves the network, is based on MPLS. Seamless MPLS is critical to effective network convergence.

Figure 1 on page 8 illustrates the traditional network architecture without convergence. Note the separate wireless and wireline MPLS cores and the multiple Ethernet and MPLS aggregation points.

**Figure 1: Traditional Network Architecture Without Convergence**

Figure 2 on page 8 shows network convergence with seamless MPLS. Service providers are moving from the traditional access and core-facing networks to this converged residential, business, and mobile backhaul design model to manage new service introduction velocity and service node flexibility, and to ensure that end-to-end service is available regardless of network changes.

**Figure 2: Network Convergence with Seamless MPLS**

Seamless MPLS with pseudowire head-end termination offers a solution to the following technical challenges:
- Building a service-agnostic packet network at scale
- Ensuring end-to-end service availability in the face of any failure scenario
- Offering network service level agreements that accommodate diverse services
- Managing new service introduction velocity
- Coping with the operational complexities resulting from all of these challenges

The ultimate benefit of a converged seamless MPLS network is simplified service delivery as shown in Figure 3 on page 9.

**Figure 3: Simplified Service Delivery**

In today’s Ethernet/MPLS environment, L2 and L3 functions no longer need to be separated. Seamless MPLS provides a flexible infrastructure to extend access toward service edge functions such as BNGs and mobile gateways, services that can be centralized or not, depending on scaling and services take rates.

Taking MPLS to the access, and enabling MPLS packet forwarding end-to-end across the network, requires new functionality and features and a systematic architecture that can scale to tens of thousands of nodes. Juniper Networks seamless MPLS architecture enables a smooth migration from traditional networks to a scalable, end-to-end MPLS network.

**Building Seamless MPLS Networks**

Taking MPLS to the access and building MPLS networks results in:
• Service flexibility, simplified provisioning, simplified operations

Seamless MPLS architecture is a systematic way of enabling MPLS end-to-end between access nodes, with all forwarding based on MPLS labels. This means that all service provisioning and operations are MPLS based. There is a clean separation of control plane, management plane, and data plane operations throughout the network that allows decoupling of the service provisioning plane from the underlying transport technology. It also makes way for optimizing and simplifying service provisioning and operations, making it possible to minimize the number of service provisioning points.

• Network resiliency with deterministic, subsecond, end-to-end convergence for services

MPLS has significant traffic engineering capabilities, enabling end-to-end service restoration. The ability to do traffic engineering based on real-time network conditions supports strict service level agreements, guaranteed service availability, and subsecond restoration of services with fast reroute mechanisms in the event of link or node failures. The goal of seamless MPLS is to extend the same benefits end-to-end across the access network.

• Scale to the order of 100,000 nodes network-wide without compromising any of the benefits

Seamless MPLS enhances the capacity to scale as needed. WANs or core typically consist of 100 to 1,000 L3 nodes, but the metro access and aggregation networks could each contain that many, with hundreds of access and aggregation subnetworks in one single network. The result is a network that can scale to over 100,000 nodes.

Seamless MPLS with Pseudowire Head-End Termination

Similar to MX Series PE routers, the MX Series BNG application integrates broadband subscriber management functionality with IP/MPLS service node functions. Supporting pseudowire head-end termination and subscriber management enables broadband network services to be transported over IP/MPLS and flexibly terminated on any MX Series service node within the IP/MPLS network. Figure 4 on page 11 shows a number of services that are converged on this common architecture, including residential services (such as video, data, and wholesale L2TP) and business services (such as L3VPN, VPLS, L2VPN, and business Internet). With direct termination on the BNG for converged residential and business services, service providers are afforded a simplified design from a provisioning perspective (fewer provisioning points).
Chapter 1: Configuring Broadband Edge as a Service Node Within Seamless MPLS Network Designs

Figure 4: Seamless MPLS with Pseudowire Head-End Termination

Related Documentation

- Solution Brief: Broadband Edge
- Reference Architecture: Broadband Edge Network Design

Example: Configuring the Broadband Edge as a Service Node Within Seamless MPLS Network Designs

This example details the steps required to configure broadband edge seamless MPLS with head-end termination for residential subscriber management deployment. Step-by-step instructions are provided for each device in the example configuration.

This section includes the following information:

- Requirements on page 12
- Overview on page 13
- Configuration on page 16
• Verification on page 120
• Troubleshooting on page 178

Requirements

Table 1 on page 12 lists the role of each device in the configuration example topology and includes the hardware used for each device. All MX Series devices in this example were tested with Juniper Networks Junos OS Release 13.3R3, which is considered the minimum software revision required.

Table 1: Device Hardware

<table>
<thead>
<tr>
<th>Device</th>
<th>Hardware</th>
</tr>
</thead>
</table>
| R0 (primary BNG) serves as the primary MPLS pseudowire termination head-end provider edge and subscriber management platform for DHCP and PPPoE, and for the L2TP access concentrator (LAC). | Chassis: MX960  
Routing Engine (RE) 0 - RE1: RE-S-1800x4  
Flexible PIC Concentrator 0 (FPC0)-FPC7: Modular Port Concentrator (MPC) Type 2 3D EQ |
| R3 (backup BNG) becomes the primary BNG if the current primary BNG (R0) fails. | Chassis: MX960  
RE0-RE1: RE-S-1800x4  
FPC0-FPC7: MPC Type 2 3D EQ |
| R1 and R2 (access and aggregation routers) serve as Access Node (AN) and Metro pre-aggregation provider edge platforms for the MPLS pseudowire tunnel-based backhaul entry point. | Chassis: MX80/MX104  
TFEB 0: Packet Forwarding Engine Processor  
FPC 0-FPC 1: MPC BUILTIN |
| R4 serves as the core router. | Chassis: T640  
FPC 0: E-FPC Type 3  
FPC 1: E-FPC Type 1  
FPC 2: E-FPC Type 2  
SIB 0-SIB 4: SIB-I8-F16 |
Table 1: Device Hardware (continued)

<table>
<thead>
<tr>
<th>Device</th>
<th>Hardware</th>
</tr>
</thead>
<tbody>
<tr>
<td>R5 (L2TP Network Server [LNS]) serves as the L2TP tunnel and session termination point for broadband wholesale service.</td>
<td>Chassis: MX480</td>
</tr>
<tr>
<td></td>
<td>RE0: RE-S-2000</td>
</tr>
<tr>
<td></td>
<td>FR1: RE-S-2000</td>
</tr>
<tr>
<td></td>
<td>FPC 0–FPC 1: MPC Type 2 3D EQ</td>
</tr>
<tr>
<td>RADIUS server provides subscriber authentication and accounting.</td>
<td>FreeRADIUS version 2.1.5 on an Intel/Linux server</td>
</tr>
</tbody>
</table>

Overview

In this example, a specific traffic model is utilized, characterized as follows:

- Pseudowire tunnels are LDP-signaled MPLS L2 circuits from access PE to BNG.
- On the BNG core side, forwarding is based on MPLS transport within a single autonomous system using OSPF and OSPFv3 as the interior gateway protocols. Alternatively, ISIS could also be used.
- Subscriber traffic is backhauled over MPLS pseudowires to the MX Series BNG configured for pseudowire head-end termination.
- Each home has five subscriber sessions total: four subscribers (IP sessions) and one VLAN session.
  - DHCPv4 for VoIP service with 128,000 committed information rate (CIR) (strict priority)
  - DHCPv6 prefix delegation (PD) for VOD service with 20 million CIR (medium priority)
  - PPPoEv4 for Internet service (low priority)
  - PPPoEv6 Neighbor Discovery Router Advertisement (NDRA) for game service (low priority)
- There are four priority queues per home.
- GRE tunnels are used for Subscriber Secure Policy traffic forwarding.
- The upstream and downstream traffic rates are each 50 Mbps per home.
- The dedicated customer VLAN (C-VLAN) model is applied (each home has a unique VLAN). The VLANs are provisioned dynamically based on incoming subscriber traffic.

The following scaling parameters apply to this example configuration:

- A total of 50,000 homes are configured; 10 percent of those (5000) have L2TP sessions.
- There are 2048 pseudoservice (PS) interfaces (pseudowire tunnel anchor interfaces) on the BNG.
• There are 25 homes assigned to each pseudowire tunnel.
• There are 256 pseudowires per MPC (128 per Packet Forwarding Engine [PFE]).
• There are 256 pseudowires per MPC for eight MPCs in a fully loaded MX960 chassis, equaling 2048 Layer 2 (L2) circuits per chassis (to support the 50,000 homes).
• There is one BFD session for each L2 circuit.
• One percent of the homes (500 homes) have Subscriber Secure Policy to forward mirrored subscriber traffic to a GRE tunnel.

NOTE: The seamless MPLS with pseudowire head-end termination use case is valuable for both business and residential subscribers. In this tested example, only residential subscribers are included.

Network resiliency for this configuration example includes:

• Graceful Routing Engine switchover (GRES) for Routing Engine failover
• ISSU
• Path protection (node down, interchassis failover)
• Local protection (link down, intrachasses failover)
• Flexible PIC Concentrator (FPC) failure
• Routing down
• L2 circuits down

MPLS fast reroute and Bidirectional Forwarding Detection (BFD) recovery methods are used.

Topology

Figure 5 on page 15 illustrates the topology of this example configuration, including the MPLS and dual stack scope.
In this example, the access and aggregation provider edge (access PE) systems (R1 and R2) are directly connected and multihomed to the active and backup BNG systems. The purpose of the PE devices in this example is to emulate 1000 active MPLS pseudowires and another group of 1000 backup MPLS pseudowires toward the active and backup BNG systems.

The BNG device acts as the MPLS service node, terminating MPLS pseudowires and performing subscriber management functions. For PPP traffic, the BNG device supports LAC function forwarding to LNS over L2TP tunnels. For DHCP (IPoE) traffic, the BNG device terminates sessions directly.

The core router (R4) aggregates the two BNG systems (R0 and R3). The configuration for the core router in this example is basic, intended only to provide BNG MPLS pseudowire head-end termination, and support broadband subscriber termination.

The RADIUS server performs Point-to-Point (PPP) subscriber authentication, authorization, and accounting (AAA), and triggers the activation of service profile configuration parameters such as filters and class of service (CoS) parameters.

The LNS system (R5) is directly connected to the core routing system. It terminates the L2TP tunnel to provide high-speed interface wholesale service to retailer and ISP.
customers. The configuration used here is a basic example that demonstrates the BNG system’s ability to relay PPP traffic to the LNS system using the L2TP tunnel.

### Configuration

The following sections present configuration information for the devices included in the example from left to right in the topology diagram. The sections include CLI quick configuration (for copy and paste), step-by-step instructions, and `show` command output that confirms the configuration.

- Configuring the Access/Aggregation Router, R1 on page 16
- Configuring the Access/Aggregation Router, R2 on page 26
- Configuring BNG Router, R0 on page 35
- Configuring BNG Router, R3 on page 70
- Configuring the Core Router, R4 on page 102
- Configuring the LNS Router, R5 on page 108
- Configuring the User Profile for the RADIUS Server on page 119

#### Configuring the Access/Aggregation Router, R1

**CLI Quick Configuration**

Figure 6 on page 16 highlights the access/aggregation routers (R1 and R2) in the context of the reference example topology.

**Figure 6: Access/Aggregation Routers in the Topology**
To quickly configure R1 as in this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```
set interfaces lo0 unit 0 family inet address 101.0.0.1/32 primary
set interfaces lo0 unit 0 family inet address 101.0.0.1/32 preferred
set interfaces lo0 unit 0 family mpls
set interfaces ge-1/0/6 description "To R0 - BNG1"
set interfaces ge-1/0/6 unit 0 family inet address 21.21.11.2/24
set interfaces ge-1/0/6 unit 0 family mpls
set interfaces ge-1/1/6 description "To R0 - BNG1"
set interfaces ge-1/1/6 unit 0 family inet address 21.21.10.2/24
set interfaces ge-1/1/6 unit 0 family mpls
set interfaces ge-1/1/4 description "To R3 - BNG2"
set interfaces ge-1/1/4 unit 0 family inet address 21.21.20.1/24
set interfaces ge-1/1/4 unit 0 family mpls
set interfaces ge-1/1/5 description "To R3 - BNG2"
set interfaces ge-1/1/5 unit 0 family inet address 21.21.21.1/24
set interfaces ge-1/1/5 unit 0 family mpls
set interfaces ge-1/0/2 flexible-vlan-tagging
set interfaces ge-1/0/2 encapsulation flexible-ethernet-services
set interfaces ge-1/0/2 gigether-options loopback
set interfaces ge-1/0/2 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/2 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/2 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 3 vlan-id-range 5-6
set interfaces ge-1/0/3 flexible-vlan-tagging
set interfaces ge-1/0/3 encapsulation flexible-ethernet-services
set interfaces ge-1/0/3 gigether-options loopback
set interfaces ge-1/0/3 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/3 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/3 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 3 vlan-id-range 5-6
set interfaces ge-1/0/4 flexible-vlan-tagging
set interfaces ge-1/0/4 encapsulation flexible-ethernet-services
set interfaces ge-1/0/4 gigether-options loopback
set interfaces ge-1/0/4 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/4 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/4 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 3 vlan-id-range 5-6
set interfaces ge-1/1/2 flexible-vlan-tagging
set interfaces ge-1/1/2 encapsulation flexible-ethernet-services
set interfaces ge-1/1/2 gigether-options loopback
set interfaces ge-1/1/2 unit 1 encapsulation vlan-ccc
set interfaces ge-1/1/2 unit 1 vlan-id-range 1-2
set interfaces ge-1/1/2 unit 2 encapsulation vlan-ccc
set interfaces ge-1/1/2 unit 2 vlan-id-range 3-4
set interfaces ge-1/1/2 unit 3 encapsulation vlan-ccc
```
set interfaces ge-1/1/2 unit 3 vlan-id-range 5-6
set interfaces ge-1/1/3 flexible-vlan-tagging
set interfaces ge-1/1/3 encapsulation flexible-ethernet-services
set interfaces ge-1/1/3 gigether-options loopback
set interfaces ge-1/1/3 unit 1 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 1 vlan-id-range 1-2
set interfaces ge-1/1/3 unit 2 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 2 vlan-id-range 3-4
set interfaces ge-1/1/3 unit 3 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 3 vlan-id-range 5-6
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 virtual-circuit-id 1
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 encapsulation-type ethernet
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 ignore-mtu-mismatch
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 backup-neighbor 103.0.0.1
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-detection
    minimum-interval 1000
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-detection
    multiplier 4
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 virtual-circuit-id 2
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 encapsulation-type ethernet
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 ignore-mtu-mismatch
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 backup-neighbor 103.0.0.1
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
    minimum-interval 1000
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
    multiplier 4
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
    detection-time threshold 5000
set routing-options router-id 101.0.0.1
set protocols mpls interface lo0.0
set protocols mpls interface ge-1/0/6.0
set protocols mpls interface ge-1/1/6.0
set protocols mpls interface ge-1/1/4.0
set protocols mpls interface ge-1/1/5.0
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-1/0/6.0
set protocols ospf area 0.0.0.0 interface ge-1/1/6.0
set protocols ospf area 0.0.0.0 interface ge-1/1/4.0
set protocols ospf area 0.0.0.0 interface ge-1/1/5.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-1/0/6.0
set protocols ldp interface ge-1/1/4.0
set protocols ldp interface ge-1/1/5.0
set protocols ldp interface ge-1/1/6.0
Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure R1:

1. Configure the interfaces.

   The loopback and BNG-facing interfaces have inet (IPv4) family addresses to enable OSPF and LDP.

   a. Configure the loopback interface.

      The PE system’s primary address is configured under a loopback interface.

      [edit interfaces]
      user@host-R1# set lo0 unit 0 family inet address 101.0.0.1/32 primary
      user@host-R1# set lo0 unit 0 family inet address 101.0.0.1/32 preferred
      user@host-R1# set lo0 unit 0 family mpls

   b. Configure the BNG-facing interfaces for both the primary and backup BNG devices.

      Two ports are connected to the primary BNG (BNG1), and two are connected to the backup BNG (BNG2). The configuration includes IPv4 (inet) and MPLS family addresses to support IP/MPLS network connectivity.

      [edit interfaces]
      user@host-R1# set ge-1/0/6 description "To R0 - BNG1"
      user@host-R1# set ge-1/0/6 unit 0 family inet address 21.21.11.2/24
      user@host-R1# set ge-1/0/6 unit 0 family mpls
      user@host-R1# set ge-1/1/6 description "To R0 - BNG1"
      user@host-R1# set ge-1/1/6 unit 0 family inet address 21.21.10.2/24
      user@host-R1# set ge-1/1/6 unit 0 family mpls
      user@host-R1# set ge-1/1/4 description "To R3 - BNG2"
      user@host-R1# set ge-1/1/4 unit 0 family inet address 21.21.20.1/24
      user@host-R1# set ge-1/1/4 unit 0 family mpls
      user@host-R1# set ge-1/1/5 description "To R3 - BNG2"
      user@host-R1# set ge-1/1/5 unit 0 family inet address 21.21.21.1/24
      user@host-R1# set ge-1/1/5 unit 0 family mpls

   2. Configure the access ports for MPLS pseudowire circuits.

      In this example, one PE device has five access ports emulating access node connections, which are used for MPLS pseudowire circuit interfaces. To configure multiple VLAN values, the `vlan-id-range` command is used. Each VLAN interface is associated with an MPLS pseudowire on a one-to-one mapping basis.

      [edit interfaces]
      user@host-R1# set ge-1/0/2 flexible-vlan-tagging
      user@host-R1# set ge-1/0/2 encapsulation flexible-ethernet-services
      user@host-R1# set ge-1/0/2 gigether-options loopback
      user@host-R1# set ge-1/0/2 unit 1 encapsulation vlan-ccc
      user@host-R1# set ge-1/0/2 unit 1 vlan-id-range 1-2
      user@host-R1# set ge-1/0/2 unit 2 encapsulation vlan-ccc
      user@host-R1# set ge-1/0/2 unit 2 vlan-id-range 3-4
      user@host-R1# set ge-1/0/2 unit 3 encapsulation vlan-ccc
      user@host-R1# set ge-1/0/2 unit 3 vlan-id-range 5-6
3. Configure the MPLS pseudowire L2 circuit connections, including:

- Ethernet encapsulation type and the ignore MTU mismatch option. These are required because the MPLS pseudowire service (PS) interface supports MPLS pseudowire type 5 mode (Ethernet encapsulation) at the BNG head-end.

- The backup MPLS pseudowire, which is the backup neighbor and virtual circuit ID for failover to the backup BNG system in the event of MPLS pseudowire failure detection.

- BFD for MPLS pseudowire reachability. MPLS pseudowire data plane failure detection uses the BFD protocol.

The configuration for two ports is shown here. Repeat this step for all access-facing ports.

```plaintext
[edit protocols]
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 virtual-circuit-id 1
```
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1
   encapsulation-type ethernet
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1
   ignore-mtu-mismatch
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 backup-neighbor
   103.0.0.1 virtual-circuit-id 1
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam
   bfd-liveness-detection minimum-interval 1000
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam
   bfd-liveness-detection multiplier 4
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam
   bfd-liveness-detection detection-time threshold 5000
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 virtual-circuit-id 2
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2
   encapsulation-type ethernet
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 ignore-mtu-mismatch
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 backup-neighbor
   103.0.0.1 virtual-circuit-id 2
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam
   bfd-liveness-detection minimum-interval 1000
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam
   bfd-liveness-detection multiplier 4
user@host-R1# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam
   bfd-liveness-detection detection-time threshold 5000

4. Configure the routing protocols.

   OSPF is enabled for IPv4 routing; LDP is enabled for MPLS label exchange.

   a. Configure the router ID.

      [edit]
      user@host-R1# set routing-options router-id 101.0.0.1

   b. Enable MPLS.

      Configure MPLS for all interfaces connected to the BNG-facing ports.

      [edit protocols]
      user@host-R1# set mpls interface lo0.0
      user@host-R1# set mpls interface ge-1/0/6.0
      user@host-R1# set mpls interface ge-1/1/6.0
      user@host-R1# set mpls interface ge-1/1/4.0
      user@host-R1# set mpls interface ge-1/1/5.0

   c. Configure OSPF to support IPv4 routing.

      To simplify OSPF area configuration, you can often use the interface all option.
      In this example, however, the use of specific interface names ensures that only
      the relevant interfaces are included in OSPF.

      [edit protocols]
      user@host-R1# set ospf area 0.0.0.0 interface lo0.0
      user@host-R1# set ospf area 0.0.0.0 interface ge-1/0/6.0
      user@host-R1# set ospf area 0.0.0.0 interface ge-1/1/6.0
      user@host-R1# set ospf area 0.0.0.0 interface ge-1/1/4.0
      user@host-R1# set ospf area 0.0.0.0 interface ge-1/1/5.0
d. Enable LDP for MPLS label exchange.

To support targeted LDP, configure LDP for the BNG-facing ports and loopback interface.

[edit protocols]
user@host-R1# set ldp interface lo0.0
user@host-R1# set ldp interface ge-1/0/6.0
user@host-R1# set ldp interface ge-1/1/4.0
user@host-R1# set ldp interface ge-1/1/5.0
user@host-R1# set ldp interface ge-1/1/6.0

Results From configuration mode, confirm your configuration by entering the following show commands:

1. Confirm the loopback interface configuration.

```
user@host-R1# show interfaces lo0
unit 0 {
  family inet {
    address 101.0.0.1/32 {
      primary;
      preferred;
    }
  }
  family mpls;
}
```

2. Confirm the BNG-facing interface configuration.

```
user@host-R1# show interfaces ge-1/0/6
description "To R0 - BNG1";
vlan-tagging;
unit 0 {
  vlan-id 1;
  family inet {
    address 21.21.11.2/24;
  }
  family mpls;
}

user@host-R1# show interfaces ge-1/1/6
description "To R0 - BNG1";
vlan-tagging;
unit 0 {
  vlan-id 1;
  family inet {
    address 21.21.10.2/24;
  }
  family mpls;
}

user@host-R1# show interfaces ge-1/1/4
description "To R3 - BNG2";
vlan-tagging;
unit 0 {
  vlan-id 1;
  family inet {
```
address 21.21.20.1/24;
}
family mpls;
}

user@host-R1# show interfaces ge-1/1/5
description "To R3 - BNG2";
vlan-tagging;
unit 0 {
    vlan-id 1;
    family inet {
        address 21.21.21.1/24;
    }
    family mpls;
}

3. Confirm the access port configuration for the MPLS pseudowire circuits.

user@host-R1# show interfaces ge-1/0/2
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
gigether-options {
    loopback;
}
unit 1 {
    encapsulation vlan-ccc;
    vlan-id-range 1-2;
}
unit 2 {
    encapsulation vlan-ccc;
    vlan-id-range 3-4;
}
unit 3 {
    encapsulation vlan-ccc;
    vlan-id-range 5-6;
}

user@host-R1# show interfaces ge-1/0/3
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
gigether-options {
    loopback;
}
unit 1 {
    encapsulation vlan-ccc;
    vlan-id-range 1-2;
}
unit 2 {
    encapsulation vlan-ccc;
    vlan-id-range 3-4;
}
unit 3 {
    encapsulation vlan-ccc;
    vlan-id-range 5-6;
}

user@host-R1# show interfaces ge-1/0/4
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
gigether-options {
    loopback;
}
unit 1 {
    encapsulation vlan-ccc;
    vlan-id-range 1-2;
}
unit 2 {
    encapsulation vlan-ccc;
    vlan-id-range 3-4;
}
unit 3 {
    encapsulation vlan-ccc;
    vlan-id-range 5-6;
}

user@host-R1# show interfaces ge-1/1/2
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
gigether-options {
    loopback;
}
unit 1 {
    encapsulation vlan-ccc;
    vlan-id-range 1-2;
}
unit 2 {
    encapsulation vlan-ccc;
    vlan-id-range 3-4;
}
unit 3 {
    encapsulation vlan-ccc;
    vlan-id-range 5-6;
}

user@host-R1# show interfaces ge-1/1/3
flexible-vlan-tagging;
encapsulation flexible-ethernet-services;
gigether-options {
    loopback;
}
unit 1 {
    encapsulation vlan-ccc;
    vlan-id-range 1-2;
}
unit 2 {
    encapsulation vlan-ccc;
    vlan-id-range 3-4;
}
unit 3 {
    encapsulation vlan-ccc;
    vlan-id-range 5-6;
}
4. Confirm the backup MPLS pseudowire configuration.

```
user@host-R1# show protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1
virtual-circuit-id 1;
encapsulation-type ethernet;
ignore-mtu-mismatch;
backup-neighbor 103.0.0.1 {
  virtual-circuit-id 1;
}
oam {
  bfd-liveness-detection {
    minimum-interval 1000;
    multiplier 4;
    detection-time {
      threshold 5000;
    }
  }
}

user@host-R1# show protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2
virtual-circuit-id 2;
encapsulation-type ethernet;
ignore-mtu-mismatch;
backup-neighbor 103.0.0.1 {
  virtual-circuit-id 2;
}
oam {
  bfd-liveness-detection {
    minimum-interval 1000;
    multiplier 4;
    detection-time {
      threshold 5000;
    }
  }
}
```

5. Confirm that MPLS is enabled on the interfaces.

```
user@host-R1# show protocols mpls
interface lo0.0;
interface ge-1/0/6.0;
interface ge-1/1/6.0;
interface ge-1/1/4.0;
interface ge-1/1/5.0;
```

6. Confirm the OSPF configuration.

```
user@host-R1# show protocols ospf
area 0.0.0.0 {
  interface lo0.0;
  interface ge-1/0/6.0;
  interface ge-1/1/6.0;
  interface ge-1/1/4.0;
  interface ge-1/1/5.0;
}
```

7. Confirm the LDP configuration.

```
user@host-R1# show protocols ldp
```
Configuring the Access/Aggregation Router, R2

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```text
set interfaces lo0 unit 0 family inet address 102.0.0.1/32 primary
set interfaces lo0 unit 0 family inet address 102.0.0.1/32 preferred
set interfaces ge-1/0/6 description "To R0 - BNG1"
set interfaces ge-1/0/6 unit 0 family inet address 21.21.13.2/24
set interfaces ge-1/0/6 unit 0 family mpls
set interfaces ge-1/1/6 description "To R0 - BNG1"
set interfaces ge-1/1/6 unit 0 family inet address 21.21.12.2/24
set interfaces ge-1/1/6 unit 0 family mpls
set interfaces ge-1/1/4 description "To R3 - BNG2"
set interfaces ge-1/1/4 unit 0 family inet address 21.21.30.1/24
set interfaces ge-1/1/4 unit 0 family mpls
set interfaces ge-1/1/5 description "To R3 - BNG2"
set interfaces ge-1/1/5 unit 0 family inet address 21.21.31.1/24
set interfaces ge-1/1/5 unit 0 family mpls
set interfaces ge-1/0/2 flexible-vlan-tagging
set interfaces ge-1/0/2 encapsulation flexible-ethernet-services
set interfaces ge-1/0/2 gigether-options loopback
set interfaces ge-1/0/2 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/2 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/2 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/2 unit 3 vlan-id-range 5-6
set interfaces ge-1/0/3 flexible-vlan-tagging
set interfaces ge-1/0/3 encapsulation flexible-ethernet-services
set interfaces ge-1/0/3 gigether-options loopback
set interfaces ge-1/0/3 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/3 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/3 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/3 unit 3 vlan-id-range 5-6
set interfaces ge-1/0/4 flexible-vlan-tagging
set interfaces ge-1/0/4 encapsulation flexible-ethernet-services
set interfaces ge-1/0/4 gigether-options loopback
set interfaces ge-1/0/4 unit 1 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 1 vlan-id-range 1-2
set interfaces ge-1/0/4 unit 2 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 2 vlan-id-range 3-4
set interfaces ge-1/0/4 unit 3 encapsulation vlan-ccc
set interfaces ge-1/0/4 unit 3 vlan-id-range 5-6
```
set interfaces ge-1/1/2 flexible-vlan-tagging
set interfaces ge-1/1/2 encapsulation flexible-ethernet-services
set interfaces ge-1/1/2 gigether-options loopback
set interfaces ge-1/1/2 unit 1 encapsulation vlan-ccc
set interfaces ge-1/1/2 unit 1 vlan-id-range 1-2
set interfaces ge-1/1/2 unit 2 encapsulation vlan-ccc
set interfaces ge-1/1/2 unit 2 vlan-id-range 3-4
set interfaces ge-1/1/2 unit 3 encapsulation vlan-ccc
set interfaces ge-1/1/2 unit 3 vlan-id-range 5-6
set interfaces ge-1/1/3 flexible-vlan-tagging
set interfaces ge-1/1/3 encapsulation flexible-ethernet-services
set interfaces ge-1/1/3 gigether-options loopback
set interfaces ge-1/1/3 unit 1 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 1 vlan-id-range 1-2
set interfaces ge-1/1/3 unit 2 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 2 vlan-id-range 3-4
set interfaces ge-1/1/3 unit 3 encapsulation vlan-ccc
set interfaces ge-1/1/3 unit 3 vlan-id-range 5-6
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 virtual-circuit-id 1001
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 encapsulation-type ethernet
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 ignore-mtu-mismatch
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 backup-neighbor 103.0.0.1
virtual-circuit-id 1001
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-detection
minimum-interval 1000
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-detection
multiplier 4
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-detection
detection-time threshold 5000
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 virtual-circuit-id 1002
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 encapsulation-type ethernet
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 ignore-mtu-mismatch
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 backup-neighbor 103.0.0.1
virtual-circuit-id 1002
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
minimum-interval 1000
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
multiplier 4
set protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-detection
detection-time threshold 5000
set routing-options router-id 102.0.0.1
set protocols mpls interface ge-1/0/6.0
set protocols mpls interface ge-1/1/6.0
set protocols mpls interface ge-1/1/4.0
set protocols mpls interface ge-1/1/5.0
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-1/0/6.0
set protocols ospf area 0.0.0.0 interface ge-1/1/6.0
set protocols ospf area 0.0.0.0 interface ge-1/1/4.0
set protocols ospf area 0.0.0.0 interface ge-1/1/5.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-1/0/6.0
set protocols ldp interface ge-1/1/4.0
set protocols ldp interface ge-1/1/5.0
set protocols ldp interface ge-1/1/6.0
Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure R2:

1. Configure the interfaces.

   The loopback and BNG-facing interfaces have inet (IPv4) family addresses to enable OSPF and LDP.

   a. Configure the loopback interface.

      The PE system's primary address is configured under a loopback interface.

      [edit interfaces]
      user@host-R2# set lo0 unit 0 family inet address 102.0.0.1/32 primary
      user@host-R2# set lo0 unit 0 family inet address 102.0.0.1/32 preferred
      user@host-R2# set lo0 unit 0 family mpls

   b. Configure the BNG-facing interfaces for both the primary and backup BNG devices.

      Two ports are connected to the primary BNG (BNG1), and two are connected to the backup BNG (BNG2). The configuration includes IPv4 (inet) and MPLS family addresses to support IP/MPLS network connectivity.

      [edit interfaces]
      user@host-R2# set ge-1/0/6 description "To R0 - BNG1"
      user@host-R2# set ge-1/0/6 unit 0 family inet address 21.21.13.2/24
      user@host-R2# set ge-1/0/6 unit 0 family mpls
      user@host-R2# set ge-1/1/6 description "To R0 - BNG1"
      user@host-R2# set ge-1/1/6 unit 0 family inet address 21.21.12.2/24
      user@host-R2# set ge-1/1/6 unit 0 family mpls
      user@host-R2# set ge-1/1/4 description "To R3 - BNG2"
      user@host-R2# set ge-1/1/4 unit 0 family inet address 21.21.30.1/24
      user@host-R2# set ge-1/1/4 unit 0 family mpls
      user@host-R2# set ge-1/1/5 description "To R3 - BNG2"
      user@host-R2# set ge-1/1/5 unit 0 family inet address 21.21.31.1/24
      user@host-R2# set ge-1/1/5 unit 0 family mpls

2. Configure the access ports for MPLS pseudowire circuits.

   In this example, one PE device has five access ports emulating access node connections, which are used for MPLS pseudowire circuit interfaces. To configure multiple VLAN values, the vlan-id-range command is used. Each VLAN interface is associated with an MPLS pseudowire on a one-to-one mapping basis.

   [edit interfaces]
   user@host-R2# set ge-1/0/2 flexible-vlan-tagging
   user@host-R2# set ge-1/0/2 encapsulation flexible-ethernet-services
   user@host-R2# set ge-1/0/2 gigether-options loopback
   user@host-R2# set ge-1/0/2 unit 1 encapsulation vlan-ccc
   user@host-R2# set ge-1/0/2 unit 1 vlan-id-range 1-2
   user@host-R2# set ge-1/0/2 unit 2 encapsulation vlan-ccc
   user@host-R2# set ge-1/0/2 unit 2 vlan-id-range 3-4
   user@host-R2# set ge-1/0/2 unit 3 encapsulation vlan-ccc
   user@host-R2# set ge-1/0/2 unit 3 vlan-id-range 5-6
user@host-R2# set ge-1/0/3 flexible-vlan-tagging
user@host-R2# set ge-1/0/3 encapsulation flexible-ethernet-services
user@host-R2# set ge-1/0/3 gigether-options loopback
user@host-R2# set ge-1/0/3 unit 1 encapsulation vlan-ccc
user@host-R2# set ge-1/0/3 unit 1 vlan-id-range 1-2
user@host-R2# set ge-1/0/3 unit 2 encapsulation vlan-ccc
user@host-R2# set ge-1/0/3 unit 2 vlan-id-range 3-4
user@host-R2# set ge-1/0/3 unit 3 encapsulation vlan-ccc
user@host-R2# set ge-1/0/3 unit 3 vlan-id-range 5-6
user@host-R2# set ge-1/0/4 flexible-vlan-tagging
user@host-R2# set ge-1/0/4 encapsulation flexible-ethernet-services
user@host-R2# set ge-1/0/4 gigether-options loopback
user@host-R2# set ge-1/0/4 unit 1 encapsulation vlan-ccc
user@host-R2# set ge-1/0/4 unit 1 vlan-id-range 1-2
user@host-R2# set ge-1/0/4 unit 2 encapsulation vlan-ccc
user@host-R2# set ge-1/0/4 unit 2 vlan-id-range 3-4
user@host-R2# set ge-1/0/4 unit 3 encapsulation vlan-ccc
user@host-R2# set ge-1/0/4 unit 3 vlan-id-range 5-6
user@host-R2# set ge-1/1/2 flexible-vlan-tagging
user@host-R2# set ge-1/1/2 encapsulation flexible-ethernet-services
user@host-R2# set ge-1/1/2 gigether-options loopback
user@host-R2# set ge-1/1/2 unit 1 encapsulation vlan-ccc
user@host-R2# set ge-1/1/2 unit 1 vlan-id-range 1-2
user@host-R2# set ge-1/1/2 unit 2 encapsulation vlan-ccc
user@host-R2# set ge-1/1/2 unit 2 vlan-id-range 3-4
user@host-R2# set ge-1/1/2 unit 3 encapsulation vlan-ccc
user@host-R2# set ge-1/1/2 unit 3 vlan-id-range 5-6
user@host-R2# set ge-1/1/3 flexible-vlan-tagging
user@host-R2# set ge-1/1/3 encapsulation flexible-ethernet-services
user@host-R2# set ge-1/1/3 gigether-options loopback
user@host-R2# set ge-1/1/3 unit 1 encapsulation vlan-ccc
user@host-R2# set ge-1/1/3 unit 1 vlan-id-range 1-2
user@host-R2# set ge-1/1/3 unit 2 encapsulation vlan-ccc
user@host-R2# set ge-1/1/3 unit 2 vlan-id-range 3-4
user@host-R2# set ge-1/1/3 unit 3 encapsulation vlan-ccc
user@host-R2# set ge-1/1/3 unit 3 vlan-id-range 5-6

3. Configure the MPLS pseudowire L2 circuit connections, including:

- Ethernet encapsulation type and the ignore MTU mismatch option. These are required because the MPLS pseudowire service (PS) interface supports MPLS pseudowire type 5 mode (Ethernet encapsulation) at the BNG head-end.

- The backup MPLS pseudowire, which is the backup neighbor and virtual circuit ID for failover to the backup BNG system in the event of MPLS pseudowire failure detection.

- BFD for MPLS pseudowire reachability. MPLS pseudowire data plane failure detection uses the BFD protocol.

The configuration for two ports is shown here. Repeat this step for all access-facing ports.

```
[edit protocols]
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 virtual-circuit-id 1001
```
4. Configure the routing protocols.

OSPF is enabled for IPv4 routing; LDP is enabled for MPLS label exchange.

a. Configure the router ID.

[edit]
user@host-R2# set routing-options router-id 102.0.0.1

b. Enable MPLS.

Configure MPLS for all interfaces connected to the BNG-facing ports.

[edit protocols]
user@host-R2# set mpls interface ge-1/0/6.0
user@host-R2# set mpls interface ge-1/1/6.0
user@host-R2# set mpls interface ge-1/1/4.0
user@host-R2# set mpls interface ge-1/1/5.0

c. Configure OSPF to support IPv4 routing.

To simplify OSPF area configuration, you can often use the interface all option. In this example, however, the use of specific interface names ensures that only the relevant interfaces are included in OSPF.

[edit protocols]
user@host-R2# set ospf area 0.0.0.0 interface lo0.0
user@host-R2# set ospf area 0.0.0.0 interface ge-1/0/6.0
user@host-R2# set ospf area 0.0.0.0 interface ge-1/1/6.0
user@host-R2# set ospf area 0.0.0.0 interface ge-1/1/4.0
user@host-R2# set ospf area 0.0.0.0 interface ge-1/1/5.0
d. Enable LDP for MPLS label exchange.

To support targeted LDP, configure LDP for the BNG-facing ports and loopback interface.

```
[edit protocols]
user@host-R2# set ldp interface lo0.0
user@host-R2# set ldp interface ge-1/0/6.0
user@host-R2# set ldp interface ge-1/1/4.0
user@host-R2# set ldp interface ge-1/1/5.0
user@host-R2# set ldp interface ge-1/1/6.0
```

**Results**  From configuration mode, confirm your configuration by entering the following `show` commands:

1. Confirm the loopback interface configuration.

   ```
   user@host-R2# show interfaces lo0
   unit 0 {
   family inet {
   address 102.0.0.1/32 {
   primary;
   preferred;
   }
   family mpls;
   }
   }
   ```

2. Confirm the BNG-facing interface configuration.

   ```
   user@host-R2# show interfaces ge-1/0/6
description "To R0 - BNG1";
unit 0 {
family inet {
address 21.21.13.2/24 {
}
family mpls;
}
user@host-R2# show interfaces ge-1/1/6
description "To R0 - BNG1";
unit 0 {
family inet {
address 21.21.12.2/24;
}
family mpls;
}
user@host-R2# show interfaces ge-1/1/4
description "To R3 - BNG2";
unit 0 {
family inet {
address 21.21.230.1/24;
}
family mpls;
}
user@host-R2# show interfaces ge-1/1/5
```
description "To R3 - BNG2";
unit 0 {
  family inet {
    address 21.21.31.1/24;
  }
  family mpls;
}

3. Confirm the access port configuration for the MPLS pseudowire circuits.

    user@host-R2# show interfaces ge-1/0/2
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    gigether-options {
      loopback;
    }
    unit 1 {
      encapsulation vlan-ccc;
      vlan-id-range 1-2;
    }
    unit 2 {
      encapsulation vlan-ccc;
      vlan-id-range 3-4;
    }
    unit 3 {
      encapsulation vlan-ccc;
      vlan-id-range 5-6;
    }

    user@host-R2# show interfaces ge-1/0/3
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    gigether-options {
      loopback;
    }
    unit 1 {
      encapsulation vlan-ccc;
      vlan-id-range 1-2;
    }
    unit 2 {
      encapsulation vlan-ccc;
      vlan-id-range 3-4;
    }
    unit 3 {
      encapsulation vlan-ccc;
      vlan-id-range 5-6;
    }

    user@host-R2# show interfaces ge-1/0/4
    flexible-vlan-tagging;
    encapsulation flexible-ethernet-services;
    gigether-options {
      loopback;
    }
    unit 1 {
      encapsulation vlan-ccc;
4. Confirm the MPLS pseudowire L2 circuit connections configuration.

```bash
user@host-R2# show protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1
virtual-circuit-id 1001;
encapsulation-type ethernet;
ignore-mtu-mismatch;
backup-neighbor 103.0.0.1 
```
virtual-circuit-id 1001;
}
}
}
}
}
user@host-R2# show protocols l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2
virtual-circuit-id 1002;
encapsulation-type ethernet;
ignore-mtu-mismatch;
backup-neighbor 103.0.0.1 {
  virtual-circuit-id 1002;
}
}
}

5. Confirm the MPLS configuration.

user@host-R2# show protocols mpls
interface ge-1/0/6.0;
interface ge-1/1/6.0;
interface ge-1/1/4.0;
interface ge-1/1/5.0;

6. Confirm the OSPF configuration.

user@host-R2# show protocols ospf
area 0.0.0.0 {
  interface lo0.0;
  interface ge-1/0/6.0;
  interface ge-1/1/6.0;
  interface ge-1/1/4.0;
  interface ge-1/1/5.0;
}

7. Confirm the LDP configuration.

user@host-R2# show protocols ldp
interface lo0.0;
interface ge-1/0/6.0;
interface ge-1/1/4.0;
interface ge-1/1/5.0;
interface ge-1/1/6.0;
Conﬁguring BNG Router, R0

CLI Quick Conﬁguration

Figure 7 on page 35 highlights the BNG routers (R0 and R3) in the context of the reference example topology.

Figure 7: BNG Routers in the Topology

To quickly conﬁgure this example, copy the following commands, paste them into a text ﬁle, remove any line breaks, change any details necessary to match your network conﬁguration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```
set system dynamic-proﬁle-options versioning
set dynamic-proﬁles client-proﬁle interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet unnumbered-address lo0.0
set dynamic-proﬁles client-proﬁle interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 unnumbered-address lo0.0
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" no-traps
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" ppp-options chap
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" ppp-options pap
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" pppoe-options underlying-interface "$junos-underlying-interface"
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" pppoe-options server
set dynamic-proﬁles pppoe-client-proﬁle interfaces pp0 unit "$junos-interface-unit" keepalives interval 30
```
set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
  family inet unnumbered-address lo0.0
set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
  family inet6 unnumbered-address lo0.0
set class-of-service forwarding-classes queue 0 FC0
set class-of-service forwarding-classes queue 1 FC1
set class-of-service forwarding-classes queue 2 FC2
set class-of-service forwarding-classes queue 3 FC3
set class-of-service forwarding-classes queue 4 FC4
set class-of-service forwarding-classes queue 5 FC5
set class-of-service forwarding-classes queue 6 FC6
set class-of-service forwarding-classes queue 7 FC7
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-scheduler-map
  SMAP_PS
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-shaping-rate 60m
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-guaranteed-rate 50m
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" no-traps
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" vlan-tags outer "$junos-stacked-vlan-id"
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" vlan-tags inner "$junos-vlan-id"
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" family inet rpf-check fail-filter RPF-PASS-DHCP-V4
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" family inet6 unnumbered-address lo0.0
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
  "$junos-interface-unit" family inet6 rpf-check fail-filter RPF-PASS-DHCP-V6
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
  "$junos-interface-name" max-advertisement-interval 1800
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
  "$junos-interface-name" min-advertisement-interval 1350
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
  "$junos-interface-name" managed-configuration
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
  scheduler-map "$junos-cos-scheduler-map"
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
  shaping-rate "$junos-cos-shaping-rate"
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
  guaranteed-rate "$junos-cos-guaranteed-rate"
set dynamic-profiles vlan-prof-0 class-of-service interfaces "$junos-interface-ifd-name"
  unit "$junos-interface-unit" output-traffic-control-profile TCP_PS
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC3 scheduler FC3_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC4 scheduler FC4_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC5 scheduler FC5_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC6 scheduler FC6_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC7 scheduler FC7_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0 forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1 forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC2 forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1 forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1 forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2 forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2 forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2 forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2 forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2 forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2 forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2 forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC3 scheduler FC3_SCH
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC0_SCH transmit-rate 128k
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC0_SCH priority strict-high
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC1_SCH transmit-rate 20m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC1_SCH priority medium-high
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC2_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC3_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH drop-profile-map loss-priority low protocol any drop-profile DP_04
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH drop-profile-map loss-priority low protocol any drop-profile DP_05
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH drop-profile-map loss-priority low protocol any drop-profile DP_06
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH drop-profile-map loss-priority low protocol any drop-profile DP_07
set dynamic-profiles DHCP-SERVICE-PROFILE variables I_V4_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables O_V4_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables I_V6_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables O_V6_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet filter input "$I_V4_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet filter output "$O_V4_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 filter input "$I_V6_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 filter output "$O_V6_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE variables I_V4_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables O_V4_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables I_V6_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables O_V6_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit "$junos-interface-unit" family inet filter input "$I_V4_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit "$junos-interface-unit" family inet filter output "$O_V4_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit "$junos-interface-unit" family inet6 filter input "$I_V6_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit "$junos-interface-unit" family inet6 filter output "$O_V6_FILTER"
set system services dhcp-local-server dhcpv6 group v6-ppp-client-0 interface pp0.0
set system services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 authentication password joshua
set system services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 authentication username include user-prefix SST_USER_DHCP_V4_DEFAULT
set system services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 dynamic-profile client-profile
set system services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 interface ps0.0
set system services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 interface ps1.0
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication password joshua
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication username include user-prefix SST_USER_DHCP_V6_DEFAULT
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 dynamic-profile client-profile
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 interface ps0.0
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-1-ACCESS-0-ps1
set system redundancy graceful-switchover
set system services subscriber-management gres-route-flush-delay
set system services resource-monitor high-threshold 80
set system commit synchronize
set chassis fpc 0 pic 0 tunnel-services bandwidth 1g
set chassis fpc 0 pic 0 traffic-manager egress-shaping-overhead 0
set chassis fpc 0 pic 1 tunnel-services bandwidth 1g
set chassis fpc 0 pic 1 traffic-manager egress-shaping-overhead 0
set chassis fpc 0 pic 2 tunnel-services bandwidth 1g
set chassis fpc 0 pic 2 traffic-manager egress-shaping-overhead 0
set chassis fpc 0 pic 3 tunnel-services bandwidth 1g
set chassis fpc 0 pic 3 traffic-manager egress-shaping-overhead 0
set access-profile Access-Profile-0
set interfaces lo0 unit 0 family inet address 100.0.0.1/32 primary
set interfaces lo0 unit 0 family inet address 100.0.0.1/32 preferred
set interfaces lo0 unit 0 family inet6 address 1000::1/128 primary
set interfaces lo0 unit 0 family inet6 address 1000::1/128 preferred
set interfaces lo0 unit 0 family mpls
set interfaces ge-4/0/0 description "To R4 - Core"
set interfaces ge-4/0/0 unit 0 family inet address 21.21.14.1/24
set interfaces ge-4/0/0 unit 0 family inet6
set interfaces ge-4/0/0 unit 0 family mpls
set interfaces ge-5/0/0 description "To R4 - Core"
set interfaces ge-5/0/0 unit 0 family inet address 21.21.15.1/24
set interfaces ge-5/0/0 unit 0 family inet6
set interfaces ge-5/0/0 unit 0 family mpls
set interfaces ge-0/0/0 description "To R1 - APE1"
set interfaces ge-0/0/0 unit 0 family inet address 21.21.11.1/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-1/0/0 description "To R1 - APE1"
set interfaces ge-1/0/0 unit 0 family inet address 21.21.10.1/24
set interfaces ge-1/0/0 unit 0 family mpls
set interfaces ge-2/0/0 description "To R2 - APE2"
set interfaces ge-2/0/0 unit 0 family inet address 21.21.13.1/24
set interfaces ge-2/0/0 unit 0 family mpls
set interfaces ge-3/0/0 description "To R2 - APE2"
set interfaces ge-3/0/0 unit 0 family inet address 21.21.12.1/24
set interfaces ge-3/0/0 unit 0 family mpls
set interfaces lt-0/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-0/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
set interfaces lt-1/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-3/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-3/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-3/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-3/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces ps0 anchor-point lt-0/0/10
set interfaces ps0 flexible-vlan-tagging
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
accept inet
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
accept inet6
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
accept pppoe
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 ranges
1-256,1-4094
set interfaces ps0 auto-configure stacked-vlan-ranges authentication password joshua
set interfaces ps0 auto-configure stacked-vlan-ranges authentication username-include
user-prefix SST_USER_VLAN_DEFAULT
set interfaces ps0 auto-configure remove-when-no-subscribers
set interfaces ps0 no-gratuitous-arp-request
set interfaces ps0 unit 0 encapsulation ethernet-ccc
set routing-options ppm redistribution-timer 1
set routing-options nonstop-routing
set routing-options nsr-phantom-holdtime 1
set routing-options router-id 100.0.0.1
set routing-options forwarding-table remnant-holdtime 100
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 virtual-circuit-id 1
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 ignore-mtu-mismatch
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
minimum-interval 1000
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
multiplier 4
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
detection-time threshold 5000
set protocols mpls ipv6-tunneling
set protocols mpls interface lo0.0
set protocols mpls interface ge-0/0/0.0
set protocols mpls interface ge-1/0/0.0
set protocols mpls interface ge-2/0/0.0
set protocols mpls interface ge-3/0/0.0
set protocols mpls interface ge-4/0/0.0
set protocols mpls interface ge-5/0/0.0
set protocols ospf export EXPORT_BNG_ACCESS_INTERNAL
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set protocols ospf area 0.0.0.0 interface ge-1/0/0.0
set protocols ospf area 0.0.0.0 interface ge-2/0/0.0
set protocols ospf area 0.0.0.0 interface ge-3/0/0.0
set protocols ospf area 0.0.0.0 interface ge-4/0/0.0
set protocols ospf area 0.0.0.0 interface ge-5/0/0.0
set protocols ospf3 export EXPORT_BNG_ACCESS_INTERNAL
set protocols ospf3 area 0.0.0.0 interface lo0.0
set protocols ospf3 area 0.0.0.0 interface ge-4/0/0.0
set protocols ospf3 area 0.0.0.0 interface ge-5/0/0.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-0/0/0.0
set protocols ldp interface ge-1/0/0.0
set protocols ldp interface ge-2/0/0.0
set protocols ldp interface ge-3/0/0.0
set protocols ldp interface ge-4/0/0.0
set protocols ldp interface ge-5/0/0.0
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from family inet
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 100.0.0.0/8 or longer
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 then accept
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from family inet6
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1000:0000:0000:0000:0000:0000:0000:0000/64 or longer
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 then accept
set firewall family inet filter INPUT-V4-FILTER-01 interface-specific
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 then count COUNTER11
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 then next term
set firewall family inet filter INPUT-V4-FILTER-01 term TERM2 then service-accounting
set firewall family inet filter INPUT-V4-FILTER-01 term TERM2 then accept
set firewall family inet filter OUTPUT-V4-FILTER-01 interface-specific
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 then count COUNTER12
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 then next term
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM2 then service-accounting
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM2 then accept
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-address 255.255.255.255/32
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-port dhcp
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then count RPF-DHCP-V4-TRAFFIC
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then accept
set firewall family inet filter RPF-PASS-DHCP-V4 term DEFAULT then discard
set firewall family inet6 filter INPUT-V6-FILTER-01 interface-specific
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 then count COUNTER21
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 then next term
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM2 then service-accounting
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM2 then accept
set firewall family inet6 filter OUTPUT-V6-FILTER-01 interface-specific
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then count COUNTER22
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then next term
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then service-accounting
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then accept
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP from destination-port dhcp
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then count RPF-DHCP-V6-TRAFFIC
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then accept
set firewall family inet6 filter RPF-PASS-DHCP-V6 term DEFAULT then discard
set access radius-server 9.0.0.9 secret "$9$aOGjqAtORclz3lM8LVb"; ## SECRET-DATA
set access radius-server 9.0.0.9 timeout 20
set access radius-server 9.0.0.9 retry 5
set access radius-server 9.0.0.9 max-outstanding-requests 1000
set access radius-server 9.0.0.9 source-address 100.0.0.1
set access domain-name-server-inet 9.0.0.100
set access domain-name-server-inet 9.0.0.101
set access domain-name-server-inet 2000:abcd::9.0.0.100
set access domain-name-server-inet 2000:abcd::9.0.0.101
set access profile Access-Profile-0 authentication-order radius
set access profile Access-Profile-0 radius radius-configuration-server 9.0.0.9
set access profile Access-Profile-0 radius radius-accounting-server 9.0.0.9
set access profile Access-Profile-0 radius radius-options nas-identifier R0-BNG1
set access profile Access-Profile-0 accounting order radius
set access profile Access-Profile-0 accounting-stop-on-failure
set access profile Access-Profile-0 accounting-stop-on-access-deny
set access profile Access-Profile-0 accounting update-interval 10
set access profile Access-Profile-0 accounting statistics volume-time
set access address-assignment pool v4-pool-0 family inet network 100.0.0.0/8
set access address-assignment pool v4-pool-0 family inet range v4-range-0 low 100.16.0.1
set access address-assignment pool v4-pool-0 family inet range v4-range-0 high 100.31.255.255
set access address-assignment pool v4-pool-0 family inet dhcp-attributes maximum-lease-time 25200
set access address-assignment pool v6-pd-pool-0 family inet6 prefix 100:0:0:0:0:0:0:0/64
set access address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 prefix-length 56
set access address-assignment pool v6-na-pool-0 family inet6 dhcp-attributes maximum-lease-time 25200
set access address-protection
set access tunnel-profile Tunnel-1 tunnel 1 preference 1
set access tunnel-profile Tunnel-1 tunnel 1 remote-gateway address 105.0.0.1
set access tunnel-profile Tunnel-1 tunnel 1 source-gateway address 100.0.0.1
set access tunnel-profile Tunnel-1 tunnel 1 secret "$9S8l0x-woJDmfZygfzS36u0LxN"; ## SECRET-DATA
set access tunnel-profile Tunnel-1 tunnel 1 medium ipv4
set access tunnel-profile Tunnel-1 tunnel 1 tunnel-type l2tp
set access tunnel-profile Tunnel-1 tunnel 1 identification Tunnel-ID-1
set access domain map ABC1.COM tunnel-profile Tunnel-1
Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure the R0 BNG router:

1. Enable dynamic profiles to use multiple versions.

   You can create new versions of dynamic profiles that are currently in use by subscribers. Any subscriber that logs in following a dynamic profile modification uses the latest version of the dynamic profile. Subscribers that are already active continue to use the older version of the dynamic profile until they log out or their session terminates.

   **NOTE:** You must enable or disable dynamic profile version creation before creating or using any dynamic profiles on the router. Enabling or disabling dynamic profile version creation after dynamic profiles are configured is not supported.

   ```
[edit system]
user@host-R0# set dynamic-profile-options versioning
```

2. Create the client profile interfaces.

   ```
[edit dynamic-profiles]
user@host-R0# set client-profile interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet unnumbered-address lo0.0
user@host-R0# set client-profile interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 unnumbered-address lo0.0
```

3. Configure the dynamic PPPoE client profile.

   To enable the router to create a dynamic PPPoE subscriber interface on a PPPoE underlying interface, define the attributes of the PPPoE logical interface in a dynamic profile, and then configure the underlying interface to use the dynamic profile.

   ```
[edit dynamic-profiles]
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" no-traps
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" ppp-options chap
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" ppp-options pap
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" pppoe-options underlying-interface "$junos-underlying-interface" pppoe-options server
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" keepalives interval 30
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" family inet unnumbered-address lo0.0
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" family inet6 unnumbered-address lo0.0
```
4. Configure the CoS forwarding classes and map them to queues.

    [edit class-of-service]
    user@host-R0# set forwarding-classes queue 0 FC0
    user@host-R0# set forwarding-classes queue 1 FC1
    user@host-R0# set forwarding-classes queue 2 FC2
    user@host-R0# set forwarding-classes queue 3 FC3
    user@host-R0# set forwarding-classes queue 4 FC4
    user@host-R0# set forwarding-classes queue 5 FC5
    user@host-R0# set forwarding-classes queue 6 FC6
    user@host-R0# set forwarding-classes queue 7 FC7

5. Configure the dynamic VLAN profiles.

Create dynamic VLAN profiles, including defaults for predefined variables, dynamic physical interfaces, and CoS parameters.

a. Configure defaults for the predefined variables.

    [edit dynamic-profiles]
    user@host-R0# set vlan-prof-0 predefined-variable-defaults cos-scheduler-map SMAP_PS
    user@host-R0# set vlan-prof-0 predefined-variable-defaults cos-shaping-rate 60m
    user@host-R0# set vlan-prof-0 predefined-variable-defaults cos-guaranteed-rate 50m

b. Configure the dynamic physical interfaces.

    [edit dynamic-profiles]
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" no-traps
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" vlan-tags outer "$junos-stacked-vlan-id"
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" vlan-tags inner "$junos-vlan-id"
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet rpf-check fail-filter RPF-PASS-DHCP-V4
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet unnumbered-address lo0.0
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet6 rpf-check fail-filter RPF-PASS-DHCP-V6
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet6 unnumbered-address lo0.0
    user@host-R0# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family pppoe dynamic-profile pppoe-client-profile

c. Configure the router advertisement.

    [edit dynamic-profiles]
    user@host-R0# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" max-advertisement-interval 1800
    user@host-R0# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" min-advertisement-interval 1350
    user@host-R0# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" managed-configuration

d. Configure the CoS traffic control profiles.

    [edit dynamic-profiles]
user@host-R0# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
scheduler-map "$junos-cos-scheduler-map"
user@host-R0# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
shaping-rate "$junos-cos-shaping-rate"
user@host-R0# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
guaranteed-rate "$junos-cos-guaranteed-rate"
user@host-R0# set vlan-prof-0 class-of-service interfaces
"$junos-interface-ifd-name" unit "$junos-interface-unit"
output-traffic-control-profile TCP_PS

e. Configure the CoS scheduler maps.

[edit dynamic-profiles]
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC0 scheduler FC0_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC2 scheduler FC2_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC3 scheduler FC3_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC4 scheduler FC4_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC5 scheduler FC5_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC6 scheduler FC6_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
forwarding-class FC7 scheduler FC7_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0
forwarding-class FC0 scheduler FC0_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC2
forwarding-class FC2 scheduler FC2_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0.FC1
forwarding-class FC0 scheduler FC0_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0.FC1
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1.FC2
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1.FC2
forwarding-class FC2 scheduler FC2_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0.FC2
forwarding-class FC0 scheduler FC0_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0.FC2
forwarding-class FC2 scheduler FC2_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1.FC2
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1.FC2
forwarding-class FC2 scheduler FC2_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS
forwarding-class FC0 scheduler FC0_SCH
Configure the CoS schedulers.

[edit dynamic-profiles]
user@host-R0# set vlan-prof-0 class-of-service schedulers FC0_SCH
  transmit-rate 128k
user@host-R0# set vlan-prof-0 class-of-service schedulers FC0_SCH priority
  strict-high
user@host-R0# set vlan-prof-0 class-of-service schedulers FC1_SCH
  transmit-rate 20m
user@host-R0# set vlan-prof-0 class-of-service schedulers FC1_SCH priority
  medium-high
user@host-R0# set vlan-prof-0 class-of-service schedulers FC2_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC3_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC4_SCH
  transmit-rate 2m
user@host-R0# set vlan-prof-0 class-of-service schedulers FC4_SCH buffer-size
  percent 2
user@host-R0# set vlan-prof-0 class-of-service schedulers FC4_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC4_SCH drop-profile-map
  loss-priority low protocol any drop-profile DP_04
user@host-R0# set vlan-prof-0 class-of-service schedulers FC5_SCH
  transmit-rate 2m
user@host-R0# set vlan-prof-0 class-of-service schedulers FC5_SCH buffer-size
  percent 2
user@host-R0# set vlan-prof-0 class-of-service schedulers FC5_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC5_SCH drop-profile-map
  loss-priority low protocol any drop-profile DP_05
user@host-R0# set vlan-prof-0 class-of-service schedulers FC6_SCH
  transmit-rate 2m
user@host-R0# set vlan-prof-0 class-of-service schedulers FC6_SCH buffer-size
  percent 2
user@host-R0# set vlan-prof-0 class-of-service schedulers FC6_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC6_SCH drop-profile-map
  loss-priority low protocol any drop-profile DP_06
user@host-R0# set vlan-prof-0 class-of-service schedulers FC7_SCH
  transmit-rate 2m
user@host-R0# set vlan-prof-0 class-of-service schedulers FC7_SCH buffer-size
  percent 2
user@host-R0# set vlan-prof-0 class-of-service schedulers FC7_SCH priority
  low
user@host-R0# set vlan-prof-0 class-of-service schedulers FC7_SCH drop-profile-map
  loss-priority low protocol any drop-profile DP_07

6. Create DHCP service profiles.
a. Set the service profile variables.

[edit dynamic-profiles]
user@host-R0# set DHCP-SERVICE-PROFILE variables I_V4_FILTER
user@host-R0# set DHCP-SERVICE-PROFILE variables O_V4_FILTER
user@host-R0# set DHCP-SERVICE-PROFILE variables I_V6_FILTER
user@host-R0# set DHCP-SERVICE-PROFILE variables O_V6_FILTER

b. Create the dynamic interfaces for the DHCP service profiles and associate the filters.

[edit dynamic-profiles]
user@host-R0# set DHCP-SERVICE-PROFILE interfaces
  "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet filter input "$I_V4_FILTER"
user@host-R0# set DHCP-SERVICE-PROFILE interfaces
  "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet filter output "$O_V4_FILTER"
user@host-R0# set DHCP-SERVICE-PROFILE interfaces
  "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 filter input "$I_V6_FILTER"
user@host-R0# set DHCP-SERVICE-PROFILE interfaces
  "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 filter output "$O_V6_FILTER"

7. Create the PPPoE service profiles.

a. Set the PPPoE service profile variables.

[edit dynamic-profiles]
user@host-R0# set PPPOE-SERVICE-PROFILE variables I_V4_FILTER
user@host-R0# set PPPOE-SERVICE-PROFILE variables O_V4_FILTER
user@host-R0# set PPPOE-SERVICE-PROFILE variables I_V6_FILTER
user@host-R0# set PPPOE-SERVICE-PROFILE variables O_V6_FILTER

b. Create the dynamic interfaces for the PPPoE service profiles and associate the filters.

[edit dynamic-profiles]
user@host-R0# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
  "$junos-interface-unit" family inet filter input "$I_V4_FILTER"
user@host-R0# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
  "$junos-interface-unit" family inet filter output "$O_V4_FILTER"
user@host-R0# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
  "$junos-interface-unit" family inet6 filter input "$I_V6_FILTER"
user@host-R0# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
  "$junos-interface-unit" family inet6 filter output "$O_V6_FILTER"

8. Configure DHCP.
Unlike traditional broadband service configuration that is tied to physical interfaces such as gigabit Ethernet or aggregated Ethernet, this solution configuration relies on pseudowire interfaces and virtual Ethernet ports for broadband subscriber termination.

All dynamically created VLANs over pseudowire interfaces in this solution configuration are allowed to process DHCP messages coming in through MPLS pseudowire subscriber tunnels and arriving at pseudowire anchor interfaces.

a. Dual stack PPPoE sessions—enable DHCPv6 for PPPoE sessions.

```
[edit system]
user@host-R0# set services dhcp-local-server dhcpv6 group v6-ppp-client-0 interface pp0.0
```

b. DHCPv4 sessions—configure the IPv4 local server group for pseudowire interfaces.

Assign the group a password, a username prefix, and a dynamic profile. Associate pseudowire interfaces with the group. Two pseudowires are shown here. Repeat this step for all pseudowire interfaces.

```
[edit system]
user@host-R0# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 authentication password joshua
user@host-R0# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 authentication username-include user-prefix SST_USER_DHCP_V4_DEFAULT
user@host-R0# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 dynamic-profile client-profile
user@host-R0# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 interface ps0.0
user@host-R0# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 interface ps1.0
```

c. DHCPv6 sessions—configure the IPv6 local server group for pseudowire interfaces.

Assign the group a password, a username prefix, and a dynamic profile. Associate pseudowire interfaces with the group. This enables DHCPv6 subscriber authentication using VLAN over pseudowire subscriber interfaces. Two pseudowires are shown here. Repeat this step for all pseudowire interfaces.

```
[edit system]
user@host-R0# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication password joshua
user@host-R0# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication username-include user-prefix SST_USER_DHCP_V6_DEFAULT
user@host-R0# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 dynamic-profile client-profile
user@host-R0# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 interface ps0.0
user@host-R0# set services dhcp-local-server dhcpv6 group v6-dhcp-client-1-ACCESS-0-ps1 interface ps1.0
```

9. Configure graceful switchover and device count.
a. Configure the master Routing Engine to switch over gracefully to the backup Routing Engine without interruption to packet forwarding.

```
[edit chassis]
user@host-R0# set redundancy graceful-switchover
```

b. Configure the number of pseudowire logical devices available to the router.

```
[edit chassis]
user@host-R0# set pseudowire-service device-count 2048
```

c. Delay removal of access routes and access-internal routes after graceful Routing Engine switchover, and establish a high threshold for resource monitoring.

```
[edit system]
user@host-R0# set services subscriber-management gres-route-flush-delay
user@host-R0# set services resource-monitor high-threshold 80
```

d. Enable configuration synchronization between Routing Engines.

```
[edit system]
user@host-R0# set commit synchronize
```

10. Configure the pseudowire tunnel services at the chassis level.

Configure the amount of bandwidth for tunnel services and enable CoS queuing, scheduling, and shaping on flexible PIC concentrators 0 through 4 (4 is not used).

One flexible PIC concentrator is shown. Repeat this step for all remaining flexible PIC concentrators.

```
[edit chassis]
user@host-R0# set fpc 0 pic 0 tunnel-services bandwidth 1g
user@host-R0# set fpc 0 pic 0 traffic-manager egress-shaping-overhead 0
user@host-R0# set fpc 0 pic 1 tunnel-services bandwidth 1g
user@host-R0# set fpc 0 pic 1 traffic-manager egress-shaping-overhead 0
user@host-R0# set fpc 0 pic 2 tunnel-services bandwidth 1g
user@host-R0# set fpc 0 pic 2 traffic-manager egress-shaping-overhead 0
user@host-R0# set fpc 0 pic 3 tunnel-services bandwidth 1g
user@host-R0# set fpc 0 pic 3 traffic-manager egress-shaping-overhead 0
```

11. Attach an access profile to all DHCP and PPPoE subscribers.

When a DHCP or PPPoE subscriber logs in, the specified access profile is instantiated and the services defined in the profile are applied to the subscriber.

```
[edit]
user@host-R0# set access-profile Access-Profile-0
```

12. Configure a loopback interface, transit links, and logical tunnel interfaces.

In the context of this solution configuration, transit links are Ethernet ports connecting the BNG device to an access/aggregation device. They are the access-facing interfaces; subscriber sessions (VLAN, PPPoE, DHCP) are not terminated or anchored on them. Logical tunnel (LT) interfaces serve as termination and anchor interfaces for the logical subscriber sessions. The LT interfaces are underlying interfaces for the pseudowire subscriber interface construct, as shown in Figure 8 on page 50.
a. Configure a loopack interface.

```
[edit interfaces]
user@host-R0# set lo0 unit 0 family inet address 100.0.0.1/32 primary
user@host-R0# set lo0 unit 0 family inet address 100.0.0.1/32 preferred
user@host-R0# set lo0 unit 0 family inet6 address 1000:0::1/128 primary
user@host-R0# set lo0 unit 0 family inet6 address 1000:0::1/128 preferred
user@host-R0# set lo0 unit 0 family mpls
```

b. Configure the transit links.

```
[edit interfaces]
user@host-R0# set ge-4/0/0 description "To R4 - Core"
user@host-R0# set ge-4/0/0 unit 0 family inet address 21.21.14.1/24
user@host-R0# set ge-4/0/0 unit 0 family inet6
user@host-R0# set ge-4/0/0 unit 0 family mpls
user@host-R0# set ge-5/0/0 description "To R4 - Core"
user@host-R0# set ge-5/0/0 unit 0 family inet address 21.21.15.1/24
user@host-R0# set ge-5/0/0 unit 0 family inet6
user@host-R0# set ge-5/0/0 unit 0 family mpls
user@host-R0# set ge-0/0/0 description "To R1 - APE1"
user@host-R0# set ge-0/0/0 unit 0 family inet address 21.21.11.1/24
user@host-R0# set ge-0/0/0 unit 0 family mpls
user@host-R0# set ge-1/0/0 description "To R1 - APE1"
user@host-R0# set ge-1/0/0 unit 0 family inet address 21.21.10.1/24
user@host-R0# set ge-1/0/0 unit 0 family mpls
user@host-R0# set ge-2/0/0 description "To R2 - APE2"
user@host-R0# set ge-2/0/0 unit 0 family inet address 21.21.13.1/24
user@host-R0# set ge-2/0/0 unit 0 family mpls
user@host-R0# set ge-3/0/0 description "To R2 - APE2"
user@host-R0# set ge-3/0/0 unit 0 family inet address 21.21.12.1/24
user@host-R0# set ge-3/0/0 unit 0 family mpls
```
c. Configure the LT interfaces that correspond to the transit links.

    [edit interfaces]
    user@host-R0# set lt-0/0/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-0/1/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-0/2/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-0/3/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-1/0/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-1/1/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-1/2/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-1/3/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-2/0/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-2/1/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-2/2/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-2/3/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-3/0/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-3/1/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-3/2/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy
    user@host-R0# set lt-3/3/10 hierarchical-scheduler maximum-hierarchy-levels
                2 implicit-hierarchy

13. Configure the pseudoservice interfaces and auto-sensed dynamic VLAN.
Subscriber management supports the creation of subscriber interfaces over point-to-point MPLS pseudowires. The pseudowire subscriber interface capability enables service providers to extend an MPLS domain from the access-aggregation network to the service edge, where subscriber management is performed. Service providers can take advantage of MPLS capabilities such as failover, rerouting, and uniform MPLS label provisioning, while using a single pseudowire to service a large number of DHCP and PPPoE subscribers in the service network.

The pseudowire is a tunnel that is either an MPLS-based L2 VPN or L2 circuit. The pseudowire tunnel transports Ethernet encapsulated traffic from an access node (for example, a DSLAM or other aggregation device) to the MX Series router that hosts the subscriber management services. The termination of the pseudowire tunnel on the MX Series router is similar to a physical Ethernet termination, and is the point at which subscriber management functions are performed. A service provider can configure multiple pseudowires on a per-DSLAM basis and then provision support for a large number of subscribers on a specific pseudowire.

At the access node end of the pseudowire, the subscriber traffic can be groomed into the pseudowire in a variety of ways, limited only by the number and types of interfaces that can be stacked on the pseudowire. Specify an anchor point, which identifies the logical tunnel interface that terminates the pseudowire tunnel at the access node.

a. Configure the PS interfaces and VLAN authentication.

One pseudowire is shown. Repeat this step for all remaining pseudowires.

```
[edit interfaces]
user@host-R0# set ps0 anchor-point lt-0/0/10
user@host-R0# set ps0 flexible-vlan-tagging
user@host-R0# set ps0 auto-configure stacked-vlan-ranges dynamic-profile
vlan-prof-0 accept inet
user@host-R0# set ps0 auto-configure stacked-vlan-ranges dynamic-profile
vlan-prof-0 accept inet6
user@host-R0# set ps0 auto-configure stacked-vlan-ranges dynamic-profile
vlan-prof-0 accept pppoe
user@host-R0# set ps0 auto-configure stacked-vlan-ranges dynamic-profile
vlan-prof-0 ranges 1-256,1-4094
user@host-R0# set ps0 auto-configure stacked-vlan-ranges authentication
password joshua
user@host-R0# set ps0 auto-configure stacked-vlan-ranges authentication
username-include user-prefix SST_USER_VLAN_DEFAULT
user@host-R0# set ps0 auto-configure remove-when-no-subscribers
user@host-R0# set ps0 no-gratuitous-arp-request
user@host-R0# set ps0 unit 0 encapsulation ethernet-ccc
```

b. Configure the routing options.

```
[edit routing-options]
user@host-R0# set ppm redistribution-timer 1
user@host-R0# set nonstop-routing
user@host-R0# set nsr-phantom-holdtime 1
user@host-R0# set router-id 100.0.0.1
user@host-R0# set forwarding-table remnant-holdtime 100
```

Configuration for one pseudoservices interface (ps0.0) is shown. Repeat this step for ps1.0 through ps2047.0.

[edit protocols]
user@host-R0# set l2circuit neighbor 101.0.0.1 interface ps0.0 virtual-circuit-id 1
user@host-R0# set l2circuit neighbor 101.0.0.1 interface ps0.0 ignore-mtu-mismatch
user@host-R0# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam
  bfd-liveness-detection minimum-interval 1000
user@host-R0# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam
  bfd-liveness-detection multiplier 4
user@host-R0# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam
  bfd-liveness-detection detection-time threshold 5000

15. Configure the routing protocols.

This configuration example utilizes MPLS, OSPF, OSPFv3, and LDP on the BNG routers.

a. Configure MPLS.

[edit protocols]
user@host-R0# set mpls ipv6-tunneling
user@host-R0# set mpls interface lo0.0
user@host-R0# set mpls interface ge-0/0/0.0
user@host-R0# set mpls interface ge-1/0/0.0
user@host-R0# set mpls interface ge-2/0/0.0
user@host-R0# set mpls interface ge-3/0/0.0
user@host-R0# set mpls interface ge-4/0/0.0
user@host-R0# set mpls interface ge-5/0/0.0

b. Configure OSPF and OSPFv3.

[edit protocols]
user@host-R0# set ospf export EXPORT_BNG_ACCESS_INTERNAL
user@host-R0# set ospf area 0.0.0.0 interface lo0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-0/0/0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-1/0/0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-2/0/0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-3/0/0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-4/0/0.0
user@host-R0# set ospf area 0.0.0.0 interface ge-5/0/0.0
user@host-R0# set ospf3 export EXPORT_BNG_ACCESS_INTERNAL
user@host-R0# set ospf3 area 0.0.0.0 interface lo0.0
user@host-R0# set ospf3 area 0.0.0.0 interface ge-4/0/0.0
user@host-R0# set ospf3 area 0.0.0.0 interface ge-5/0/0.0

b. Configure LDP.

[edit protocols]
user@host-R0# set ldp interface lo0.0
user@host-R0# set ldp interface ge-0/0/0.0
user@host-R0# set ldp interface ge-1/0/0.0
user@host-R0# set ldp interface ge-2/0/0.0
user@host-R0# set ldp interface ge-3/0/0.0
user@host-R0# set ldp interface ge-4/0/0.0
user@host-R0# set ldp interface ge-5/0/0.0
16. Configure the routing policy.

```plaintext
[edit policy-options]
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from family inet
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 100.0.0.0/8 orlonger
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 then accept
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from family inet6
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1000::0000:0000:0000:0000:0000:0000/64 orlonger
user@host-R0# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 then accept
```

17. Configure the firewall filters.

a. Configure the input, output, and RPF DHCP filters for IPv4.

```plaintext
[edit firewall]
user@host-R0# set family inet filter INPUT-V4-FILTER-01 interface-specific
user@host-R0# set family inet filter INPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
user@host-R0# set family inet filter INPUT-V4-FILTER-01 term TERM1 then count COUNTER11
user@host-R0# set family inet filter INPUT-V4-FILTER-01 term TERM1 then next term
user@host-R0# set family inet filter INPUT-V4-FILTER-01 term TERM2 then service-accounting
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 interface-specific
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 then count COUNTER12
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 then next term
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 term TERM2 then service-accounting
user@host-R0# set family inet filter OUTPUT-V4-FILTER-01 term TERM2 then accept
user@host-R0# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-address 255.255.255.255/32
user@host-R0# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-port dhcp
user@host-R0# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then count RPF-DHCP-V4-TRAFFIC
user@host-R0# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then accept
user@host-R0# set family inet filter RPF-PASS-DHCP-V4 term DEFAULT then discard
```

b. Configure the input, output, and RPF DHCP filters for IPv6.

```plaintext
[edit firewall]
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 interface-specific
```
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 then count COUNTER21
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 then next term
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 term TERM2 then service-accounting
user@host-R0# set family inet6 filter INPUT-V6-FILTER-01 term TERM2 then accept
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 interface-specific
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then count COUNTER22
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then next term
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then service-accounting
user@host-R0# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then accept
user@host-R0# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP from destination-port dhcp
user@host-R0# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then count RPF-DHCP-V6-TRAFFIC
user@host-R0# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then accept
user@host-R0# set family inet6 filter RPF-PASS-DHCP-V6 term DEFAULT then discard

18. Configure access to the RADIUS server and DNS.

   [edit access]
   user@host-R0# set radius-server 9.0.0.9 secret "$9$aOGjqAtORclz3IM8LVb"; ## SECRET-DATA
   user@host-R0# set radius-server 9.0.0.9 timeout 20
   user@host-R0# set radius-server 9.0.0.9 retry 5
   user@host-R0# set radius-server 9.0.0.9 max-outstanding-requests 1000
   user@host-R0# set radius-server 9.0.0.9 source-address 100.0.0.1
   user@host-R0# set domain-name-server-inet 9.0.0.100
   user@host-R0# set domain-name-server-inet 9.0.0.101
   user@host-R0# set domain-name-server-inet6 2000:abcd::9.0.0.100
   user@host-R0# set domain-name-server-inet6 2000:abcd::9.0.0.101

19. Configure the access profiles for RADIUS authentication and accounting.

   [edit access]
   user@host-R0# set profile Access-Profile-0 authentication-order radius
   user@host-R0# set profile Access-Profile-0 radius authentication-server 9.0.0.9
   user@host-R0# set profile Access-Profile-0 radius accounting-server 9.0.0.9
   user@host-R0# set profile Access-Profile-0 radius options nas-identifier R0-BNG1
   user@host-R0# set profile Access-Profile-0 accounting options radius accounting-accounting-stop-on-failure
   user@host-R0# set profile Access-Profile-0 accounting accounting-stop-on-access-deny
   user@host-R0# set profile Access-Profile-0 accounting update-interval 10
   user@host-R0# set profile Access-Profile-0 accounting statistics volume-time
20. Configure the IPv4 and IPv6 address assignment pools.

a. Configure the IPv4 address pools.

```
[edit access]
user@host-R0# set address-assignment pool v4-pool-0 family inet network 100.0.0.0/8
user@host-R0# set address-assignment pool v4-pool-0 family inet range v4-range-0 low 100.16.0.1
user@host-R0# set address-assignment pool v4-pool-0 family inet range v4-range-0 high 100.31.255.255
user@host-R0# set address-assignment pool v4-pool-0 family inet
dhcp-attributes maximum-lease-time 25200
```

b. Configure the IPv6 address pools.

```
[edit access]
user@host-R0# set address-assignment pool v6-pd-pool-0 family inet6 prefix 1000::/64
user@host-R0# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 prefix-length 56
user@host-R0# set address-assignment pool v6-na-pool-0 family inet6
dhcp-attributes maximum-lease-time 25200
```

c. Configure address protection.

```
[edit access]
user@host-R0# set address-protection
```

21. Configure tunnel profiles.

a. Configure the attributes of a tunnel profile.

```
[edit access]
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 preference 1
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 remote-gateway address 105.0.0.1
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 source-gateway address 100.0.0.1
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 secret "$6$8l0x-woJDmfzYgfz36u0LxN"; ## SECRET-DATA
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 medium ipv4
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 tunnel-type l2tp
user@host-R0# set tunnel-profile Tunnel-1 tunnel 1 identification Tunnel-ID-1
```

b. Configure the domain maps for the tunnel profile.

The BNG LAC component uses domain maps to initiate L2TP sessions without RADIUS interaction. Optionally, RADIUS can be used for PPP authentication and to dynamically provide L2TP tunnel attributes such as tunnel destination.

```
[edit access]
user@host-R0# set domain map ABC1.COM tunnel-profile Tunnel-1
```

Results

From configuration mode, confirm your configuration by entering the following show commands:

1. Confirm the dynamic profile version creation configuration.
2. Confirm the client profile interface configuration.

```
user@host-R0# show dynamic-profiles client-profile interfaces {
  "$junos-interface-ifd-name" {
    unit "$junos-underlying-interface-unit" {
      family inet {
        unnumbered-address lo0.0;
      }
      family inet6 {
        unnumbered-address lo0.0;
      }
    }
  }
}
```

3. Confirm the dynamic PPPoE client profile configuration.

```
user@host-R0# show dynamic-profiles pppoe-client-profile interfaces {
  pp0 {
    unit "$junos-interface-unit" {
      no-traps;
      ppp-options {
        chap;
        pap;
      }
      pppoe-options {
        underlying-interface "$junos-underlying-interface";
        server;
      }
      keepalives interval 30;
      family inet {
        unnumbered-address lo0.0;
      }
      family inet6 {
        unnumbered-address lo0.0;
      }
    }
  }
}
```

4. Confirm the CoS forwarding class queue configuration.

```
user@host-R0# show class-of-service forwarding-classes
queue 0 FC0;
queue 1 FC1;
queue 2 FC2;
queue 3 FC3;
queue 4 FC4;
queue 5 FC5;
queue 6 FC6;
queue 7 FC7;
```

5. Confirm the dynamic VLAN profile configuration.
user@host-R0# show dynamic-profiles vlan-prof-0
predefined-variable-defaults {
  cos-scheduler-map SMAP_PS;
  cos-shaping-rate 60m;
  cos-guaranteed-rate 50m;
}
interfaces {
  "$junos-interface-ifd-name" {
    unit "$junos-interface-unit" {
      no-traps;
      vlan-tags outer "$junos-stacked-vlan-id" inner "$junos-vlan-id";
      family inet {
        rpf-check fail-filter RPF-PASS-DHCP-V4;
        unnumbered-address lo0.0;
      }
      family inet6 {
        rpf-check fail-filter RPF-PASS-DHCP-V6;
        unnumbered-address lo0.0;
      }
      family pppoe {
        dynamic-profile pppoe-client-profile;
      }
    }
  }
}
protocols {
  router-advertisement {
    interface "$junos-interface-name" {
      max-advertisement-interval 1800;
      min-advertisement-interval 1350;
      managed-configuration;
    }
  }
}
class-of-service {
  traffic-control-profiles {
    TCP_PS {
      scheduler-map "$junos-cos-scheduler-map";
      shaping-rate "$junos-cos-shaping-rate";
      guaranteed-rate "$junos-cos-guaranteed-rate";
    }
  }
  interfaces {
    "$junos-interface-ifd-name" {
      unit "$junos-interface-unit" {
        output-traffic-control-profile TCP_PS;
      }
    }
  }
}
scheduler-maps {
  SMAP_ALL {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
    forwarding-class FC3 scheduler FC3_SCH;
    forwarding-class FC4 scheduler FC4_SCH;
  }
}
forwarding-class FC5 scheduler FC5_SCH;
forwarding-class FC6 scheduler FC6_SCH;
forwarding-class FC7 scheduler FC7_SCH;
}
SMAP_FC0 {
    forwarding-class FC0 scheduler FC0_SCH;
}
SMAP_FC1 {
    forwarding-class FC1 scheduler FC1_SCH;
}
SMAP_FC2 {
    forwarding-class FC2 scheduler FC2_SCH;
}
SMAP_FC0_FC1 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
}
SMAP_FC1_FC2 {
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
}
SMAP_FC0_FC2 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
}
SMAP_FC0_FC1_FC2 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
}
SMAP_PS {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
    forwarding-class FC3 scheduler FC3_SCH;
}
}
schedulers {
FC0_SCH {
    transmit-rate 128k;
    priority strict-high;
}
FC1_SCH {
    transmit-rate 20m;
    priority medium-high;
}
FC2_SCH {
    priority low;
}
FC3_SCH {
    priority low;
}
FC4_SCH {
    transmit-rate 2m;
    buffer-size percent 2;
    priority low;
drop-profile-map loss-priority low protocol any drop-profile DP_04;
}
FC5_SCH {
    transmit-rate 2m;
    buffer-size percent 2;
    priority low;
    drop-profile-map loss-priority low protocol any drop-profile DP_05;
}
FC6_SCH {
    transmit-rate 2m;
    buffer-size percent 2;
    priority low;
    drop-profile-map loss-priority low protocol any drop-profile DP_06;
}
FC7_SCH {
    transmit-rate 2m;
    buffer-size percent 2;
    priority low;
    drop-profile-map loss-priority low protocol any drop-profile DP_07;
}
}
}

6. Confirm the DHCP service profile configuration.

user@host-R0# show dynamic-profiles DHCP-SERVICE-PROFILE
variables {
    I_V4_FILTER;
    O_V4_FILTER;
    I_V6_FILTER;
    O_V6_FILTER;
}
interfaces {
    "$junos-interface-ifd-name" {
        unit "$junos-underlying-interface-unit" {
            family inet {
                filter {
                    input "$I_V4_FILTER";
                    output "$O_V4_FILTER";
                }
            }
            family inet6 {
                filter {
                    input "$I_V6_FILTER";
                    output "$O_V6_FILTER";
                }
            }
        }
    }
}

7. Confirm the PPPoE service profile configuration.

user@host-R0# show dynamic-profiles PPPOE-SERVICE-PROFILE
variables {
    I_V4_FILTER;
    O_V4_FILTER;
I_V6_FILTER;
O_V6_FILTER;
}
interfaces {
  pp0 {
    unit "$junos-interface-unit" {
      family inet {
        filter {
          input "$I_V4_FILTER";
          output "$O_V4_FILTER";
        }
      }
      family inet6 {
        filter {
          input "$I_V6_FILTER";
          output "$O_V6_FILTER";
        }
      }
    }
  }
}

8. Confirm the DHCP local server configuration.

user@host-R0# show system services dhcp-local-server
dhcppv6 {
  group v6-ppp-client-0 {
    interface pp0.0;
  }
  group v4-rtClient-0-ACCESS-0-ps0 {
    authentication {
      password joshua;
      username-include {
        user-prefix SST_USER_DHCP_V4_DEFAULT;
      }
    }
    dynamic-profile client-profile;
    interface ps0.0;
    interface ps1.0;
  }
  group v6-dhcp-client-0-ACCESS-0-ps0 {
    authentication {
      password joshua;
      username-include {
        user-prefix SST_USER_DHCP_V6_DEFAULT;
      }
    }
    dynamic-profile client-profile;
    interface ps0.0;
    interface ps1.0;
  }
}

9. Confirm the graceful switchover and device count configuration.

user@host-R0# show chassis redundancy
graceful-switchover;
10. Confirm the pseudowire tunnel service configuration.

```bash
user@host-R0# show chassis fpc 0
pic 0 {
  tunnel-services {
    bandwidth 1g;
  }
  traffic-manager {
    egress-shaping-overhead 0;
  }
}
pic 1 {
  tunnel-services {
    bandwidth 1g;
  }
  traffic-manager {
    egress-shaping-overhead 0;
  }
}
pic 2 {
  tunnel-services {
    bandwidth 1g;
  }
  traffic-manager {
    egress-shaping-overhead 0;
  }
}
pic 3 {
  tunnel-services {
    bandwidth 1g;
  }
  traffic-manager {
    egress-shaping-overhead 0;
  }
}
```

11. Confirm the loopback interface, transit link, and logical tunnel interface configuration.

```bash
user@host-R0# show interfaces lo0
lo0 {
  unit 0 {
    family inet {
      address 100.0.0.1/32 {
        primary;
        preferred;
      }
    }
    family inet6 {
      address 1000:0::1/128 {
        primary;
        preferred;
      }
    }
    family mpls;
  }
```
12. Confirm the PS interface and VLAN authentication configuration.

    user@host-R0# show interfaces ps0
    anchor-point {
        lt-0/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-0/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-0/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-0/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
    }
flexible-vlan-tagging;
auto-configure {
  stacked-vlan-ranges {
    dynamic-profile vlan-prof-0 {
      accept [ inet inet6 pppoe ];
      ranges {
        1-256,1-4094;
      }
    }
  }
  authentication {
    password joshua;
    username-include {
      user-prefix SST_USER_VLAN_DEFAULT;
    }
  }
  remove-when-no-subscribers;
}
no-gratuitous-arp-request;
unit 0 {
  encapsulation ethernet-ccc;
}

user@host-R0# show routing-options
ppm {
  redistribution-timer 1;
}
nonstop-routing;
nsr-phantom-holdtime 1;
router-id 100.0.0.1;
forwarding-table {
  remnant-holdtime 100;
}

13. Confirm the L2 circuit connections.

user@host-R0# show protocols l2circuit neighbor 101.0.0.1 interface ps0.0
virtual-circuit-id 1;
ignore-mtu-mismatch;
oam {
  bfd-liveness-detection {
    minimum-interval 1000;
    multiplier 4;
    detection-time {
      threshold 5000;
    }
  }
}

14. Confirm the routing protocol configuration.

user@host-R0# show protocols
mpls {
  ipv6-tunneling;
  interface lo0.0;
interface ge-0/0/0.0;
interface ge-1/0/0.0;
interface ge-2/0/0.0;
interface ge-3/0/0.0;
interface ge-4/0/0.0;
interface ge-5/0/0.0;
}
ospf {
  export EXPORT_BNG_ACCESS_INTERNAL;
  area 0.0.0.0 {
    interface lo0.0;
    interface ge-0/0/0.0;
    interface ge-1/0/0.0;
    interface ge-2/0/0.0;
    interface ge-3/0/0.0;
    interface ge-4/0/0.0;
    interface ge-5/0/0.0;
  }
}
ospf3 {
  export EXPORT_BNG_ACCESS_INTERNAL;
  area 0.0.0.0 {
    interface lo0.0;
    interface ge-4/0/0.0;
    interface ge-5/0/0.0;
  }
}
ldp {
  interface lo0.0;
  interface ge-0/0/0.0;
  interface ge-1/0/0.0;
  interface ge-2/0/0.0;
  interface ge-3/0/0.0;
  interface ge-4/0/0.0;
  interface ge-5/0/0.0;
}

15. Confirm the policy statement configuration.

  user@host-R0# show policy-options
  policy-statement EXPORT_BNG_ACCESS_INTERNAL { 
    term 1 { 
      from { 
        family inet; 
        route-filter 100.0.0.0/8 orlonger;
      } 
      then accept; 
    } 
    term 2 { 
      from { 
        family inet6; 
        route-filter 1000:0000:0000:0000:0000:0000:0000:0000/64 orlonger; 
      } 
      then accept; 
    } 
  }
16. Confirm the firewall settings configuration.

    user@host-R0# show firewall
    family inet {
      filter INPUT-V4-FILTER-01 {
        interface-specific;
        term TERM1 {
          from {
            packet-length-except 64;
          }
          then {
            count COUNTER11;
            next term;
          }
        }
        term TERM2 {
          then {
            service-accounting;
            accept;
          }
        }
      }
      filter OUTPUT-V4-FILTER-01 {
        interface-specific;
        term TERM1 {
          from {
            packet-length-except 64;
          }
          then {
            count COUNTER12;
            next term;
          }
        }
        term TERM2 {
          then {
            service-accounting;
            accept;
          }
        }
      }
      filter RPF-PASS-DHCP-V4 {
        term ALLOW-DHCP {
          from {
            destination-address {
              255.255.255.255/32;
            }
            destination-port dhcp;
          }
          then {
            count RPF-DHCP-V4-TRAFFIC;
            accept;
          }
        }
        term DEFAULT {
          then {
            discard;
          }
        }
      }
    }
family inet6 {
  filter INPUT-V6-FILTER-01 {
    interface-specific;
    term TERM1 {
      from {
        packet-length-except 64;
      }
      then {
        count COUNTER21;
        next term;
      }
    }
    term TERM2 {
      then {
        service-accounting;
        accept;
      }
    }
  }
  filter OUTPUT-V6-FILTER-01 {
    interface-specific;
    term TERM1 {
      from {
        packet-length-except 64;
      }
      then {
        count COUNTER22;
        next term;
      }
    }
    term TERM2 {
      then {
        service-accounting;
        accept;
      }
    }
  }
  filter RPF-PASS-DHCP-V6 {
    term ALLOW-DHCP {
      from {
        destination-port dhcp;
      }
      then {
        count RPF-DHCP-V6-TRAFFIC;
        accept;
      }
    }
    term DEFAULT {
      then discard;
    }
  }
}
17. Confirm the RADIUS server and DNS access configuration.

```
user@host-R0# show access radius-server
9.0.0.9 {
    secret "$9$aOGjqAtORclz3IM8Lb"; # SECRET-DATA
    timeout 20;
    retry 5;
    max-outstanding-requests 1000;
    source-address 100.0.0.1;
}
```

```
user@host-R0# show access domain-name-server-inet
9.0.0.100;
9.0.0.101;
```

```
user@host-R0# show access domain-name-server-inet6
2000:abcd::9.0.0.100;
2000:abcd::9.0.0.101;
```

18. Confirm the access profile configuration.

```
user@host-R0# show access profile Access-Profile-0
authentication-order radius;
radius {
    authentication-server 9.0.0.9;
    accounting-server 9.0.0.9;
    options {
        nas-identifier R0-BNG1;
    }
}
accounting {
    order radius;
    accounting-stop-on-failure;
    accounting-stop-on-access-deny;
    update-interval 10;
    statistics volume-time;
}
```

19. Confirm the address assignment pool configuration.

```
user@host-R0# show access address-assignment
pool v4-pool-0 {
    family inet {
        network 100.0.0.0/8;
        range v4-range-0 {
            low 100.16.0.1;
            high 100.31.255.255;
        }
        dhcp-attributes {
            maximum-lease-time 25200;
        }
    }
}
pool v6-pd-pool-0 {
    family inet6 {
        prefix 1000:0000:0000:0000:0000:0000:0000:0000/64;
        range v6-range-0 prefix-length 56;
    }
}
```
user@host-R0# show access address-protection
address-protection;

20. Confirm the tunnel profile configuration.

user@host-R0# show access tunnel-profile Tunnel-1

tunnel 1 {
  preference 1;
  remote-gateway {
    address 105.0.0.1;
  }
  source-gateway {
    address 100.0.0.1;
  }
  secret "$9$8l0x-woJDmfzYgfz36uOLxN"; ## SECRET-DATA
  medium ipv4;
  tunnel-type l2tp;
  identification Tunnel-ID-1;
}

user@host-R0# show access domain
map ABC1.COM {
  tunnel-profile Tunnel-1;
}

Configuring BNG Router, R3

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

    set system dynamic-profile-options versioning
    set dynamic-profiles client-profile interfaces "$junos-interface-ifd-name" unit
      "$junos-underlying-interface-unit" family inet unnumbered-address lo0.0
    set dynamic-profiles client-profile interfaces "$junos-interface-ifd-name" unit
      "$junos-underlying-interface-unit" family inet6 unnumbered-address lo0.0
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      no-traps
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      ppp-options chap
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      ppp-options pap
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      pppoe-options underlying-interface "$junos-underlying-interface"
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      pppoe-options server
    set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
      keepalives interval 30
set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
   family inet unnumbered-address lo0.0
set dynamic-profiles pppoe-client-profile interfaces pp0 unit "$junos-interface-unit"
   family inet6 unnumbered-address lo0.0
set class-of-service forwarding-classes queue 0 FC0
set class-of-service forwarding-classes queue 1 FC1
set class-of-service forwarding-classes queue 2 FC2
set class-of-service forwarding-classes queue 3 FC3
set class-of-service forwarding-classes queue 4 FC4
set class-of-service forwarding-classes queue 5 FC5
set class-of-service forwarding-classes queue 6 FC6
set class-of-service forwarding-classes queue 7 FC7
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-scheduler-map
   SMAP_PS
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-shaping-rate 60m
set dynamic-profiles vlan-prof-0 predefined-variable-defaults cos-guaranteed-rate 50m
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" no-traps
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" vlan-tags outer "$junos-stacked-vlan-id"
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" vlan-tags inner "$junos-vlan-id"
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" family inet rpf-check fail-filter RPF-PASS-DHCP-V4
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" family inet6 unnumbered-address lo0.0
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" family inet6 rpf-check fail-filter RPF-PASS-DHCP-V6
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" family inet6 unnumbered-address lo0.0
set dynamic-profiles vlan-prof-0 interfaces "$junos-interface-ifd-name" unit
   "$junos-interface-unit" family pppoe dynamic-profile pppoe-client-profile
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
   "$junos-interface-name" max-advertisement-interval 1800
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
   "$junos-interface-name" min-advertisement-interval 1350
set dynamic-profiles vlan-prof-0 protocols router-advertisement interface
   "$junos-interface-name" managed-configuration
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
   scheduler-map "$junos-cos-scheduler-map"
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
   shaping-rate "$junos-cos-shaping-rate"
set dynamic-profiles vlan-prof-0 class-of-service traffic-control-profiles TCP_PS
   guaranteed-rate "$junos-cos-guaranteed-rate"
set dynamic-profiles vlan-prof-0 class-of-service interfaces "$junos-interface-ifd-name"
   unit "$junos-interface-unit" output-traffic-control-profile TCP_PS
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
   forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
   forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
   forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
   forwarding-class FC3 scheduler FC3_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
   forwarding-class FC4 scheduler FC4_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC5 scheduler FC5_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC6 scheduler FC6_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_ALL
  forwarding-class FC7 scheduler FC7_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC2
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS
  forwarding-class FC0 scheduler FC0_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS
  forwarding-class FC1 scheduler FC1_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS
  forwarding-class FC2 scheduler FC2_SCH
set dynamic-profiles vlan-prof-0 class-of-service scheduler-maps SMAP_PS
  forwarding-class FC3 scheduler FC3_SCH
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC0_SCH transmit-rate
  128k
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC0_SCH priority strict-high
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC1_SCH transmit-rate 20m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC1_SCH priority medium-high
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC2_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC3_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH buffer-size percent
  2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC4_SCH drop-profile-map
  loss-priority low protocol any drop-profile DP_04
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH buffer-size percent
  2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC5_SCH drop-profile-map
loss-priority low protocol any drop-profile DP_05
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC6_SCH drop-profile-map
loss-priority low protocol any drop-profile DP_06
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH transmit-rate 2m
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH buffer-size percent 2
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH priority low
set dynamic-profiles vlan-prof-0 class-of-service schedulers FC7_SCH drop-profile-map
set dynamic-profiles DHCP-SERVICE-PROFILE variables I_V4_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables O_V4_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables I_V6_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE variables O_V6_FILTER
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name"
unit "$junos-underlying-interface-unit" family inet filter input "$I_V4_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name"
unit "$junos-underlying-interface-unit" family inet filter output "$O_V4_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name"
unit "$junos-underlying-interface-unit" family inet6 filter input "$I_V6_FILTER"
set dynamic-profiles DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name"
unit "$junos-underlying-interface-unit" family inet6 filter output "$O_V6_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE variables I_V4_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables O_V4_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables I_V6_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE variables O_V6_FILTER
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit
"$junos-interface-unit" family inet filter input "$I_V4_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit
"$junos-interface-unit" family inet filter output "$O_V4_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit
"$junos-interface-unit" family inet6 filter input "$I_V6_FILTER"
set dynamic-profiles PPPOE-SERVICE-PROFILE interfaces pp0 unit
"$junos-interface-unit" family inet6 filter output "$O_V6_FILTER"
set system ports console log-out-on-disconnect
set system services dhcp-local-server dhcpv6 group v6-ppp-client-0 interface pp0.0
set system services dhcp-local-server v4-rtClient-0-ACCESS-0-ps0 authentication password joshua
set system services dhcp-local-server v4-rtClient-0-ACCESS-0-ps0 authentication username-include user-prefix SST_USER_DHCP_V4_DEFAULT
set system services dhcp-local-server dhcpv6 group v4-rtClient-0-ACCESS-0-ps0 dynamic-profile client-profile
set system services dhcp-local-server v4-rtClient-0-ACCESS-0-ps0 interface ps0.0
set system services dhcp-local-server v4-rtClient-0-ACCESS-0-ps0 interface ps0.0
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication password joshua
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 authentication username-include user-prefix SST_USER_DHCP_V6_DEFAULT
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0 dynamic-profile client-profile
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0
interface ps0.0
set system services dhcp-local-server dhcpv6 group v6-dhcp-client-1-ACCESS-0-ps1
interface ps1.0
set chassis redundancy graceful-switchover
set chassis pseudowire-service device-count 2048
set system services subscriber-management gres-route-flush-delay
set system services resource-monitor high-threshold 80
set system commit synchronize
set chassis fpc 0 pic 0 tunnel-services bandwidth 1g
set chassis fpc 0 pic 1 tunnel-services bandwidth 1g
set chassis fpc 0 pic 2 tunnel-services bandwidth 1g
set chassis fpc 0 pic 3 tunnel-services bandwidth 1g
set access-profile Access-Profile-0
set interfaces lo0 unit 0 family inet address 103.0.0.1/32 primary
set interfaces lo0 unit 0 family inet address 103.0.0.1/32 preferred
set interfaces lo0 unit 0 family inet6 address 1003:0::1/128 primary
set interfaces lo0 unit 0 family inet6 address 1003:0::1/128 preferred
set interfaces lo0 unit 0 family mpls
set interfaces ge-4/0/0 description "To R2 - Core"
set interfaces ge-4/0/0 unit 0 family inet address 21.21.40.1/24
set interfaces ge-4/0/0 unit 0 family inet6
set interfaces ge-4/0/0 unit 0 family mpls
set interfaces ge-0/0/0 description "To R1 - APE1"
set interfaces ge-0/0/0 unit 0 family inet address 21.21.20.2/24
set interfaces ge-0/0/0 unit 0 family mpls
set interfaces ge-1/0/0 description "To R1 - APE1"
set interfaces ge-1/0/0 unit 0 family inet address 21.21.21.2/24
set interfaces ge-1/0/0 unit 0 family mpls
set interfaces ge-2/0/0 description "To R2 - APE2"
set interfaces ge-2/0/0 unit 0 family inet address 21.21.30.2/24
set interfaces ge-2/0/0 unit 0 family mpls
set interfaces ge-3/0/0 description "To R2 - APE2"
set interfaces ge-3/0/0 unit 0 family inet address 21.21.31.2/24
set interfaces ge-3/0/0 unit 0 family mpls
set interfaces lt-0/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-0/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-0/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-0/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-1/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-1/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-1/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-1/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
implicit-hierarchy
set interfaces lt-2/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces lt-2/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces lt-3/0/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces lt-3/1/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces lt-3/2/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces lt-3/3/10 hierarchical-scheduler maximum-hierarchy-levels 2
    implicit-hierarchy
set interfaces ps0 anchor-point lt-0/0/10
set interfaces ps0 flexible-vlan-tagging
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
    accept inet
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
    accept inet6
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
    accept pppoe
set interfaces ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0
    ranges 1-256,1-4094
set interfaces ps0 auto-configure stacked-vlan-ranges authentication password joshua
set interfaces ps0 auto-configure stacked-vlan-ranges authentication username-include
    user-prefix SST_USER_VLAN_DEFAULT
set interfaces ps0 auto-configure remove-when-no-subscribers
set interfaces ps0 no-gratuitous-arp-request
set interfaces ps0 unit 0 encapsulation ethernet-ccc
set routing-options ppm redistribution-timer 1
set routing-options nonstop-routing
set routing-options nsr-phantom-holdtime 1
set routing-options router-id 103.0.0.1
set routing-options forwarding-table remnant-holdtime 100
set protocols l2circuit forwarding-table remnant-holdtime 100
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 virtual-circuit-id 1
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 ignore-mtu-mismatch
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
    minimum-interval 1000
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
    multiplier 4
set protocols l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection
    detection-time threshold 5000
set protocols mpls ipv6-tunneling
set protocols mpls interface lo0.0
set protocols mpls interface ge-0/0/0.0
set protocols mpls interface ge-1/0/0.0
set protocols mpls interface ge-2/0/0.0
set protocols mpls interface ge-3/0/0.0
set protocols mpls interface ge-4/0/0.0
set protocols ospf export EXPORT_BNG_ACCESS_INTERNAL
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/0.0
set protocols ospf area 0.0.0.0 interface ge-1/0/0.0
set protocols ospf area 0.0.0.0 interface ge-2/0/0.0
set protocols ospf area 0.0.0.0 interface ge-3/0/0.0
set protocols ospf area 0.0.0.0 interface ge-4/0/0.0
set protocols ospf3 export EXPORT_BNG_ACCESS_INTERNAL
set protocols ospf3 area 0.0.0.0 interface lo0.0
set protocols ospf3 area 0.0.0.0 interface ge-4/0/0.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-0/0/0.0
set protocols ldp interface ge-1/0/0.0
set protocols ldp interface ge-2/0/0.0
set protocols ldp interface ge-3/0/0.0
set protocols ldp interface ge-4/0/0.0
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from family inet
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 100.0.0.0/8 orlonger
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 103.0.0.0/8 orlonger
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 then accept
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from family inet6
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1000::0000:0000:0000:0000:0000:0000:0000/64 orlonger
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1003::0000:0000:0000:0000:0000:0000:0000/64 orlonger
set policy-options policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 then accept
set firewall family inet filter INPUT-V4-FILTER-01 interface-specific
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 then count COUNTER11
set firewall family inet filter INPUT-V4-FILTER-01 term TERM1 then next term
set firewall family inet filter INPUT-V4-FILTER-01 term TERM2 then service-accounting
set firewall family inet filter INPUT-V4-FILTER-01 term TERM2 then accept
set firewall family inet filter OUTPUT-V4-FILTER-01 interface-specific
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 then count COUNTER12
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM1 then next term
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM2 then service-accounting
set firewall family inet filter OUTPUT-V4-FILTER-01 term TERM2 then accept
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-address 255.255.255.255/32
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-port dhcp
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then count RPF-DHCP-V4-TRAFFIC
set firewall family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then accept
set firewall family inet filter RPF-PASS-DHCP-V4 term DEFAULT then discard
set firewall family inet6 filter INPUT-V6-FILTER-01 interface-specific
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 then count COUNTER21
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM1 then next term
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM2 then service-accounting
set firewall family inet6 filter INPUT-V6-FILTER-01 term TERM2 then accept
set firewall family inet6 filter OUTPUT-V6-FILTER-01 interface-specific
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then count COUNTER22
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then next term
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then service-accounting
set firewall family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then accept
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP from
destination-port dhcp
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then count
RPF-DHCP-V6-TRAFFIC
set firewall family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then accept
set firewall family inet6 filter RPF-PASS-DHCP-V6 term DEFAULT then discard
set access radius-server 9.0.0.9 secret "$9$aOGjqAtORctz3IM8LVb$"; ## SECRET-DATA
set access radius-server 9.0.0.9 timeout 20
set access radius-server 9.0.0.9 retry 5
set access radius-server 9.0.0.9 max-outstanding-requests 1000
set access radius-server 9.0.0.9 source-address 103.0.0.1
set access domain-name-server-inet 9.0.0.100
set access domain-name-server-inet 9.0.0.101
set access domain-name-server-inet6 2000:abcd::9.0.0.100
set access domain-name-server-inet6 2000:abcd::9.0.0.101
set access profile Access-Profile-0 authentication-order radius
set access profile Access-Profile-0 radius authentication-server 9.0.0.9
set access profile Access-Profile-0 radius accounting-server 9.0.0.9
set access profile Access-Profile-0 radius options nas-identifier R3-BNG1
set access profile Access-Profile-0 accounting order radius
set access profile Access-Profile-0 accounting accounting-stop-on-failure
set access profile Access-Profile-0 accounting accounting-stop-on-access-deny
set access profile Access-Profile-0 accounting update-interval 10
set access profile Access-Profile-0 accounting statistics volume-time
set access address-assignment pool v4-pool-0 family inet network 103.0.0.0/8
set access address-assignment pool v4-pool-0 family inet range v4-range-0 low 103.16.0.1
set access address-assignment pool v4-pool-0 family inet range v4-range-0 high
103.31.255.255
set access address-assignment pool v4-pool-0 family inet dhcp-attributes
maximum-lease-time 99999
set access address-assignment pool v6-na-pool-0 family inet6 prefix
1003:0000:0000:0000:0000:0000:0000:0000/64
set access address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low
1003::/128
set access address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low
1003::ffff:fff/128
set access address-protection

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure the R3 BNG router:

1. Enable dynamic profiles to use multiple versions.

You can create new versions of dynamic profiles that are currently in use by subscribers. Any subscriber that logs in following a dynamic profile modification uses the latest version of the dynamic profile. Subscribers that are already active continue to use the older version of the dynamic profile until they log out or their session terminates.
NOTE: You must enable or disable dynamic profile version creation before creating or using any dynamic profiles on the router. Enabling or disabling dynamic profile version creation after dynamic profiles are configured is not supported.

2. Create the client profile interfaces.

   [edit dynamic-profiles]
   user@host-R3# set client-profile interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet unnumbered-address lo0.0
   user@host-R3# set client-profile interfaces "$junos-interface-ifd-name" unit "$junos-underlying-interface-unit" family inet6 unnumbered-address lo0.0

3. Configure the dynamic PPPoE client profile.

   To enable the router to create a dynamic PPPoE subscriber interface on a PPPoE underlying interface, define the attributes of the PPPoE logical interface in a dynamic profile, and then configure the underlying interface to use the dynamic profile.

   [edit dynamic-profiles]
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" no-traps
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" ppp-options chap
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" ppp-options pap
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" pppoe-options underlying-interface "$junos-underlying-interface" pppoe-options server
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" keepalives interval 30
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" family inet unnumbered-address lo0.0
   user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" family inet6 unnumbered-address lo0.0

4. Configure the CoS forwarding classes and map them to queues.

   [edit class-of-service]
   user@host-R3# set forwarding-classes queue 0 FC0
   user@host-R3# set forwarding-classes queue 1 FC1
   user@host-R3# set forwarding-classes queue 2 FC2
   user@host-R3# set forwarding-classes queue 3 FC3
   user@host-R3# set forwarding-classes queue 4 FC4
   user@host-R3# set forwarding-classes queue 5 FC5
   user@host-R3# set forwarding-classes queue 6 FC6
   user@host-R3# set forwarding-classes queue 7 FC7

5. Configure the dynamic VLAN profiles.
Create dynamic VLAN profiles, including defaults for predefined variables, dynamic physical interfaces, and CoS parameters.

a. Configure defaults for the predefined variables.

```
[edit dynamic-profiles]
user@host-R3# set vlan-prof-0 predefined-variable-defaults cos-scheduler-map SMAP_PS
user@host-R3# set vlan-prof-0 predefined-variable-defaults cos-shaping-rate 60m
user@host-R3# set vlan-prof-0 predefined-variable-defaults cos-guaranteed-rate 50m
```

b. Configure the dynamic physical interfaces.

```
[edit dynamic-profiles]
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" no-traps
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" vlan-tags outer "$junos-stacked-vlan-id"
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" vlan-tags inner "$junos-vlan-id"
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet rpf-check fail-filter RPF-PASS-DHCP-V4
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet unnumbered-address lo0.0
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet6 rpf-check fail-filter RPF-PASS-DHCP-V6
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet6 unnumbered-address lo0.0
user@host-R3# set vlan-prof-0 interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family pppoe dynamic-profile pppoe-client-profile
```

c. Configure router advertisement.

```
[edit dynamic-profiles]
user@host-R3# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" max-advertisement-interval 1800
user@host-R3# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" min-advertisement-interval 1350
user@host-R3# set vlan-prof-0 protocols router-advertisement interface "$junos-interface-name" managed-configuration
```

d. Configure the CoS traffic control profiles.

```
[edit dynamic-profiles]
user@host-R3# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS scheduler-map "$junos-cos-scheduler-map"
user@host-R3# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS shaping-rate "$junos-cos-shaping-rate"
user@host-R3# set vlan-prof-0 class-of-service traffic-control-profiles TCP_PS guaranteed-rate "$junos-cos-guaranteed-rate"
user@host-R3# set vlan-prof-0 class-of-service interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" output-traffic-control-profile TCP_PS
```

e. Configure the CoS scheduler maps.

```
[edit dynamic-profiles]
```
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC3 scheduler FC3_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC4 scheduler FC4_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC5 scheduler FC5_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC6 scheduler FC6_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_ALL forwarding-class FC7 scheduler FC7_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0 forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1 forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC2 forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC3 forwarding-class FC3 scheduler FC3_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC4 forwarding-class FC4 scheduler FC4_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC5 forwarding-class FC5 scheduler FC5_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC6 forwarding-class FC6 scheduler FC6_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC7 forwarding-class FC7 scheduler FC7_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1 forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1 forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2 forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC2 forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2 forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC2 forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC3 forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC3 forwarding-class FC3 scheduler FC3_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC3 forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC1_FC3 forwarding-class FC3 scheduler FC3_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC2_FC3 forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC2_FC3 forwarding-class FC3 scheduler FC3_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC2 scheduler FC2_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class FC3 scheduler FC3_SCH

f. Configure the CoS schedulers.

[edit dynamic-profiles]
user@host-R3# set vlan-prof-0 class-of-service schedulers FC0_SCH transmit-rate 128k
user@host-R3# set vlan-prof-0 class-of-service schedulers FC0_SCH priority strict-high
6. Create DHCP service profiles.

   a. Set the service profile variables.

```
[edit dynamic-profiles]
user@host-R3# set DHCP-SERVICE-PROFILE variables I_V4_FILTER
user@host-R3# set DHCP-SERVICE-PROFILE variables O_V4_FILTER
user@host-R3# set DHCP-SERVICE-PROFILE variables I_V6_FILTER
user@host-R3# set DHCP-SERVICE-PROFILE variables O_V6_FILTER
```

   b. Create the dynamic interfaces for the DHCP service profiles and associate the filters.

```
[edit dynamic-profiles]
```
7. Create the PPPoE service profiles.
   a. Set the PPPoE service profile variables.
      [edit dynamic-profiles]
      user@host-R3# set PPPOE-SERVICE-PROFILE variables I_V4_FILTER
      user@host-R3# set PPPOE-SERVICE-PROFILE variables O_V4_FILTER
      user@host-R3# set PPPOE-SERVICE-PROFILE variables I_V6_FILTER
      user@host-R3# set PPPOE-SERVICE-PROFILE variables O_V6_FILTER
   b. Create the dynamic interfaces for the PPPoE service profiles and associate the filters.
      [edit dynamic-profiles]
      user@host-R3# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
      "$junos-interface-unit" family inet filter input "$I_V4_FILTER"
      user@host-R3# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
      "$junos-interface-unit" family inet filter output "$O_V4_FILTER"
      user@host-R3# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
      "$junos-interface-unit" family inet6 filter input "$I_V6_FILTER"
      user@host-R3# set PPPOE-SERVICE-PROFILE interfaces pp0 unit
      "$junos-interface-unit" family inet6 filter output "$O_V6_FILTER"

8. Configure DHCP.
   Unlike traditional broadband service configuration that is tied to physical interfaces such as gigabit Ethernet or aggregated Ethernet, this solution configuration relies on pseudowire interfaces and virtual Ethernet ports for broadband subscriber termination.
   All dynamically created VLANs over pseudowire interfaces in this solution configuration are allowed to process DHCP messages coming in through MPLS pseudowire subscriber tunnels and arriving at pseudowire anchor interfaces.
   a. Dual stack PPPoE sessions—enable DHCPv6 for PPPoE sessions.
      [edit system]
      user@host-R3# set services dhcp-local-server dhcpv6 group v6-ppp-client-0
      interface pp0.0
   b. DHCPv4 sessions—configure the IPv4 local server group for pseudowire interfaces.
      Assign the group a password, a username prefix, and a dynamic profile. Associate pseudowire interfaces with the group. Two pseudowires are shown here. Repeat this step for all pseudowire interfaces.
c. DHCPv6 sessions—configure the IPv6 local server group for pseudowire interfaces.

Assign the group a password, a username prefix, and a dynamic profile. Associate pseudowire interfaces with the group. This enables DHCPv6 subscriber authentication using VLAN over pseudowire subscriber interfaces. Two pseudowires are shown here. Repeat this step for all pseudowire interfaces.

9. Configure graceful switchover and device count.
   a. Configure the master Routing Engine to switch over gracefully to the backup Routing Engine without interruption to packet forwarding.

   [edit chassis]
   user@host-R3# set redundancy graceful-switchover

   b. Configure the number of pseudowire logical devices available to the router.

   [edit chassis]
   user@host-R3# set pseudowire-service device-count 2048

   c. Delay removal of access routes and access-internal routes after graceful Routing Engine switchover, and establish a high threshold for resource monitoring.

   [edit system]
   user@host-R3# set services subscriber-management gres-route-flush-delay
   user@host-R3# set services resource-monitor high-threshold 80

   d. Enable configuration synchronization between Routing Engines.

   [edit system]
   user@host-R3# set commit synchronize

10. Configure the pseudowire tunnel services at the chassis level.

Configure the amount of bandwidth for tunnel services on flexible PIC concentrators 0 through 3.

One flexible PIC concentrator is shown. Repeat this step for all remaining flexible PIC concentrators.

```
[edit chassis]
user@host-R3# set fpc 0 pic 0 tunnel-services bandwidth 1g
user@host-R3# set fpc 0 pic 1 tunnel-services bandwidth 1g
user@host-R3# set fpc 0 pic 2 tunnel-services bandwidth 1g
user@host-R3# set fpc 0 pic 3 tunnel-services bandwidth 1g
```

11. Attach an access profile to all DHCP subscribers.

When a DHCP subscriber logs in, the specified access profile is instantiated and the services defined in the profile are applied to the subscriber.

```
[edit]
user@host-R3# set access-profile Access-Profile-0
```

12. Configure the transit links and logical tunnel interfaces.

a. Configure a loopack interface.

```
[edit interfaces]
user@host-R3# set lo0 unit 0 family inet address 103.0.0.1/32 primary
user@host-R3# set lo0 unit 0 family inet address 103.0.0.1/32 preferred
user@host-R3# set lo0 unit 0 family inet6 address 1003:0::1/128 primary
user@host-R3# set lo0 unit 0 family inet6 address 1003:0::1/128 preferred
user@host-R3# set lo0 unit 0 family mpls
```

b. Configure the transit links.

```
[edit interfaces]
user@host-R3# set ge-4/0/0 description "To R2 - Core"
user@host-R3# set ge-4/0/0 unit 0 family inet address 21.21.40.1/24
user@host-R3# set ge-4/0/0 unit 0 family inet6
user@host-R3# set ge-4/0/0 unit 0 family mpls
user@host-R3# set ge-0/0/0 description "To R1 - APE1"
user@host-R3# set ge-0/0/0 unit 0 family inet address 21.21.20.2/24
user@host-R3# set ge-0/0/0 unit 0 family mpls
user@host-R3# set ge-1/0/0 description "To R1 - APE1"
user@host-R3# set ge-1/0/0 unit 0 family inet address 21.21.21.2/24
user@host-R3# set ge-1/0/0 unit 0 family mpls
user@host-R3# set ge-2/0/0 description "To R2 - APE2"
user@host-R3# set ge-2/0/0 unit 0 family inet address 21.21.30.2/24
user@host-R3# set ge-2/0/0 unit 0 family mpls
user@host-R3# set ge-3/0/0 description "To R2 - APE2"
user@host-R3# set ge-3/0/0 unit 0 family inet address 21.21.31.2/24
user@host-R3# set ge-3/0/0 unit 0 family mpls
```

c. Configure the LT interfaces that correspond to the transit links.

```
[edit interfaces]
user@host-R3# set lt-0/0/10 hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy
user@host-R3# set lt-0/1/10 hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy
user@host-R3# set lt-0/2/10 hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy
```
user@host-R3# set lt-0/3/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-1/0/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-1/1/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-1/2/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-1/3/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-2/0/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-2/1/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-2/2/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-2/3/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-3/0/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-3/1/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-3/2/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy
user@host-R3# set lt-3/3/10 hierarchical-scheduler maximum-hierarchy-levels
  2 implicit-hierarchy

13. Configure the PS interfaces and VLAN authentication.

Subscriber management supports the creation of subscriber interfaces over point-to-point MPLS pseudowires. The pseudowire subscriber interface capability enables service providers to extend an MPLS domain from the access-aggregation network to the service edge, where subscriber management is performed. Service providers can take advantage of MPLS capabilities such as failover, rerouting, and uniform MPLS label provisioning, while using a single pseudowire to service a large number of DHCP and PPPoE subscribers in the service network.

The pseudowire is a tunnel that is either an MPLS-based L2 VPN or L2 circuit. The pseudowire tunnel transports Ethernet encapsulated traffic from an access node (for example, a DSLAM or other aggregation device) to the MX Series router that hosts the subscriber management services. The termination of the pseudowire tunnel on the MX Series router is similar to a physical Ethernet termination, and is the point at which subscriber management functions are performed. A service provider can configure multiple pseudowires on a per-DSLAM basis and then provision support for a large number of subscribers on a specific pseudowire.

At the access node end of the pseudowire, the subscriber traffic can be groomed into the pseudowire in a variety of ways, limited only by the number and types of interfaces that can be stacked on the pseudowire. Specify an anchor point, which identifies the logical tunnel interface that terminates the pseudowire tunnel at the access node.

a. Configure the PS interfaces and VLAN authentication.
One pseudowire is shown. Repeat this step for all remaining pseudowires.

[edit interfaces]
user@host-R3# set ps0 anchor-point lt-0/0/10
user@host-R3# set ps0 flexible-vlan-tagging
user@host-R3# set ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 accept inet
user@host-R3# set ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 accept inet6
user@host-R3# set ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 accept pppoe
user@host-R3# set ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 ranges 1-256,1-4094
user@host-R3# set ps0 auto-configure stacked-vlan-ranges dynamic-profile vlan-prof-0 ranges 1-256,1-4094
user@host-R3# set ps0 auto-configure stacked-vlan-ranges authentication password joshua
user@host-R3# set ps0 auto-configure stacked-vlan-ranges authentication username-include user-prefix SST_USER_VLAN_DEFAULT
user@host-R3# set ps0 auto-configure remove-when-no-subscribers
user@host-R3# set ps0 no-gratuitous-arp-request
user@host-R3# set ps0 unit 0 encapsulation ethernet-ccc

b. Configure the routing options.

[edit routing-options]
user@host-R3# set ppm redistribution-timer 1
user@host-R3# set nonstop-routing
user@host-R3# set nsr-phantom-holdtime 1
user@host-R3# set router-id 103.0.0.1
user@host-R3# set forwarding-table remnant-holdtime 100


Configuration for one pseudoservices interface (ps0.0) is shown. Repeat this step for ps1.0 through ps2047.0.

[edit protocols]
user@host-R3# set l2circuit neighbor 101.0.0.1 interface ps0.0 virtual-circuit-id 1
user@host-R3# set l2circuit neighbor 101.0.0.1 interface ps0.0 ignore-mtu-mismatch
user@host-R3# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection minimum-interval 1000
user@host-R3# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection multiplier 4
user@host-R3# set l2circuit neighbor 101.0.0.1 interface ps0.0 oam bfd-liveness-detection detection-time threshold 5000

15. Configure the routing protocols.

This configuration example utilizes MPLS, OSPF, OSPFv3, and LDP on the BNG routers.

a. Configure MPLS.

[edit protocols]
user@host-R3# set mpls ipv6-tunneling
user@host-R3# set mpls interface lo0.0
user@host-R3# set mpls interface ge-0/0/0.0
user@host-R3# set mpls interface ge-1/0/0.0
user@host-R3# set mpls interface ge-2/0/0.0
user@host-R3# set mpls interface ge-3/0/0.0
user@host-R3# set mpls interface ge-4/0/0.0

b. Configure OSPF and OSPFv3.

[edit protocols]
user@host-R3# set ospf export EXPORT_BNG_ACCESS_INTERNAL
user@host-R3# set ospf area 0.0.0.0 interface lo0.0
user@host-R3# set ospf area 0.0.0.0 interface ge-0/0/0.0
user@host-R3# set ospf area 0.0.0.0 interface ge-1/0/0.0
user@host-R3# set ospf area 0.0.0.0 interface ge-2/0/0.0
user@host-R3# set ospf area 0.0.0.0 interface ge-3/0/0.0
user@host-R3# set ospf area 0.0.0.0 interface ge-4/0/0.0
user@host-R3# set ospfv3 export EXPORT_BNG_ACCESS_INTERNAL
user@host-R3# set ospfv3 area 0.0.0.0 interface lo0.0
user@host-R3# set ospfv3 area 0.0.0.0 interface ge-4/0/0.0

c. Configure LDP.

[edit protocols]
user@host-R3# set ldp interface lo0.0
user@host-R3# set ldp interface ge-0/0/0.0
user@host-R3# set ldp interface ge-1/0/0.0
user@host-R3# set ldp interface ge-2/0/0.0
user@host-R3# set ldp interface ge-3/0/0.0
user@host-R3# set ldp interface ge-4/0/0.0

16. Configure the routing policy.

[edit policy-options]
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from family inet
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 100.0.0.0/8 orlonger
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 from route-filter 103.0.0.0/8 orlonger
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 1 then accept
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from family inet6
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1000:0000:0000:0000:0000:0000:0000:0000/64 orlonger
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 from route-filter 1003:0000:0000:0000:0000:0000:0000:0000/64 orlonger
user@host-R3# set policy-statement EXPORT_BNG_ACCESS_INTERNAL term 2 then accept

17. Configure the firewall filters.

a. Configure the input, output, and RPF DHCP filters for IPv4.

[edit firewall]
user@host-R3# set family inet filter INPUT-V4-FILTER-01 interface-specific
user@host-R3# set family inet filter INPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
user@host-R3# set family inet filter INPUT-V4-FILTER-01 term TERM1 then count COUNTER11
user@host-R3# set family inet filter INPUT-V4-FILTER-01 term TERM1 then next term
user@host-R3# set family inet filter INPUT-V4-FILTER-01 term TERM2 then service-accounting
user@host-R3# set family inet filter INPUT-V4-FILTER-01 term TERM2 then accept
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 interface-specific
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 from packet-length-except 64
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 then count COUNTER12
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 term TERM1 then next term
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 term TERM2 then service-accounting
user@host-R3# set family inet filter OUTPUT-V4-FILTER-01 term TERM2 then accept
user@host-R3# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-address 255.255.255.255/32
user@host-R3# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP from destination-port dhcp
user@host-R3# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then count RPF-DHCP-V4-TRAFFIC
user@host-R3# set family inet filter RPF-PASS-DHCP-V4 term ALLOW-DHCP then accept
user@host-R3# set family inet filter RPF-PASS-DHCP-V4 term DEFAULT then discard

b. Configure the input, output, and RPF DHCP filters for IPv6.

[edit firewall]
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 interface-specific
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 then count COUNTER21
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 term TERM1 then next term
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 term TERM2 then service-accounting
user@host-R3# set family inet6 filter INPUT-V6-FILTER-01 term TERM2 then accept
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 interface-specific
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 from packet-length-except 64
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then count COUNTER22
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM1 then next term
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then service-accounting
user@host-R3# set family inet6 filter OUTPUT-V6-FILTER-01 term TERM2 then accept
user@host-R3# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP from destination-port dhcp
user@host-R3# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then count RPF-DHCP-V6-TRAFFIC
user@host-R3# set family inet6 filter RPF-PASS-DHCP-V6 term ALLOW-DHCP then accept
user@host-R3# set family inet6 filter RPF-PASS-DHCP-V6 term DEFAULT then discard

18. Configure the RADIUS server and DNS access.

[edit access]
user@host-R3# set radius-server 9.0.0.9 secret "$9$aOGjqAtORclz3lM8LVb"; ## SECRET-DATA
user@host-R3# set radius-server 9.0.0.9 timeout 20
user@host-R3# set radius-server 9.0.0.9 retry 5
user@host-R3# set radius-server 9.0.0.9 max-outstanding-requests 1000
user@host-R3# set radius-server 9.0.0.9 source-address 103.0.0.1
user@host-R3# set domain-name-server-inet 9.0.0.100
user@host-R3# set domain-name-server-inet 9.0.0.101
user@host-R3# set domain-name-server-inet6 2000:abcd::9.0.0.100
user@host-R3# set domain-name-server-inet6 2000:abcd::9.0.0.101

19. Configure the access profiles for RADIUS authentication and accounting.

[edit access]
user@host-R3# set profile Access-Profile-0 authentication-order radius
user@host-R3# set profile Access-Profile-0 radius authentication-server 9.0.0.9
user@host-R3# set profile Access-Profile-0 radius accounting-server 9.0.0.9
user@host-R3# set profile Access-Profile-0 radius options nas-identifier R3-BNG1
user@host-R3# set profile Access-Profile-0 accounting order radius
user@host-R3# set profile Access-Profile-0 accounting accounting-stop-on-failure
user@host-R3# set profile Access-Profile-0 accounting accounting-stop-on-access-deny
user@host-R3# set profile Access-Profile-0 accounting update-interval 10
user@host-R3# set profile Access-Profile-0 accounting statistics volume-time

20. Configure the IPv4 and IPv6 address assignment pools.

a. Configure the IPv4 address pools.

[edit access]
user@host-R3# set address-assignment pool v4-pool-0 family inet network 103.0.0.0/8
user@host-R3# set address-assignment pool v4-pool-0 family inet range v4-range-0 low 103.16.0.1
user@host-R3# set address-assignment pool v4-pool-0 family inet range v4-range-0 high 103.31.255.255
user@host-R3# set address-assignment pool v4-pool-0 family inet dhcp-attributes maximum-lease-time 99999

b. Configure the IPv6 address pools.

[edit access]
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 prefix 1003::/64
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 prefix 1003::/128
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low 1003::2/128
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low 1003::ffff:ffff/128

20. Configure the IPv6 address pools.

[edit access]
user@host-R3# set address-assignment pool v6-pool-0 family inet6 prefix 1003::/64
user@host-R3# set address-assignment pool v6-pool-0 family inet6 prefix 1003::/128
user@host-R3# set address-assignment pool v6-pool-0 family inet6 range v6-range-0 low 1003::2/128
user@host-R3# set address-assignment pool v6-pool-0 family inet6 range v6-range-0 low 1003::ffff:ffff/128

b. Configure the IPv6 address pools.

[edit access]
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 prefix 1003::/64
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 prefix 1003::/128
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low 1003::2/128
user@host-R3# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low 1003::ffff:ffff/128

c. Configure address protection.

[edit access]
user@host-R3# set address-protection

Results: From configuration mode, confirm your configuration by entering the following show commands:

1. Confirm the dynamic profile version creation configuration.
   user@host-R3# show system dynamic-profile-options versioning;

2. Confirm the client profile interface configuration.
   user@host-R3# show dynamic-profiles client-profile interfaces {
   "$junos-interface-ifd-name" {
     unit "$junos-underlying-interface-unit" {
       family inet {
         unnumbered-address lo0.0;
       }
       family inet6 {
         unnumbered-address lo0.0;
       }
     }
   }
}

3. Confirm the dynamic PPPoE client profile configuration.
   user@host-R3# show dynamic-profiles pppoe-client-profile interfaces {
   pp0 {
     unit "$junos-interface-unit" {
       no-traps;
       ppp-options {
         chap;
         pap;
       }
       pppoe-options {
         underlying-interface "$junos-underlying-interface";
         server;
       }
     }
   }
   keepalives interval 30;
   family inet {
     unnumbered-address lo0.0;
   }
   family inet6 {
     unnumbered-address lo0.0;
   }
}

4. Confirm the CoS forwarding class queue configuration.
   user@host-R3# show class-of-service forwarding-classes
   queue 0 FC0;
   queue 1 FC1;
   queue 2 FC2;
5. Confirm the dynamic VLAN profile configuration.

```
user@host-R3# show dynamic-profiles vlan-prof-0
predefined-variable-defaults {
    cos-scheduler-map SMAP_PS;
    cos-shaping-rate 60m;
    cos-guaranteed-rate 50m;
}
interfaces {
    "$junos-interface-ifd-name" {
        unit "$junos-interface-unit" {
            no-traps;
            vlan-tags outer "$junos-stacked-vlan-id" inner "$junos-vlan-id";
            family inet {
                rpf-check fail-filter RPF-PASS-DHCP-V4;
                unnumbered-address lo0.0;
            }
            family inet6 {
                rpf-check fail-filter RPF-PASS-DHCP-V6;
                unnumbered-address lo0.0;
            }
            family pppoe {
                dynamic-profile pppoe-client-profile;
            }
        }
    }
}
protocols {
    router-advertisement {
        interface "$junos-interface-name" {
            max-advertisement-interval 1800;
            min-advertisement-interval 1350;
            managed-configuration;
        }
    }
}
class-of-service {
    traffic-control-profiles {
        TCP_PS {
            scheduler-map "$junos-cos-scheduler-map";
            shaping-rate "$junos-cos-shaping-rate";
            guaranteed-rate "$junos-cos-guaranteed-rate";
        }
    }
    interfaces {
        "$junos-interface-ifd-name" {
            unit "$junos-interface-unit" {
                output-traffic-control-profile TCP_PS;
            }
        }
    }
```
scheduler-maps {
  SMAP_ALL {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
    forwarding-class FC3 scheduler FC3_SCH;
    forwarding-class FC4 scheduler FC4_SCH;
    forwarding-class FC5 scheduler FC5_SCH;
    forwarding-class FC6 scheduler FC6_SCH;
    forwarding-class FC7 scheduler FC7_SCH;
  }
  SMAP_FC0 {
    forwarding-class FC0 scheduler FC0_SCH;
  }
  SMAP_FC1 {
    forwarding-class FC1 scheduler FC1_SCH;
  }
  SMAP_FC2 {
    forwarding-class FC2 scheduler FC2_SCH;
  }
  SMAP_FC0_FC1 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
  }
  SMAP_FC1_FC2 {
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
  }
  SMAP_FC0_FC2 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
  }
  SMAP_FC0_FC1_FC2 {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
  }
  SMAP_PS {
    forwarding-class FC0 scheduler FC0_SCH;
    forwarding-class FC1 scheduler FC1_SCH;
    forwarding-class FC2 scheduler FC2_SCH;
    forwarding-class FC3 scheduler FC3_SCH;
  }
}

schedulers {
  FC0_SCH {
    transmit-rate 128k;
    priority strict-high;
  }
  FC1_SCH {
    transmit-rate 20m;
    priority medium-high;
  }
  FC2_SCH {
    priority low;
  }
}
FC3_SCH {
  priority low;
}
FC4_SCH {
  transmit-rate 2m;
  buffer-size percent 2;
  priority low;
  drop-profile-map loss-priority low protocol any drop-profile DP_04;
}
FC5_SCH {
  transmit-rate 2m;
  buffer-size percent 2;
  priority low;
  drop-profile-map loss-priority low protocol any drop-profile DP_05;
}
FC6_SCH {
  transmit-rate 2m;
  buffer-size percent 2;
  priority low;
  drop-profile-map loss-priority low protocol any drop-profile DP_06;
}
FC7_SCH {
  transmit-rate 2m;
  buffer-size percent 2;
  priority low;
  drop-profile-map loss-priority low protocol any drop-profile DP_07;
}
}

6. Confirm the DHCP service profile configuration.

    user@host-R3# show dynamic-profiles DHCP-SERVICE-PROFILE
    variables {
      I_V4_FILTER;
      O_V4_FILTER;
      I_V6_FILTER;
      O_V6_FILTER;
    }
    interfaces {
      "$junos-interface-ifd-name" {
        unit "$junos-underlying-interface-unit" {
          family inet {
            filter {
              input "$I_V4_FILTER";
              output "$O_V4_FILTER";
            }
          }
          family inet6 {
            filter {
              input "$I_V6_FILTER";
              output "$O_V6_FILTER";
            }
          }
        }
      }
    }
7. Confirm the PPPoE service profile configuration.

    user@host-R3# show dynamic-profiles PPPOE-SERVICE-PROFILE
    variables {
        I_V4_FILTER;
        O_V4_FILTER;
        I_V6_FILTER;
        O_V6_FILTER;
    }
    interfaces {
        pp0 {
            unit "\$junos-interface-unit" {
                family inet {
                    filter {
                        input "$I_V4_FILTER";
                        output "$O_V4_FILTER";
                    }
                }
                family inet6 {
                    filter {
                        input "$I_V6_FILTER";
                        output "$O_V6_FILTER";
                    }
                }
            }
        }
    }

8. Confirm the DHCP local server configuration.

    user@host-R3# show system services dhcp-local-server
dhcpv6 {
        group v6-ppp-client-0 {
            interface pp0.0;
        }
        group v4-rtClient-0-ACCESS-0-ps0 {
            authentication {
                password joshua;
                username-include {
                    user-prefix SST_USER_DHCP_V4_DEFAULT;
                }
            }
            dynamic-profile client-profile;
            interface ps0.0;
            interface ps1.0;
        }
        group v6-dhcp-client-0-ACCESS-0-ps0 {
            authentication {
                password joshua;
                username-include {
                    user-prefix SST_USER_DHCP_V6_DEFAULT;
                }
            }
            dynamic-profile client-profile;
interface ps0.0;
interface ps1.0;
}
}

9. Confirm the graceful switchover and device count configuration.

```bash
user@host-R3# show chassis redundancy
graceful-switchover;
```

```bash
user@host-R3# show chassis pseudowire-service
device-count 2048 {
```

10. Confirm the pseudowire tunnel service configuration.

```bash
user@host-R3# show chassis fpc 0
pic 0 {
    tunnel-services {
        bandwidth 1g;
    }
}
pic 1 {
    tunnel-services {
        bandwidth 1g;
    }
}
pic 2 {
    tunnel-services {
        bandwidth 1g;
    }
}
pic 3 {
    tunnel-services {
        bandwidth 1g;
    }
}
```

11. Confirm the transit link and logical tunnel interface configuration.

```bash
user@host-R3# show interfaces
lo0 {
    unit 0 {
        family inet {
            address 103.0.0.1/32 {
                primary;
                preferred;
            }
        }
        family inet6 {
            address 1003:0::1/128 {
                primary;
                preferred;
            }
        }
        family mpls;
    }
    ge-4/0/0 {
```
description "To R2 - Core";
unit 0 {
    family inet {
        address 21.21.40.1/24;
    }
    family inet6;
    family mpls;
}
ge-0/0/0 {
    description "To R1 - APE1";
    unit 0 {
        family inet {
            address 21.21.20.2/24;
        }
        family mpls;
    }
}
ge-1/0/0 {
    description "To R1 - APE1";
    unit 0 {
        family inet {
            address 21.21.21.2/24;
        }
        family mpls;
    }
}
ge-2/0/0 {
    description "To R2 - APE2";
    unit 0 {
        family inet {
            address 21.21.30.2/24;
        }
        family mpls;
    }
}
ge-3/0/0 {
    description "To R2 - APE2";
    unit 0 {
        family inet {
            address 21.21.31.2/24;
        }
        family mpls;
    }
}
lt-0/0/10 {
    hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
}
lt-0/1/10 {
    hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
}
lt-0/2/10 {
    hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
}
lt-0/3/10 {
    hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
}
12. Confirm the PS interface and VLAN authentication configuration.

    user@host-R3# show interfaces ps0
    anchor-point {
        lt-0/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-1/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-2/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/0/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/1/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/2/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
        lt-3/3/10 {
            hierarchical-scheduler maximum-hierarchy-levels 2 implicit-hierarchy;
        }
    }
    flexible-vlan-tagging;
    auto-configure {
        stacked-vlan-ranges {
            dynamic-profile vlan-prof-0 {
                accept [ inet inet6 pppoe ];
                ranges [ 1-256,1-4094 ];
            }
        }
        authentication {
            password joshua;
            username-include {
                ...
user-prefix SST_USER_VLAN_DEFAULT;

remove-when-no-subscribers;

no-gratuitous-arp-request;

unit 0 {
  encapsulation ethernet-ccc;
}

user@host-R3# show routing-options
ppm {
  redistribution-timer 1;
}
nonstop-routing;
nsr-phantom-holdtime 1;
routing-id 103.0.0.1;
forwarding-table {
  remnant-holdtime 100;
}

13. Confirm the L2 circuit connections.

user@host-R3# show protocols l2circuit neighbor 101.0.0.1 interface ps0.0
virtual-circuit-id 1;
ignore-mtu-mismatch;
oam {
  bfd-liveness-detection {
    minimum-interval 1000;
    multiplier 4;
    detection-time {
      threshold 5000;
    }
  }
}

14. Confirm the routing protocol configuration.

user@host-R3# show protocols
mpls {
  ipv6-tunneling;
  interface lo0.0;
  interface ge-0/0/0.0;
  interface ge-1/0/0.0;
  interface ge-2/0/0.0;
  interface ge-3/0/0.0;
  interface ge-4/0/0.0;
}
ospf {
  export EXPORT_BNG_ACCESS_INTERNAL;
  area 0.0.0.0 {
    interface lo0.0;
    interface ge-0/0/0.0;
    interface ge-1/0/0.0;
    interface ge-2/0/0.0;
    interface ge-3/0/0.0;
  }
}
interface ge-4/0/0.0;
}
}
ospf3 {
export EXPORT_BNG_ACCESS_INTERNAL;
area 0.0.0.0 {
    interface lo0.0;
    interface ge-4/0/0.0;
}
}
ldp {
    interface lo0.0;
    interface ge-0/0/0.0;
    interface ge-1/0/0.0;
    interface ge-2/0/0.0;
    interface ge-3/0/0.0;
    interface ge-4/0/0.0;
}

15. Confirm the policy statement configuration.

    user@host-R3# show policy-options
    policy-statement EXPORT_BNG_ACCESS_INTERNAL {
        term 1 {
            from {
                family inet;
                route-filter 100.0.0.0/8 orlonger;
                route-filter 103.0.0.0/8 orlonger;
            }
            then accept;
        }
        term 2 {
            from {
                family inet6;
                route-filter 1000::0000:0000:0000:0000:0000:0000:0000/64 orlonger;
                route-filter 1003:0000:0000:0000:0000:0000:0000:0000/64 orlonger;
            }
            then accept;
        }
    }

16. Confirm the firewall settings configuration.

    user@host-R3# show firewall
    family inet {
        filter INPUT-V4-FILTER-01 {
            interface-specific;
            term TERM1 {
                from {
                    packet-length-except 64;
                }
                then {
                    count COUNTER11;
                    next term;
                }
            }
            term TERM2 {
then {
  service-accounting;
  accept;
}
}

filter OUTPUT-V4-FILTER-01 {
  interface-specific;
  term TERM1 {
    from {
      packet-length-except 64;
    }
    then {
      count COUNTER12;
      next term;
    }
  }
  term TERM2 {
    then {
      service-accounting;
      accept;
    }
  }
}

filter RPF-PASS-DHCP-V4 {
  term ALLOW-DHCP {
    from {
      destination-address {
        255.255.255.255/32;
      }
      destination-port dhcp;
    }
    then {
      count RPF-DHCP-V4-TRAFFIC;
      accept;
    }
  }
  term DEFAULT {
    then {
      discard;
    }
  }
}

family inet6 {
  filter INPUT-V6-FILTER-01 {
    interface-specific;
    term TERM1 {
      from {
        packet-length-except 64;
      }
      then {
        count COUNTER21;
        next term;
      }
    }
  }
}

term TERM2 {
  then {
    service-accounting;
    accept;
  }
}
}

filter OUTPUT-V6-FILTER-01 {
  interface-specific;
  term TERM1 {
    from {
      packet-length-except 64;
    }
    then {
      count COUNTER22;
      next term;
    }
  }
  term TERM2 {
    then {
      service-accounting;
      accept;
    }
  }
}

filter RPF-PASS-DHCP-V6 {
  term ALLOW-DHCP {
    from {
      destination-port dhcp;
    }
    then {
      count RPF-DHCP-V6-TRAFFIC;
      accept;
    }
  }
  term DEFAULT {
    then discard;
  }
}

17. Confirm the RADIUS server and DNS access configuration.

user@host-R3# show access radius-server
9.0.0.9 {
  secret "$9$aOGjqAtORclz3IM8Lv$b"; ## SECRET-DATA
  timeout 20;
  retry 5;
  max-outstanding-requests 1000;
  source-address 103.0.0.1;
}

user@host-R3# show access domain-name-server-inet
9.0.0.100;
9.0.0.101;
18. Confirm the access profile configuration.

```
user@host-R3# show access profile Access-Profile-0
authentication-order radius;
radius {
    authentication-server 9.0.0.9;
    accounting-server 9.0.0.9;
    options {
        nas-identifier R3-BNG1;
    }
}
accounting {
    order radius;
    accounting-stop-on-failure;
    accounting-stop-on-access-deny;
    update-interval 10;
    statistics volume-time;
}
```

19. Confirm the address assignment pool configuration.

```
user@host-R3# show access address-assignment
pool v4-pool-0 {
    family inet {
        network 103.0.0.0/8;
        range v4-range-0 {
            low 103.16.0.1;
            high 103.31.255.255;
        }
        dhcp-attributes {
            maximum-lease-time 99999;
        }
    }
}
pool v6-na-pool-0 {
    family inet6 {
        prefix 1003:0000:0000:0000:0000:0000:0000:0000/64;
        range v6-range-0 {
            low 1003::2/128;
            high 1003::ffff:ffff/128;
        }
    }
}
```

```
user@host-R3# show access address-protection
address-protection;
```

**Configuring the Core Router, R4**

Figure 9 on page 103 highlights the core router (R4) in the context of the reference example topology.
To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```plaintext
set interfaces lo0 unit 0 family inet address 104.0.0.1/32 primary
set interfaces lo0 unit 0 family inet address 104.0.0.1/32 preferred
set interfaces lo0 unit 0 family inet6 address 1004::1/128 primary
set interfaces lo0 unit 0 family inet6 address 1004::1/128 preferred
set interfaces ge-0/0/2 unit 0 family inet address 21.21.14.2/24
set interfaces ge-0/0/2 unit 0 family inet6
set interfaces ge-0/0/2 unit 0 family mpls
set interfaces ge-0/0/3 unit 0 family inet address 21.21.15.2/24
set interfaces ge-0/0/3 unit 0 family inet6
set interfaces ge-0/0/3 unit 0 family mpls
set interfaces ge-0/0/4 unit 0 family inet address 21.21.40.2/24
set interfaces ge-0/0/4 unit 0 family inet6
set interfaces ge-0/0/4 unit 0 family mpls
set interfaces ge-0/1/3 unit 0 family inet address 21.21.50.1/24
set interfaces ge-0/1/3 unit 0 family inet6
set interfaces ge-0/1/3 unit 0 family mpls
set interfaces ge-0/1/4 unit 0 family inet address 21.21.51.2/24
set interfaces ge-0/1/4 unit 0 family inet6
set interfaces ge-0/1/4 unit 0 family mpls
set interfaces ge-0/1/7 unit 0 family inet address 9.0.0.1/24
set interfaces ge-0/1/7 unit 0 family inet6
set interfaces ge-0/1/7 unit 0 family mpls
```

Copyright © 2016, Juniper Networks, Inc.
set routing-options router-id 104.0.0.1
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/2.0
set protocols ospf area 0.0.0.0 interface ge-0/0/3.0
set protocols ospf area 0.0.0.0 interface ge-0/0/4.0
set protocols ospf area 0.0.0.0 interface ge-0/1/3.0
set protocols ospf area 0.0.0.0 interface ge-0/1/4.0
set protocols ospf area 0.0.0.0 interface ge-0/1/7.0 passive
set protocols ospf3 area 0.0.0.0 interface lo0.0
set protocols ospf3 area 0.0.0.0 interface ge-0/0/2.0
set protocols ospf3 area 0.0.0.0 interface ge-0/0/3.0
set protocols ospf3 area 0.0.0.0 interface ge-0/0/4.0
set protocols ospf3 area 0.0.0.0 interface ge-0/1/3.0
set protocols ospf3 area 0.0.0.0 interface ge-0/1/4.0
set protocols mpls ipv6-tunneling
set protocols mpls interface lo0.0
set protocols mpls interface ge-0/0/2.0
set protocols mpls interface ge-0/0/3.0
set protocols mpls interface ge-0/0/4.0
set protocols mpls interface ge-0/1/3.0
set protocols mpls interface ge-0/1/4.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-0/0/2.0
set protocols ldp interface ge-0/0/3.0
set protocols ldp interface ge-0/0/4.0
set protocols ldp interface ge-0/1/3.0
set protocols ldp interface ge-0/1/4.0

Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure Device R4:

1. Configure the interfaces.

   The loopback and BNG-facing interfaces support both IPv4 (inet) and IPv6 (inet6) address families for a dual stack routing environment. The LNS-facing interfaces do not include IPv6 family addressing because IPv6 traffic is overlaid over the L2TP tunnel that has only IPv4 source and destination.

   a. Configure the loopback interface.

      [edit interfaces]
      user@host-R4# set lo0 unit 0 family inet address 104.0.0.1/32 primary
      user@host-R4# set lo0 unit 0 family inet address 104.0.0.1/32 preferred
      user@host-R4# set lo0 unit 0 family inet6 address 1004::1/128 primary
      user@host-R4# set lo0 unit 0 family inet6 address 1004::1/128 preferred

   b. Configure BNG-facing interfaces for both the active and backup BNG devices.

      The configured ports for each BNG device pass traffic between the core network and the active BNG device.

      [edit interfaces]
      user@host-R4# set ge-0/0/2 unit 0 family inet address 21.21.14.2/24
      user@host-R4# set ge-0/0/2 unit 0 family inet6
2. Configure the routing protocols.

OSPF is enabled to support IPv4 routing; OSPFv3 is enabled to support IPv6 routing.

a. Configure the router ID.

```
[edit]
user@host-R4# set routing-options router-id 104.0.0.1
```

b. Configure OSPF for IPv4 routing.

```
[edit protocols]
user@host-R4# set ospf area 0.0.0.0 interface lo0.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/0/2.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/0/3.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/0/4.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/1/3.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/1/4.0
user@host-R4# set ospf area 0.0.0.0 interface ge-0/1/7.0 passive
```

c. Configure OSPFv6 for IPv6 routing.

```
[edit protocols]
user@host-R4# set ospf3 area 0.0.0.0 interface lo0.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/0/2.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/0/3.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/0/4.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/1/3.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/1/4.0
user@host-R4# set ospf3 area 0.0.0.0 interface ge-0/1/7.0
```

d. Configure MPLS for all interfaces connected to BNG-facing and LNS-facing ports.

IPv6 MPLS tunneling allows IPv6 routes to be resolved over an MPLS network by converting LDP and RSVP routes stored in the inet.3 routing table to IPv4-mapped IPv6 addresses, and then copying them into the inet6.3 routing table. The inet6.3 routing table can be used to resolve next hops for both inet6 and inet6- vpn routes.

```
[edit protocols]
user@host-R4# set mpls ipv6-tunneling
user@host-R4# set mpls interface lo0.0
```
user@host-R4# set mpls interface ge-0/0/2.0
user@host-R4# set mpls interface ge-0/0/3.0
user@host-R4# set mpls interface ge-0/0/4.0
user@host-R4# set mpls interface ge-0/1/3.0
user@host-R4# set mpls interface ge-0/1/4.0

e. Enable MPLS LDP signaling.

Configure LDP for BNG-facing and access PE-facing ports. Enabling LDP on the loopback interface is necessary for end-to-end MPLS L2 circuit service.

[edit protocols]
user@host-R4# set ldp interface lo0.0
user@host-R4# set ldp interface ge-0/0/2.0
user@host-R4# set ldp interface ge-0/0/3.0
user@host-R4# set ldp interface ge-0/0/4.0
user@host-R4# set ldp interface ge-0/1/3.0
user@host-R4# set ldp interface ge-0/1/4.0

Results  From configuration mode, confirm your configuration by entering the following show commands:

1. Confirm the interface configuration.

   user@host-R4# show interfaces lo0
   unit 0 {
       family inet {
           address 104.0.0.1/32 {
               primary;
               preferred;
           }
       }
   }
   family inet6 {
       address 1004:0::1/128 {
           primary;
           preferred;
       }
   }

   user@host-R4# show interfaces ge-0/0/2
   unit 0 {
       family inet {
           address 21.21.14.2/24;
       }
       family inet6;
       family mpls;
   }

   user@host-R4# show interfaces ge-0/0/3
   unit 0 {
       family inet {
           address 21.21.15.2/24;
       }
       family inet6;
       family mpls;
   }
user@host-R4# show interfaces ge-0/0/4
unit 0 {
    family inet {
        address 21.21.40.2/24;
    }
    family inet6;
    family mpls;
}

user@host-R4# show interfaces ge-0/1/3
unit 0 {
    family inet {
        address 21.21.50.1/24;
    }
    family inet6;
    family mpls;
}

user@host-R4# show interfaces ge-0/1/4
unit 0 {
    family inet {
        address 21.21.51.1/24;
    }
    family inet6;
    family mpls;
}

user@host-R4# show interfaces ge-0/1/7
unit 0 {
    family inet {
        address 9.0.0.1/24;
    }
    family inet6;
    family mpls;
}

2. Confirm the routing protocol configuration.

user@host-R4# show protocols ospf
area 0.0.0.0 {
    interface ge-0/0/2.0;
    interface lo0.0;
    interface ge-0/0/3.0;
    interface ge-0/0/4.0;
    interface ge-0/1/3.0;
    interface ge-0/1/4.0;
    interface ge-0/1/7.0 {
        passive;
    }
}

user@host-R4# show protocols ospf3
area 0.0.0.0 {
    interface ge-0/0/2.0;
    interface lo0.0;
    interface ge-0/0/3.0;
    interface ge-0/0/4.0;
    interface ge-0/1/3.0;
interface ge-0/1/4.0;
}

user@host-R4# show protocols mpls
interface ge-0/0/2.0;
interface lo0.0;
interface ge-0/0/3.0;
interface ge-0/0/4.0;
interface ge-0/1/3.0;
interface ge-0/1/4.0;
user@host-R4# show protocols ldp
interface ge-0/0/2.0;
interface ge-0/0/3.0;
interface ge-0/0/4.0;
interface ge-0/1/3.0;
interface ge-0/1/4.0;
interface lo0.0;

Configuring the LNS Router, R5

To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network.
configuration, and then copy and paste the commands into the CLI at the `[edit]` hierarchy level.

```plaintext
set interfaces lo0 unit 0 family inet address 105.0.0.1/32 primary preferred
set interfaces lo0 unit 0 family inet6 address 1005:0::1/128 primary preferred
set interfaces ge-0/0/3 description "To R4 - Core"
set interfaces ge-0/0/3 unit 0 family inet address 21.21.50.2/24
set interfaces ge-0/0/3 unit 0 family inet6
set interfaces ge-0/0/3 unit 0 family mpls
set interfaces ge-0/0/5 description "To R4 - Core"
set interfaces ge-0/0/5 unit 0 family inet address 21.21.51.2/24
set interfaces ge-0/0/5 unit 0 family inet6
set interfaces ge-0/0/5 unit 0 family mpls
set interfaces ge-0/1/4 description "Retailer/ISP facing link1"
set interfaces ge-0/1/4 unit 0 family inet address 200.0.0.1/24
set interfaces ge-0/1/4 unit 0 family inet6 address 3000:db8:ffff:4::1/64
set interfaces ge-1/0/4 description "Retailer/ISP facing link2"
set interfaces ge-1/0/4 unit 0 family inet address 199.99.9.1/24
set interfaces ge-1/0/4 unit 0 family inet6 address 3000:db8:ffff:5::1/64
set routing-options router-id 105.0.0.1
set protocols ospf area 0.0.0.0 interface lo0.0
set protocols ospf area 0.0.0.0 interface ge-0/0/3.0
set protocols ospf area 0.0.0.0 interface ge-0/0/5.0
set protocols ospf area 0.0.0.0 interface ge-0/1/4.0
set protocols ospf area 0.0.0.0 interface ge-1/0/4.0
set protocols ospf3 area 0.0.0.0 interface lo0.0
set protocols ospf3 area 0.0.0.0 interface ge-0/0/3.0
set protocols ospf3 area 0.0.0.0 interface ge-0/0/5.0
set protocols ospf3 area 0.0.0.0 interface ge-0/1/4.0
set protocols ospf3 area 0.0.0.0 interface ge-1/0/4.0
set protocols mpls interface ge-0/0/3.0
set protocols mpls interface ge-0/0/5.0
set protocols ldp interface lo0.0
set protocols ldp interface ge-0/0/3.0
set protocols ldp interface ge-0/0/5.0
set chassis fpc 1 pic 0 inline-services bandwidth 1g
set dynamic-profiles lns-profile routing-instances "$junos-routing-instance" interface "$junos-interface-name"
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
set access group-profile lns-group-profile ppp ppp-options pap
set access group-profile lns-group-profile ppp ppp-options chap
set access group-profile lns-group-profile pp keepalive 0
set access profile lns-profile client default l2tp lcp-renegotiation
set access profile lns-profile client default l2tp shared-secret "$9SGkFmCbicScIcyLXUJH"; # SECRET-DATA
set access profile lns-profile client default user-group-profile lns-group-profile
```
set access radius-server 9.0.0.9 secret "$S9SIGzhyKY2aUI7-.5QzCA"; ## SECRET-DATA
set access radius-server 9.0.0.9 source-address 105.0.0.1
set access profile AccProf-LNS authentication-order none
set services l2tp tunnel-group lns-tunnel-group l2tp-access-profile lns-profile
set services l2tp tunnel-group lns-tunnel-group local-gateway address 105.0.0.1
set services l2tp tunnel-group lns-tunnel-group local-gateway gateway-name R5
set services l2tp tunnel-group lns-tunnel-group service-device-pool lns_service_device_pool
set services l2tp tunnel-group lns-tunnel-group dynamic-profile lns-profile
set services service-device-pools pool lns_service_device_pool interface si-1/0/0
set access address-assignment pool v4-l2tp-pool-0 family inet network 100.0.0.0/8
set access address-assignment pool v4-l2tp-pool-0 family inet range l2tpv4 low 100.48.0.1
set access address-assignment pool v4-l2tp-pool-0 family inet range l2tpv4 high 100.63.255.255
set access address-assignment pool v6-l2tp-pool-0 family inet6 prefix 1000::/32
set access address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range low 100:0000::0000:0001://64
set access address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range high 100:0000::ffff://64
set access address-assignment pool v6-ndra-pool-0 family inet6 range v6-range-0 prefix-length 64
set access system services dhcp-local-server dhcpv6 overrides delegated-pool v6-l2tp-pool-0
set access system services dhcp-local-server dhcpv6 group v6-ppp-client-0 interface si-1/0/0.0
set chassis fpc 1 pic 1 tunnel-services bandwidth 10g
set access vt-1/1/0 unit 0 family inet
set access vt-1/1/0 unit 0 family inet6
set access services radius-flow-tap source-ipv4-address 199.99.9.1
set access services radius-flow-tap interfaces vt-1/1/0.0
Step-by-Step Procedure

The following example requires you to navigate various levels in the configuration hierarchy. For information about navigating the CLI, see Using the CLI Editor in Configuration Mode in the CLI User Guide.

To configure Device R5:

1. Configure the interfaces.

   The loopback and retailer and ISP-facing interfaces support both IPv4 (inet) and IPv6 (inet6) address families for a dual stack routing environment. The core-facing interfaces do not include IPv6 family addressing because IPv6 traffic is overlaid over the L2TP tunnel that has only IPv4 source and destination.

   a. Configure the LNS system’s primary address under a loopback interface.

      ```
      [edit interfaces]
      user@host-R5# set lo0 unit 0 family inet address 105.0.0.1/32 primary preferred
      user@host-R5# set lo0 unit 0 family inet6 address 1005:0::1/128 primary preferred
      ```

   b. Configure the core-facing interfaces.

      The two configured ports pass traffic between the LNS device and the core networks.

      ```
      [edit interfaces]
      user@host-R5# set ge-0/0/3 description "To R4 - Core"
      user@host-R5# set ge-0/0/3 unit 0 family inet address 21.21.50.2/24
      user@host-R5# set ge-0/0/3 unit 0 family inet6
      user@host-R5# set ge-0/0/3 unit 0 family mpls
      user@host-R5# set ge-0/0/5 description "To R4 - Core"
      user@host-R5# set ge-0/0/5 unit 0 family inet address 21.21.51.2/24
      user@host-R5# set ge-0/0/5 unit 0 family inet6
      user@host-R5# set ge-0/0/5 unit 0 family mpls
      ```

   c. Configure the retailer and ISP-facing interfaces.

      The two configured ports pass traffic between the LNS, and retailer and ISP networks.

      ```
      [edit interfaces]
      user@host-R5# set ge-0/1/4 description "Retailer/ISP facing link1"
      user@host-R5# set ge-0/1/4 unit 0 family inet address 200.0.0.1/24
      user@host-R5# set ge-0/1/4 unit 0 family inet6 address 3000:db8:ffff:4::1/64
      user@host-R5# set ge-1/0/4 description "Retailer/ISP facing link2"
      user@host-R5# set ge-1/0/4 unit 0 family inet address 199.99.9.1/24
      user@host-R5# set ge-1/0/4 unit 0 family inet6 address 3000:db8:ffff:5::1/64
      ```

2. Configure the routing protocols.

   OSPF is enabled to support IPv4 routing; OSPFv3 is enabled to support IPv6 routing.

   a. Configure the router ID.

      ```
      [edit]
      user@host-R5# set routing-options router-id 105.0.0.1
      ```

   b. Configure OSPF for IPv4 routing.

      ```
      [edit protocols]
      user@host-R5# set ospf area 0.0.0.0 interface lo0.0
      ```
c. Configure OSPFv3 for IPv6 routing.

```plaintext
[edit protocols]
user@host-R5# set ospf3 area 0.0.0.0 interface lo0.0
user@host-R5# set ospf3 area 0.0.0.0 interface ge-0/0/3.0
user@host-R5# set ospf3 area 0.0.0.0 interface ge-0/0/5.0
user@host-R5# set ospf3 area 0.0.0.0 interface ge-0/1/4.0
user@host-R5# set ospf3 area 0.0.0.0 interface ge-1/0/4.0
```

d. Enable MPLS.

Configure MPLS for all core-facing interfaces.

```plaintext
[edit protocols]
user@host-R5# set mpls interface ge-0/0/3.0
user@host-R5# set mpls interface ge-0/0/5.0
```

e. Enable LDP.

```plaintext
[edit protocols]
user@host-R5# set ldp interface lo0.0
user@host-R5# set ldp interface ge-0/0/3.0
user@host-R5# set ldp interface ge-0/0/5.0
```

3. Configure the LNS components.

L2TP traffic is processed using the inline service capability of the general network interface module rather than a dedicated service module. Line modules, therefore, process both L2TP and non-L2TP traffic.

a. Enable inline services.

Configure the bandwidth assigned for the inline service of the module.

```plaintext
[edit chassis]
user@host-R5# set fpc 1 pic 0 inline-services bandwidth 1g
```

b. Configure the dynamic profile.

Configure the dynamic profile required for dynamic configuration of L2TP session interface characteristics.

```plaintext
[edit dynamic-profiles]
user@host-R5# set lns-profile routing-instances "$junos-routing-instance" interface "$junos-interface-name"
user@host-R5# set dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" dial-options l2tp-interface-id dedicated
user@host-R5# set dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" no-keepalives
user@host-R5# set dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet unnumbered-address "$junos-loopback-interface"
user@host-R5# set dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit "$junos-interface-unit" family inet6 unnumbered-address "$junos-loopback-interface"
```
c. Configure the access group profile.

Configure the characteristics of the PPP protocol running over the L2TP tunnel.

```
[edit access]
user@host-R5# set group-profile lns-group-profile ppp ppp-options pap
user@host-R5# set group-profile lns-group-profile ppp ppp-options chap
user@host-R5# set group-profile lns-group-profile ppp keepalive 0
```

d. Configure the L2TP client profile.

Configure the L2TP client (LAC) characteristics, which are used to configure PPP link layer characteristics.

```
[edit access]
user@host-R5# set profile lns-profile client default l2tp lcp-renegotiation
user@host-R5# set profile lns-profile client default l2tp shared-secret
"$9$GKjkPFnCBIc5QIcylLXUjH"; ## SECRET-DATA
user@host-R5# set profile lns-profile client default user-group-profile lns-group-profile
```

e. Configure the RADIUS server access.

```
[edit access]
user@host-R5# set radius-server 9.0.0.9 secret "$9$IGzhyKY2aUi.7-.5QzCA";
## SECRET-DATA
user@host-R5# set radius-server 9.0.0.9 source-address 105.0.0.1
```

f. Configure the authorization, authentication, and accounting (AAA) profile.

Configure an access profile for incoming L2TP AAA calls.

```
[edit access]
user@host-R5# set profile AccProf-LNS authentication-order none
```

g. Configure global L2TP services.

Configure an L2TP tunnel group profile that contains the L2TP gateway's local address configuration and refers to other previously configured profiles for L2 and L3 network characteristics.

```
[edit services]
user@host-R5# set l2tp tunnel-group lns-tunnel-group l2tp-access-profile lns-profile
user@host-R5# set l2tp tunnel-group lns-tunnel-group local-gateway address 105.0.0.1
user@host-R5# set l2tp tunnel-group lns-tunnel-group local-gateway gateway-name R5
user@host-R5# set l2tp tunnel-group lns-tunnel-group service-device-pool lns_service_device_pool
user@host-R5# set l2tp tunnel-group lns-tunnel-group dynamic-profile lns-profile
user@host-R5# set service-device-pools pool lns_service_device_pool interface si-1/0/0
```

h. Configure the address pools.

The local inet address pool is used for subscriber end devices (CPE, desktop, and so on) to obtain IPv4 addresses using PPP IPCP negotiation. The local inet6 address pool is used for subscriber end devices to obtain IPv6 prefixes using DHCPv6.

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[edit access]  
user@host-R5# set address-assignment pool v4-l2tp-pool-0 family inet network 100.0.0.0/8  
user@host-R5# set address-assignment pool v4-l2tp-pool-0 family inet range l2tpv4 low 100.48.0.1  
user@host-R5# set address-assignment pool v4-l2tp-pool-0 family inet range l2tpv4 high 100.63.255.255  
user@host-R5# set address-assignment pool v6-l2tp-pool-0 family inet6 prefix 1000:0000::/32  
user@host-R5# set address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range low 1000:0000:0000:0001::/64  
user@host-R5# set address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range high 1000:0000:0000:ffff::/64  
user@host-R5# set address-assignment pool v6-ndra-pool-0 family inet6 prefix 3000:0000:0000:0000:0000:0000:0000:0000/32  
user@host-R5# set address-assignment pool v6-ndra-pool-0 family inet6 range v6-range-0 prefix-length 64


Enable DHCPv6 message processing on the L2TP session interface (si-0/0/0 interface). PPP provides interface ID (link local address) exchange for IPv6 support, but it does not provide global routable IPv6 prefixes. DHCPv6 protocol is employed for IPv6 prefix allocation.

[edit access]  
user@host-R5# set system services dhcp-local-server dhcpv6 overrides delegated-pool v6-l2tp-pool-0  
user@host-R5# set system services dhcp-local-server dhcpv6 group v6-ppp-client-0 interface si-1/0/0.0

5. Secure a policy for traffic mirroring.

Configure a RADIUS protocol-based per-subscriber traffic mirror so that an external authority can enable traffic mirroring on a specific subscriber session.

a. Enable inline tunnel services.

[edit chassis]  
user@host-R5# set fpc 1 pic 1 tunnel-services bandwidth 10g

b. Enable inet (IPv4) and inet6 (IPv6) address families.

[edit access]  
user@host-R5# set vt-1/1/0 unit 0 family inet  
user@host-R5# set vt-1/1/0 unit 0 family inet6

c. Enable the RADIUS flow-tap service.

For information about flow-tap, see Flow-Tap Architecture.

[edit access]  
user@host-R5# set services radius-flow-tap source-ipv4-address 199.99.9.1  
user@host-R5# set services radius-flow-tap interfaces vt-1/1/0.0

Results  1. Confirm the interface configuration.

user@host-R5# show interfaces lo0  
unit 0 {
family inet {
    address 105.0.0.1/32 {
        primary;
        preferred;
    }
}
family inet6 {
    address 1005::1/128 {
        primary;
        preferred;
    }
}

user@host-R5# show interfaces ge-0/0/3
description "To R4 - Core";
unit 0 {
    family inet {
        address 21.21.50.2/24;
    }
    family inet6 {
    }
    family mpls {
    }
}

user@host-R5# show interfaces ge-0/0/5
description "To R4 - Core";
unit 0 {
    family inet {
        address 21.21.51.2/24;
    }
    family inet6 {
    }
    family mpls {
    }
}

user@host-R5# show interfaces ge-0/1/4
description "Retailer/ISP facing link1";
unit 0 {
    family inet {
        address 200.0.0.1/24;
    }
    family inet6 {
        address 3000:db8:ffff:4::1/64;
    }
}

user@host-R5# show interfaces ge-1/0/4
description "Retailer/ISP facing link2";
unit 0 {
    family inet {
        address 199.99.9.1/24;
    }
}
family inet6 {
    address 3000:db8:ffff:5::1/64;
}

2. Confirm the routing protocol configuration.

    user@host-R5# show protocols ospf
    area 0.0.0.0 [
        interface lo0.0;
        interface ge-0/0/3.0;
        interface ge-0/0/5.0;
        interface ge-0/1/4.0;
        interface ge-1/0/4.0;
    ]

    user@host-R5# show protocols ospf3
    area 0.0.0.0 [  
        interface lo0.0;
        interface ge-0/0/3.0;
        interface ge-0/0/5.0;
        interface ge-0/1/4.0;
        interface ge-1/0/4.0;
    ]

    user@host-R5# show protocols mpls
    interface ge-0/0/3.0;
    interface ge-0/0/5.0;

    user@host-R5# show protocols ldp
    interface lo0.0;
    interface ge-0/0/3.0;
    interface ge-0/0/5.0;

3. Confirm the inline service configuration.

    user@host-R5# show chassis fpc1
    pic 0 [  
        inline-services [  
            bandwidth 1g;
        ]
    ]

4. Confirm the dynamic profile configuration.

    user@host-R5# show dynamic-profiles lns-profile
    routing-instances [  
        "$junos-routing-instance" [  
            interface "$junos-interface-name";
        ]
    ]

    interfaces [  
        "$junos-interface-ifd-name" [  
            unit "$junos-interface-unit" [  
                dial-options [  
                    l2tp-interface-id dedicated;
                ]
            no-keepalives;
            family inet [  
                }
unnumbered-address "$junos-loopback-interface";
}
family inet6 {
  unnumbered-address "$junos-loopback-interface";
}
}

5. Confirm the access group profile configuration.
user@host-R5# show access group-profile lns-group-profile
  ppp {
    ppp-options {
      pap;
      chap;
    }
    keepalive 0;
  }

6. Confirm the L2TP client profile configuration.
user@host-R5# show access profile lns-profile
  client default {
    l2tp {
      shared-secret "$9$GKjkPFnCBic5QIcyLXUjH"; ## SECRET-DATA
    }
    user-group-profile lns-group-profile;
  }

7. Confirm the RADIUS server configuration.
user@host-R5# show access radius-server 9.0.0.9
  secret "$9$IGzhyKY2aUl7-.5QzCA"; ## SECRET-DATA;
  source-address 105.0.0.1;

8. Confirm the AAA profile configuration.
user@host-R5# show access profile AccProf-LNS
  authentication-order none;

9. Confirm the global L2TP services configuration.
user@host-R5# show services
  l2tp {
    tunnel-group lns-tunnel-group {
      l2tp-access-profile lns-profile;
      local-gateway {
        address 105.0.0.1;
        gateway-name R5;
      }
    }
    service-device-pool lns_service_device_pool;
    dynamic-profile lns-profile;
  }
}
10. Confirm the IPv4 and IPv6 address pool configuration.

```bash
user@host-R5# show access address-assignment pool v4-l2tp-pool-0
family inet {
    network 100.0.0.0/8;
    range l2tpv4 {
        low 100.48.0.1;
        high 100.63.255.255;
    }
}

user@host-R5# show access address-assignment pool v6-l2tp-pool-0
family inet6 {
    prefix 1000:0000::/32;
    range v6-range-0 {
        low 1000:0000:0000:0001::/64;
        high 1000:0000:0000:ffff::/64;
    }
}

user@host-R5# show access address-assignment pool v6-ndra-pool-0
family inet6 {
    prefix 3000:0000:0000:0000:0000:0000:0000:0000:/32;
    range v6-range-0 {
        prefix-length 64;
    }
}
```

11. Confirm the DHCPv6 configuration.

```bash
user@host-R5# show system services dhcp-local-server
dhcpv6 {
    overrides {
        delegated-pool v6-l2tp-pool-0;
    }
    group v6-ppp-client-0 {
        interface si-0/0/0.0;
    }
}
```

12. Confirm the inline tunnel services configuration for traffic mirroring.

```bash
user@host-R5# show chassis fpc 1
pic 1 {
    tunnel-services {
        bandwidth 10g;
    }
}
```

13. Confirm that inet and inet6 address families are enabled.

```bash
user@host-R5# show interfaces vt-1/1/0
unit 0 {
    family inet;
    family inet6;
}
14. Confirm that the RADIUS flow-tap service is enabled.

```
user@host-R5# show services radius-flow-tap
source-ipv4-address 199.99.91;
interfaces {
  vt-1/1/0.0;
}
```

**Configuring the User Profile for the RADIUS Server**

**Step-by-Step Procedure**

To configure the user profile for the RADIUS server:

1. Include the following service activation RADIUS attributes in the user profile configuration:

   ```
   SST_USER_DHCP_V4_DEFAULT Auth-Type := Accept, User-Password := "joshua"
   ERX-Service-Activate:1 += "DHCP-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)",
   
   SST_USER_DHCP_V6_DEFAULT Auth-Type := Accept, User-Password := "joshua"
   ERX-Service-Activate:1 += "DHCP-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)",
   
   SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM Auth-Type := Accept, User-Password := "joshua"
   ```
Verification

The following sections show how to verify that the configuration is working properly. Within each group, verification steps are listed for the devices from left to right in the example topology.

- Verify Route Summary Information on page 120
- Verify the Loopback and Physical Ports on page 124
- Verify OSPF and OSPF3 Functionality on page 134
- Verify LDP Functionality on page 139
- Verify MPLS Interfaces on page 141
- Verify Circuit Cross-Connect (CCC) Interfaces and L2 Circuits on R1, R2, and R0 on page 142
- Verify Logical Tunnel (LT) Interfaces on R0 and R3 on page 146
- Verify Pseudoservice (PS) Interfaces on R0 and R3 on page 148
- Verify DHCPv4 Over Dynamic VLAN Interfaces on R0 on page 148
- Verify DHCPv6-PD Over Dynamic VLAN Interfaces on R0 on page 151
- Verify PPPoE Over Dynamic VLAN Interfaces on R0 on page 153
- Verify DHCP-PD Over PPPoE Over Dynamic VLAN Interfaces on R0 on page 156
- Verify LAC PPP over Dynamic Interfaces on R0 on page 159
- Verify the AAA Access and RADIUS Server Configuration and Statistics on R0 on page 163
- Verify That on R3, No L2 Circuits Are Up and No BFD Sessions Are Running on page 166
- Verify L2TP Functionality on R5 on page 167
- Verify Dynamic VLAN Authentication and Accounting on the RADIUS Server on page 171

Verify Route Summary Information

Purpose

Confirm that destinations and routes are functional:

- On R1, confirm inet, MPLS, and L2 circuit destinations and routes on router ID 101.0.0.1.
- On R2, confirm inet, inet6, MPLS, and L2 circuit destinations and routes on router ID 102.0.0.1.
- On R0, confirm inet, inet6, MPLS, and L2 circuit destinations and routes on router ID 100.0.0.1.
• On R4, confirm inet, inet6, and MPLS destinations and routes on router ID 104.0.0.1.
• On R5, confirm inet, inet6, and MPLS destinations and routes on router ID 105.0.0.1.
**Action**  On each device, run the `show route summary` command from operational mode.

```bash
user@host-R1> show route summary
Router ID: 101.0.0.1

inet.0: 31 destinations, 32 routes (31 active, 0 holddown, 0 hidden)
  Direct: 6 routes, 6 active
  Local: 5 routes, 5 active
  OSPF: 19 routes, 18 active
  Static: 2 routes, 2 active

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

mpls.0: 2013 destinations, 2013 routes (2013 active, 0 holddown, 0 hidden)
  MPLS: 6 routes, 6 active
  LDP: 7 routes, 7 active
  L2CKT: 2000 routes, 2000 active

__mpls-oam__.mpls.0: 1000 destinations, 1000 routes (1000 active, 0 holddown, 0 hidden)
  L2CKT: 1000 routes, 1000 active

l2circuit.0: 3000 destinations, 3000 routes (3000 active, 0 holddown, 0 hidden)
  LDP: 2000 routes, 2000 active
  L2CKT: 1000 routes, 1000 active

user@host-R2> show route summary
Router ID: 102.0.0.1

inet.0: 31 destinations, 32 routes (31 active, 0 holddown, 0 hidden)
  Direct: 6 routes, 6 active
  Local: 5 routes, 5 active
  OSPF: 19 routes, 18 active
  Static: 2 routes, 2 active

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

mpls.0: 2106 destinations, 2106 routes (2106 active, 0 holddown, 0 hidden)
  MPLS: 3 routes, 3 active
  LDP: 7 routes, 7 active
  L2CKT: 2096 routes, 2096 active

inet6.0: 4 destinations, 4 routes (4 active, 0 holddown, 0 hidden)
  Direct: 2 routes, 2 active
  Local: 2 routes, 2 active

l2circuit.0: 3144 destinations, 3144 routes (3144 active, 0 holddown, 0 hidden)
  LDP: 2096 routes, 2096 active
  L2CKT: 1048 routes, 1048 active

user@host-R0> show route summary
Router ID: 100.0.0.1

inet.0: 33 destinations, 34 routes (33 active, 0 holddown, 0 hidden)
  Direct: 8 routes, 8 active
  Local: 7 routes, 7 active
  OSPF: 17 routes, 16 active
  Static: 2 routes, 2 active
```
inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

mpls.0: 4110 destinations, 4110 routes (4110 active, 0 holddown, 0 hidden)
  MPLS: 6 routes, 6 active
  LDP: 8 routes, 8 active
  L2CKT: 4096 routes, 4096 active

__mpls-oam__.mpls.0: 2048 destinations, 2048 routes (2048 active, 0 holddown, 0 hidden)
  L2CKT: 2048 routes, 2048 active

inet6.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)
  Direct: 4 routes, 3 active
  Local: 3 routes, 3 active
  OSPF3: 6 routes, 6 active

inet6.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

l2circuit.0: 4096 destinations, 4096 routes (4096 active, 0 holddown, 0 hidden)
  LDP: 2048 routes, 2048 active
  L2CKT: 2048 routes, 2048 active

user@host-R3>show route summary
Router ID: 103.0.0.1

inet.0: 32 destinations, 33 routes (32 active, 0 holddown, 0 hidden)
  Direct: 7 routes, 7 active
  Local: 6 routes, 6 active
  OSPF: 18 routes, 17 active
  Static: 2 routes, 2 active

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

mpls.0: 14 destinations, 14 routes (14 active, 0 holddown, 0 hidden)
  MPLS: 6 routes, 6 active
  LDP: 8 routes, 8 active

inet6.0: 10 destinations, 10 routes (10 active, 0 holddown, 0 hidden)
  Direct: 3 routes, 3 active
  Local: 1 routes, 1 active
  OSPF3: 6 routes, 6 active

inet6.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

l2circuit.0: 2048 destinations, 2048 routes (2048 active, 0 holddown, 0 hidden)
  L2CKT: 2048 routes, 2048 active

user@host-R4>show route summary
Router ID: 104.0.0.1

inet.0: 30 destinations, 30 routes (30 active, 0 holddown, 0 hidden)
  Direct: 7 routes, 7 active
  Local: 6 routes, 6 active
  OSPF: 17 routes, 17 active

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active
mpls.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
  MPLS: 4 routes, 4 active
  LDP: 8 routes, 8 active

inet6.0: 14 destinations, 18 routes (14 active, 0 holddown, 0 hidden)
  Direct: 7 routes, 3 active
  Local: 5 routes, 5 active
  OSPF3: 6 routes, 6 active

inet6.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

user@host-R5> show route summary
Router ID: 105.0.0.1

inet.0: 34 destinations, 34 routes (34 active, 0 holddown, 0 hidden)
  Direct: 6 routes, 6 active
  Local: 5 routes, 5 active
  OSPF: 18 routes, 18 active
  Static: 5 routes, 5 active

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
  LDP: 5 routes, 5 active

mpls.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)
  MPLS: 6 routes, 6 active
  LDP: 6 routes, 6 active

inet6.0: 16 destinations, 20 routes (16 active, 0 holddown, 0 hidden)
  Direct: 9 routes, 5 active
  Local: 7 routes, 7 active
  OSPF3: 4 routes, 4 active

**Meaning**  Destinations and routes are functional.

**Verify the Loopback and Physical Ports**

**Purpose**  On each device, test connections to the loopback and physical ports.
On each device, run the `show interfaces` command from operational mode for each port to confirm the interfaces are Up. Then run the `ping` command to verify communication with each interface.

```
user@host-R1> show interfaces lo0 terse
Interface       Admin Link Proto Local               Remote
lo0             up    up
lo0.0           up    up   inet     101.0.0.1           --> 0/0
lo0.16384       up    up   inet
lo0.16385       up    up   inet

user@host-R1> ping 101.0.0.1 rapid
PING 101.0.0.1 (101.0.0.1): 56 data bytes
!!!!!
--- 101.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.074/0.176/0.288/0.092 ms

user@host-R1> show interfaces ge-1/0/6 terse
Interface       Admin Link Proto Local               Remote
ge-1/0/6        up    up
ge-1/0/6.0      up    up   inet     21.21.11.2/24
 mpls
multiservice

user@host-R1> ping 21.21.11.2 rapid
!!!!!
--- 21.21.11.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.067/0.090/0.169/0.040 ms

user@host-R1> show interfaces ge-1/1/6 terse
Interface       Admin Link Proto Local               Remote
ge-1/1/6        up    up
ge-1/1/6.0      up    up   inet     21.21.10.2/24
 mpls
multiservice

user@host-R1> ping 21.21.10.2 rapid
PING 21.21.10.2 (21.21.10.2): 56 data bytes
!!!!!
--- 21.21.10.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.068/0.091/0.169/0.039 ms

user@host-R1> show interfaces ge-1/1/4 terse
Interface       Admin Link Proto Local               Remote
ge-1/1/4        up    up
ge-1/1/4.0      up    up   inet     21.21.20.1/24
 mpls
multiservice

user@host-R1> ping 21.21.20.1 rapid
!!!!!
--- 21.21.20.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.070/0.114/0.282/0.084 ms
```
Interface               Admin Link Proto    Local                 Remote
ge-1/1/5                up    up
ge-1/1/5.0              up    up   inet     21.21.21.1/24
 mplis
 multiserive

user@host-R1>ping 21.21.21.1 rapid
!!!!!
--- 21.21.21.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.070/0.200/0.420/0.157 ms

user@host-R2>show interfaces lo0 terse
Interface               Admin Link Proto    Local                 Remote
lo0                     up    up
lo0.0                   up    up   inet     102.0.0.1           --> 0/0
 mplis
 lo0.16384               up    up   inet     127.0.0.1           --> 0/0
 lo0.16385               up    up   inet

user@host-R2>ping 102.0.0.1 rapid
PING 102.0.0.1 (102.0.0.1): 56 data bytes
!!!!!
--- 102.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.070/0.086/0.138/0.026 ms

user@host-R2>show interfaces ge-1/0/6 terse
Interface               Admin Link Proto    Local                 Remote
ge-1/0/6                up    up
ge-1/0/6.0              up    up   inet     21.21.13.2/24
 mplis
 multiserive

user@host-R2>ping 21.21.13.2 rapid
!!!!!
--- 21.21.13.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.142/0.168/0.256/0.044 ms

user@host-R2>show interfaces ge-1/1/6 terse
Interface               Admin Link Proto    Local                 Remote
ge-1/1/6                up    up
ge-1/1/6.0              up    up   inet     21.21.12.2/24
 mplis
 multiserive

user@host-R2>ping 21.21.12.2 rapid
!!!!!
--- 21.21.12.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.072/0.103/0.219/0.058 ms

user@host-R2>show interfaces ge-1/1/4 terse
Interface               Admin Link Proto    Local                 Remote
ge-1/1/4                up    up
ge-1/1/4.0              up    up   inet     21.21.30.1/24
 mplis
 multiserive

user@host-R2>ping 21.21.30.1 rapid
!!!!!!
--- 21.21.30.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.069/0.097/0.138/0.032 ms

user@host-R2> show interfaces ge-1/1/5 terse
Interface                  Admin Link Proto Local                 Remote
ge-1/1/5                   up    up
ge-1/1/5.0                 up    up   inet     21.21.31.1/24
                          mpls
                          multiservice

user@host-R2> ping 21.21.31.1 rapid
!!!!!!
--- 21.21.31.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.070/0.084/0.131/0.023 ms

user@host-R0> show interfaces lo0 terse
Interface                  Admin Link Proto Local                 Remote
lo0                       up    up
lo0.0                     up    up   inet     100.0.0.1           --> 0/0
                          inet6   1000::1
                          fe80::2a0:a50f:fc76:14de
                          mpls
lo0.16384                 up    up   inet     127.0.0.1           --> 0/0
lo0.16385                 up    up   inet

user@host-R0> ping 100.0.0.1 rapid
PING 100.0.0.1 (100.0.0.1): 56 data bytes
!!!!!!
--- 100.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.052/0.080/0.115/0.021 ms

user@host-R0> ping 1000::1 rapid
PING6(56=40+8+8 bytes) 1000::1 --> 1000::1
!!!!!!
--- 1000::1 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.155/0.345/0.957/0.311 ms

user@host-R0> show interfaces ge-0/0/0 terse
Interface                  Admin Link Proto Local                 Remote
ge-0/0/0                   up    up
ge-0/0/0.0                 up    up   inet     21.21.11.1/24
                          mpls
                          multiservice

user@host-R0> ping 21.21.11.1 rapid
!!!!!!
--- 21.21.11.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.050/0.112/0.248/0.072 ms

user@host-R0> show interfaces ge-1/0/0 terse
Interface                  Admin Link Proto Local                 Remote
ge-1/0/0                   up    up
ge-1/0/0.0                 up    up   inet     21.21.10.1/24
                          mpls
multiservice

user@host-R0> ping 21.21.10.1 rapid
!!!!!
--- 21.21.10.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.051/0.087/0.129/0.031 ms

user@host-R0> show interfaces ge-2/0/0 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-2/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-2/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>21.21.13.1/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mpls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

user@host-R0> ping 21.21.13.1 rapid
!!!!!
--- 21.21.13.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.050/0.083/0.114/0.027 ms

user@host-R0> show interfaces ge-3/0/0 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-3/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-3/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>21.21.12.1/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mpls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

user@host-R0> ping 21.21.12.1 rapid
!!!!!
--- 21.21.12.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.050/0.084/0.115/0.027 ms

user@host-R0> show interfaces ge-4/0/0 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-4/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-4/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>21.21.14.1/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mpls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inet6</td>
<td></td>
<td></td>
<td>fe80::ae4b:c8ff:fe45:6800/64</td>
<td></td>
</tr>
</tbody>
</table>

user@host-R0> ping 21.21.14.1 rapid
!!!!!
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.051/0.104/0.201/0.055 ms

user@host-R0> ping fe80::ae4b:c8ff:fe45:6800 rapid
PING6(56=40+8+8 bytes) fe80::ae4b:c8ff:fe45:6800 --> fe80::ae4b:c8ff:fe45:6800
!!!!!
--- fe80::ae4b:c8ff:fe45:6800 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.084/0.106/0.121/0.013 ms

user@host-R0> show interfaces ge-5/0/0 terse
<table>
<thead>
<tr>
<th>Interface</th>
<th>Admin</th>
<th>Link</th>
<th>Proto</th>
<th>Local</th>
<th>Remote</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-5/0/0</td>
<td>up</td>
<td>up</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ge-5/0/0.0</td>
<td>up</td>
<td>up</td>
<td>inet</td>
<td>21.21.15.1/24</td>
<td></td>
</tr>
<tr>
<td></td>
<td>mpls</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>inet6</td>
<td></td>
<td></td>
<td>fe80::ae4b:c8ff:fe45:6be0/64</td>
<td></td>
</tr>
</tbody>
</table>
multiservice

user@host-R0> ping 21.21.15.1 rapid
!!!!
--- 21.21.15.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.052/0.082/0.113/0.021 ms

user@host-R0> ping fe80::ae4b:c8ff:fe45:6be0 rapid
PING6(56=40+8+8 bytes) fe80::ae4b:c8ff:fe45:6be0 --> fe80::ae4b:c8ff:fe45:6be0
!!!!
--- fe80::ae4b:c8ff:fe45:6be0 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.062/0.131/0.206/0.047 ms

user@host-R3> show interfaces lo0 terse

Interface       Admin Link Proto     Local                 Remote
lo0             up    up
lo0.0           up    up   inet     103.0.0.1           --> 0/0
inet6           1003::1
fe80::2a0:a50f:fc76:14d2
mpls
lo0.16384       up    up   inet     127.0.0.1           --> 0/0
lo0.16385       up    up   inet

user@host-R3> ping 103.0.0.1 rapid
PING 103.0.0.1 (103.0.0.1): 56 data bytes
!!!!
--- 103.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.053/0.081/0.114/0.025 ms

user@host-R3> ping 1003::1 rapid
PING6(56=40+8+8 bytes) 1003::1 --> 1003::1
!!!!
--- 1003::1 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.062/0.092/0.170/0.040 ms

user@host-R3> show interfaces ge-0/0/0 terse

Interface       Admin Link Proto     Local                 Remote
ge-0/0/0         up    up
ge-0/0/0.0       up    up   inet     21.21.20.2/24
mpls
multiservice

user@host-R3> ping 21.21.20.2 rapid
!!!!
--- 21.21.20.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.055/0.096/0.137/0.034 ms

user@host-R3> show interfaces ge-1/0/0 terse

Interface       Admin Link Proto     Local                 Remote
ge-1/0/0         up    up
ge-1/0/0.0       up    up   inet     21.21.21.2/24
mpls
multiservice

user@host-R3> ping 21.21.21.2 rapid
--- 21.21.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.057/0.083/0.113/0.018 ms

user@host-R3> show interfaces ge-2/0/0 terse
Interface               Admin Link Proto    Local                 Remote
ge-2/0/0                up    up
ge-2/0/0.0              up    up   inet     21.21.30.2/24
mpls
multiservice

user@host-R3> ping 21.21.30.2 rapid
!!!!!
--- 21.21.30.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.053/0.087/0.119/0.027 ms

user@host-R3> show interfaces ge-3/0/0 terse
Interface               Admin Link Proto    Local                 Remote
ge-3/0/0                up    up
ge-3/0/0.0              up    up   inet     21.21.31.2/24
mpls
multiservice

user@host-R3> ping 21.21.31.2 rapid
!!!!!
--- 21.21.31.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.054/0.082/0.116/0.025 ms

user@host-R3> show interfaces ge-4/0/0 terse
Interface               Admin Link Proto    Local                 Remote
ge-4/0/0                up    up
ge-4/0/0.0              up    up   inet     21.21.40.1/24
inet6    fe80::ae4b:c8ff:fe45:f000/64
mpls
multiservice

user@host-R3> ping 21.21.40.1 rapid
!!!!!
--- 21.21.40.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.053/0.083/0.118/0.027 ms

user@host-R3> ping fe80::ae4b:c8ff:fe45:f000 rapid
PING6 (56=40+8+8 bytes) fe80::ae4b:c8ff:fe45:f000 --> fe80::ae4b:c8ff:fe45:f000
!!!!!
--- fe80::ae4b:c8ff:fe45:f000 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.061/0.078/0.112/0.019 ms

user@host-R4> show interfaces lo0.1 terse
Interface               Admin Link Proto    Local                 Remote
lo0.0                   up    up   inet     104.0.0.1           --> 0/0
inet6    1004::1
fe80::aad0:e50f:fc50:b2ff

user@host-R4> ping 104.0.0.1 rapid
PING 104.0.0.1 (104.0.0.1): 56 data bytes
--- 104::1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.092/0.116/0.205/0.044 ms

user@host-R4> ping 1004::1 rapid
PING6(56=40+8+8 bytes) 1004::1 --> 1004::1

--- 1004::1 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.196/0.230/0.344/0.057 ms

user@host-R4> show interfaces ge-0/0/2 terse
Interface Admin Link Proto Local Remote
ge-0/0/2.0 up up inet 21.21.14.2/24
inet6 fe80::aad0:e5ff:fe50:b200/64
mpls
multiservice

user@host-R4> ping 21.21.14.2 rapid

5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.094/0.116/0.195/0.040 ms

user@host-R4> ping fe80::aad0:e5ff:fe50:b200 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b200 --> fe80::aad0:e5ff:fe50:b200

--- fe80::aad0:e5ff:fe50:b200 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.231/0.476/1.114/0.324 ms

user@host-R4> show interfaces ge-0/0/3 terse
Interface Admin Link Proto Local Remote
ge-0/0/3.0 up up inet 21.21.15.2/24
inet6 fe80::aad0:e5ff:fe50:b262/64
mpls
multiservice

user@host-R4> ping 21.21.15.2 rapid
PING 21.21.15.2 (21.21.15.2): 56 data bytes

--- 21.21.15.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.096/0.171/0.344/0.093 ms

user@host-R4> ping fe80::aad0:e5ff:fe50:b262 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b262 --> fe80::aad0:e5ff:fe50:b262

--- fe80::aad0:e5ff:fe50:b262 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.231/0.476/1.114/0.324 ms

user@host-R4> show interfaces ge-0/0/4 terse
Interface Admin Link Proto Local Remote
ge-0/0/4.0 up up inet 21.21.40.2/24
inet6 fe80::aad0:e5ff:fe50:b201/64
mpls
multiservice
user@host-R4> ping 21.21.40.2 rapid
!!!!!
--- 21.21.40.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.093/0.116/0.194/0.039 ms

user@host-R4> ping fe80::aad0:e5ff:fe50:b201 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b201 --> fe80::aad0:e5ff:fe50:b201
!!!!!
--- fe80::aad0:e5ff:fe50:b201 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.231/0.476/1.114/0.324 ms

user@host-R4> show interfaces ge-0/1/3 terse
Interface       Admin Link Proto    Local                 Remote
ge-0/1/3         up    up   inet     21.21.50.1/24
                 inet6 fe80::aad0:e5ff:fe50:b268/64
                 mpls
                multiservice

user@host-R4> ping 21.21.50.1 rapid
!!!!!
--- 21.21.50.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.097/0.203/0.330/0.095 ms

user@host-R4> ping fe80::aad0:e5ff:fe50:b268 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b268 --> fe80::aad0:e5ff:fe50:b268
!!!!!
--- fe80::aad0:e5ff:fe50:b268 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.231/0.476/1.114/0.324 ms

user@host-R4> show interfaces ge-0/1/4 terse
Interface       Admin Link Proto    Local                 Remote
ge-0/1/4         up    up   inet     21.21.51.1/24
                 inet6 fe80::aad0:e5ff:fe50:b269/64
                 mpls
                multiservice

user@host-R4> ping 21.21.51.1 rapid
!!!!!
--- 21.21.51.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.094/0.143/0.331/0.094 ms

user@host-R4> ping fe80::aad0:e5ff:fe50:b269 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b269 --> fe80::aad0:e5ff:fe50:b269
!!!!!
--- fe80::aad0:e5ff:fe50:b269 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.231/0.476/1.114/0.324 ms

user@host-R4> show interfaces ge-0/1/7 terse
Interface       Admin Link Proto    Local                 Remote
ge-0/1/7         up    up   inet     9.0.0.1/24
                multiservice
user@host-R4> ping 9.0.0.1 rapid
PING 9.0.0.1 (9.0.0.1): 56 data bytes
!!!!!
--- 9.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.194/0.262/0.322/0.049 ms

user@host-R5> show interfaces lo0 terse
Interface     Admin Link Proto    Local                 Remote
lo0           up    up
lo0.0         up    up   inet     105.0.0.1           --> 0/0
               inet6  1005::1
               fe80::aad0:e50f:fc50:b2ff
lo0.16384     up    up   inet     127.0.0.1           --> 0/0
lo0.16385     up    up   inet

user@host-R5> ping 105.0.0.1 rapid
PING 105.0.0.1 (105.0.0.1): 56 data bytes
!!!!!
--- 105.0.0.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.092/0.137/0.209/0.053 ms

user@host-R5> ping 1005::1 rapid
PING6(56=40+8+8 bytes) 1005::1 --> 1005::1
!!!!!
--- 1005::1 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.196/0.307/0.682/0.188 ms

user@host-R5> show interfaces ge-0/0/3 terse
Interface     Admin Link Proto    Local                 Remote
ge-0/0/3       up    up
ge-0/0/3.0     up    up   inet     21.21.50.2/24
               inet6  fe80::aad0:e5ff:fe50:b2ff
               mpls
               multiservice

user@host-R5> ping 21.21.50.2 rapid
PING 21.21.50.2 (21.21.50.2): 56 data bytes
!!!!!
--- 21.21.50.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.093/0.145/0.226/0.055 ms

user@host-R5> ping fe80::aad0:e5ff:fe50:b280 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b280 --> fe80::aad0:e5ff:fe50:b280
!!!!!
--- fe80::aad0:e5ff:fe50:b280 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.198/0.230/0.349/0.059 ms

user@host-R5> show interfaces ge-0/0/5 terse
Interface     Admin Link Proto    Local                 Remote
ge-0/0/5       up    up
ge-0/0/5.0     up    up   inet     21.21.51.2/24
               inet6  fe80::aad0:e5ff:fe50:b281/64
               mpls
               multiservice

user@host-R5> ping 21.21.51.2 rapid
!!!!!
--- 21.21.51.2 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.243/0.395/0.495/0.083 ms

user@host-R5> ping fe80::aad0:e5ff:fe50:b281 rapid
PING6(56=40+8+8 bytes) fe80::aad0:e5ff:fe50:b281 --> fe80::aad0:e5ff:fe50:b281
!!!!!
--- fe80::aad0:e5ff:fe50:b281 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.124/0.204/0.381/0.101 ms

user@host-R5> show interfaces ge-0/1/4 terse
Interface Admin Link Proto    Local                 Remote
ge-0/1/4       up    up           10.9.46.229/24
ge-0/1/4.0     up    up   inet     10.9.46.229/24
               inet6 3000:db8:ffff:4::1/64
               fe80::aad0:e5ff:fe50:b260/64
multiservice

user@host-R5> ping 10.9.46.229 rapid
PING 10.9.46.229 (10.9.46.229): 56 data bytes
!!!!!
--- 10.9.46.229 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.093/0.137/0.244/0.059 ms

user@host-R5> ping 3000:db8:ffff:4::1 rapid
PING6(56=40+8+8 bytes) 3000:db8:ffff:4::1 --> 3000:db8:ffff:4::1
!!!!!
--- 3000:db8:ffff:4::1 ping6 statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/std-dev = 0.123/0.147/0.237/0.045 ms

user@host-R5> show interfaces ge-1/0/4 terse
Interface Admin Link Proto    Local                 Remote
ge-1/0/4       up    up           199.99.9.1/24
ge-1/0/4.0     up    up   inet     199.99.9.1/24
               inet6 3000:db8:ffff:5::1/64
               fe80::aad0:e5ff:fe50:b267/64
multiservice

user@host-R5> ping 199.99.9.1 rapid
PING 199.99.9.1 (199.99.9.1): 56 data bytes
!!!!!
--- 199.99.9.1 ping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.094/0.129/0.195/0.042 ms

Meaning  Loopback and physical port interfaces are functional and communicating.

Verify OSPF and OSPF3 Functionality

Purpose  On each device, display OSPF and OSPF3 (when applicable) interface, neighbor, and route information to ensure all entities are functioning correctly.
On each device, run the `show ospf interface`, `show ospf neighbor`, and `show route protocol ospf | match /32` commands from operational mode.

On each device with OSPF3 configuration, also run the `show ospf3 interface`, `show ospf3 neighbor`, and `show route table inet6.0 | match /128` commands.

```
user@host-R1> show ospf interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-1/0/6.0          DR      0.0.0.0         101.0.0.1       100.0.0.1          1
ge-1/1/6.0          DR      0.0.0.0         101.0.0.1       100.0.0.1          1
ge-1/1/4.0          DR      0.0.0.0         101.0.0.1       103.0.0.1          1
ge-1/1/5.0          DR      0.0.0.0         101.0.0.1       103.0.0.1          1
lo0.0               DR      0.0.0.0         101.0.0.1       0.0.0.0            0

user@host-R1> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
21.21.11.1       ge-1/0/6.0             Full      100.0.0.1        128    36
21.21.10.1       ge-1/1/6.0             Full      100.0.0.1        128    38
21.21.20.2       ge-1/1/4.0             Full      103.0.0.1        128    39
21.21.21.2       ge-1/1/5.0             Full      103.0.0.1        128    35

user@host-R1> show route protocol ospf | match /32
100.0.0.1/32       *[OSPF/10] 1d 23:37:08, metric 1
102.0.0.1/32       *[OSPF/10] 00:04:36, metric 2
103.0.0.1/32       *[OSPF/10] 02:08:49:59, metric 1
104.0.0.1/32       *[OSPF/10] 1d 23:37:08, metric 2
105.0.0.1/32       *[OSPF/10] 1d 23:37:08, metric 3
224.0.0.5/32       *[OSPF/10] 03:02:09, metric 1

user@host-R2> show ospf interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-1/0/6.0          DR      0.0.0.0         102.0.0.1       100.0.0.1          1
ge-1/1/6.0          DR      0.0.0.0         102.0.0.1       100.0.0.1          1
ge-1/1/4.0          BDR     0.0.0.0         103.0.0.1       102.0.0.1          1
ge-1/1/5.0          BDR     0.0.0.0         103.0.0.1       102.0.0.1          1
lo0.0               DR      0.0.0.0         102.0.0.1       0.0.0.0            0

user@host-R2> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
21.21.13.1       ge-1/0/6.0             Full      100.0.0.1        128    37
21.21.12.1       ge-1/1/6.0             Full      100.0.0.1        128    31
21.21.30.2       ge-1/1/4.0             Full      103.0.0.1        128    36
21.21.31.2       ge-1/1/5.0             Full      103.0.0.1        128    39

user@host-R2> show route protocol ospf | match /32
100.0.0.1/32       *[OSPF/10] 00:05:09, metric 1
101.0.0.1/32       *[OSPF/10] 00:04:58, metric 2
103.0.0.1/32       *[OSPF/10] 00:04:58, metric 1
104.0.0.1/32       *[OSPF/10] 00:04:58, metric 2
105.0.0.1/32       *[OSPF/10] 00:04:58, metric 3
224.0.0.5/32       *[OSPF/10] 00:07:22, metric 1

user@host-R0> show ospf interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-0/0/0.0          BDR     0.0.0.0         101.0.0.1       100.0.0.1          1
ge-2/0/0.0          BDR     0.0.0.0         102.0.0.1       100.0.0.1          1
ge-1/0/0.0          BDR     0.0.0.0         101.0.0.1       100.0.0.1          1
ge-3/0/0.0          BDR     0.0.0.0         102.0.0.1       100.0.0.1          1
ge-5/0/0.0          BDR     0.0.0.0         104.0.0.1       100.0.0.1          1
lo0.0               DR      0.0.0.0         101.0.0.1       0.0.0.0            0
ge-4/0/0.0          BDR     0.0.0.0         104.0.0.1       100.0.0.1          1

```
user@host-R0> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
21.21.11.2       ge-0/0/0.0             Full      101.0.0.1        128    34
21.21.13.2       ge-2/0/0.0             Full      102.0.0.1        128    38
21.21.10.2       ge-1/0/0.0             Full      101.0.0.1        128    35
21.21.12.2       ge-3/0/0.0             Full      102.0.0.1        128    32
21.21.15.2       ge-5/0/0.0             Full      104.0.0.1        128    36
21.21.14.2       ge-4/0/0.0             Full      104.0.0.1        128    36

user@host-R0> show route protocol ospf | match /32
101.0.0.1/32       *[OSPF/10] 1d 23:42:43, metric 1
102.0.0.1/32       *[OSPF/10] 00:10:17, metric 1
103.0.0.1/32       *[OSPF/10] 00:10:16, metric 2
104.0.0.1/32       *[OSPF/10] 1d 23:20:42, metric 1
105.0.0.1/32       *[OSPF/10] 1d 23:20:42, metric 2
224.0.0.5/32       *[OSPF/10] 1d 23:47:44, metric 1

user@host-R0> show ospf3 interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-5/0/0.0          BDR     0.0.0.0         104.0.0.1       100.0.0.1          1
lo0.0               DR      0.0.0.0         100.0.0.1       0.0.0.0            0
ge-4/0/0.0          BDR     0.0.0.0         104.0.0.1        100.0.0.1          1

user@host-R0> show ospf3 neighbor
ID               Interface              State     Pri  Dead
104.0.0.1         ge-5/0/0.0             Full      128     36
Neighbor-address fe80::aad0:e5ff:fe50:b262
104.0.0.1         ge-4/0/0.0             Full      128     37
Neighbor-address fe80::aad0:e5ff:fe50:b200

user@host-R0> show route table inet6.0 | match /128
1000::1/128        *[Direct/0] 1d 23:49:15
1003::1/128        *[OSPF3/10] 1d 07:13:56, metric 2
1004::1/128        *[OSPF3/10] 1d 23:22:04, metric 1
1005::1/128        *[OSPF3/10] 1d 07:13:37, metric 2
fe80::2a0:a500:176:14de/128
fe80::2a0:a50f:fc76:14de/128
fe80::ae4b:c8ff:fe45:6800/128
fe80::ae4b:c8ff:fe45:6be0/128
ff02::5/128        *[OSPF3/10] 1d 23:49:17, metric 1

user@host-R3> show ospf interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-0/0/0.0          BDR     0.0.0.0         101.0.0.1        103.0.0.1          1
ge-2/0/0.0          DR      0.0.0.0         103.0.0.1        102.0.0.1          1
ge-1/0/0.0          BDR     0.0.0.0         101.0.0.1        103.0.0.1          1
ge-3/0/0.0          DR      0.0.0.0         103.0.0.1        102.0.0.1          1
lo0.0               DR      0.0.0.0         103.0.0.1        0.0.0.0            0
ge-4/0/0.0          BDR     0.0.0.0         104.0.0.1        103.0.0.1          1

user@host-R3> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
21.21.20.1       ge-0/0/0.0             Full      101.0.0.1        128    36
21.21.30.1       ge-2/0/0.0             Full      102.0.0.1        128    32
21.21.21.1       ge-1/0/0.0             Full      101.0.0.1        128    39
21.21.31.1       ge-3/0/0.0             Full      102.0.0.1        128    36
21.21.40.2       ge-4/0/0.0             Full      104.0.0.1        128    31

user@host-R3> show route protocol ospf | match /32
100.0.0.1/32       *[OSPF/10] 01:46:52, metric 2
101.0.0.1/32       *[OSPF/10] 2d 10:32:20, metric 1
102.0.0.1/32       *[OSPF/10] 01:46:52, metric 1
104.0.0.1/32       *[OSPF/10] 2d 05:56:03, metric 1
user@host-R3> show ospf3 interface

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Area</th>
<th>DR ID</th>
<th>BDR ID</th>
<th>Nbrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>lo0.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>103.0.0.1</td>
<td>0.0.0.0</td>
<td>0</td>
</tr>
<tr>
<td>ge-4/0/0.0</td>
<td>BDR</td>
<td>0.0.0.0</td>
<td>104.0.0.0</td>
<td>103.0.0.1</td>
<td>1</td>
</tr>
</tbody>
</table>

user@host-R3> show ospf3 neighbor

<table>
<thead>
<tr>
<th>ID</th>
<th>State</th>
<th>Pri</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>104.0.0.1</td>
<td>ge-4/0/0.0</td>
<td>128</td>
<td>34</td>
</tr>
<tr>
<td>Neighbor-address</td>
<td>fe80::ead0:e5ff:fe50:b201</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

user@host-R3> show ospf route table protocol ospf | match /128

| 1000::1/128 | *[OSPF3/10] | 1d 08:49:40, metric 2 |
| 1004::1/128 | *[OSPF3/10] | 2d 05:56:19, metric 1 |
| 1005::1/128 | *[OSPF3/10] | 2d 08:49:22, metric 2 |
| ff02::5/128 | *[OSPF3/10] | 3d 06:40:09, metric 1 |

user@host-R4> show ospf interface

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Area</th>
<th>DR ID</th>
<th>BDR ID</th>
<th>Nbrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>100.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/1/3.0</td>
<td>BDR</td>
<td>0.0.0.0</td>
<td>105.0.0.1</td>
<td>104.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/1/4.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>105.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/1/7.0</td>
<td>DRother</td>
<td>0.0.0.0</td>
<td>0.0.0.0</td>
<td>0.0.0.0</td>
<td>0</td>
</tr>
<tr>
<td>lo0.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>0.0.0.0</td>
<td>0</td>
</tr>
<tr>
<td>ge-0/0/2.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>100.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/0/4.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>103.0.0.1</td>
<td>1</td>
</tr>
</tbody>
</table>

user@host-R4> show ospf neighbor

<table>
<thead>
<tr>
<th>Address</th>
<th>Interface</th>
<th>State</th>
<th>Pri</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.21.15.1</td>
<td>ge-0/0/3.0</td>
<td>Full</td>
<td>128</td>
<td>34</td>
</tr>
<tr>
<td>21.21.50.2</td>
<td>ge-0/1/3.0</td>
<td>Full</td>
<td>128</td>
<td>34</td>
</tr>
<tr>
<td>21.21.51.2</td>
<td>ge-0/1/4.0</td>
<td>Full</td>
<td>128</td>
<td>35</td>
</tr>
<tr>
<td>21.21.41.1</td>
<td>ge-0/0/2.0</td>
<td>Full</td>
<td>128</td>
<td>35</td>
</tr>
<tr>
<td>21.21.40.1</td>
<td>ge-0/0/4.0</td>
<td>Full</td>
<td>128</td>
<td>33</td>
</tr>
</tbody>
</table>

user@host-R4> show ospf route protocol ospf | match /32

| 100.0.0.1/32   | *[OSPF/10] | 2d 00:42:12, metric 1 |
| 101.0.0.1/32   | *[OSPF/10] | 2d 00:42:12, metric 2 |
| 102.0.0.1/32   | *[OSPF/10] | 01:31:41, metric 2    |
| 103.0.0.1/32   | *[OSPF/10] | 2d 05:40:47, metric 1 |
| 105.0.0.1/32   | *[OSPF/10] | 2d 00:42:12, metric 2 |
| 224.0.0.5/32   | *[OSPF/10] | 2d 05:43:18, metric 1 |

user@host-R4> show ospf3 interface

<table>
<thead>
<tr>
<th>Interface</th>
<th>State</th>
<th>Area</th>
<th>DR ID</th>
<th>BDR ID</th>
<th>Nbrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>ge-0/0/3.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>100.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/1/3.0</td>
<td>BDR</td>
<td>0.0.0.0</td>
<td>105.0.0.1</td>
<td>104.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/1/4.0</td>
<td>BDR</td>
<td>0.0.0.0</td>
<td>105.0.0.1</td>
<td>104.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>lo0.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>0.0.0.0</td>
<td>0</td>
</tr>
<tr>
<td>ge-0/0/2.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>100.0.0.1</td>
<td>1</td>
</tr>
<tr>
<td>ge-0/0/4.0</td>
<td>DR</td>
<td>0.0.0.0</td>
<td>104.0.0.1</td>
<td>103.0.0.1</td>
<td>1</td>
</tr>
</tbody>
</table>

user@host-R4> show ospf3 neighbor

<table>
<thead>
<tr>
<th>ID</th>
<th>State</th>
<th>Pri</th>
<th>Dead</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.0.0.1</td>
<td>ge-0/0/3.0</td>
<td>128</td>
<td>32</td>
</tr>
<tr>
<td>Neighbor-address</td>
<td>fe80::ae4b:c8ff:fe45:be0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>105.0.0.1</td>
<td>ge-0/1/3.0</td>
<td>128</td>
<td>34</td>
</tr>
<tr>
<td>Neighbor-address</td>
<td>fe80::ead0:e5ff:fe50:b280</td>
<td></td>
<td></td>
</tr>
<tr>
<td>105.0.0.1</td>
<td>ge-0/1/4.0</td>
<td>128</td>
<td>32</td>
</tr>
<tr>
<td>Neighbor-address</td>
<td>fe80::ead0:e5ff:fe50:b281</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100.0.0.1</td>
<td>ge-0/0/2.0</td>
<td>128</td>
<td>38</td>
</tr>
<tr>
<td>Neighbor-address</td>
<td>fe80::ae4b:c8ff:fe45:8600</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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103.0.0.1        ge-0/0/4.0             Full      128     38
Neighbor-address fe80::ae4b:c8ff:fe45:f000

user@host-R4> show route table inet6.0 | match /128
1000::1/128        *[OSPF3/10] 2d 00:42:17, metric 1
1003::1/128        *[OSPF3/10] 2d 05:40:47, metric 1
1004::1/128        *[Direct/0] 2d 05:43:18
1005::1/128        *[OSPF3/10] 1d 08:33:49, metric 1
fe80::aad0:e50f:fc50:b2ff/128
fe80::aad0:e5ff:fe50:b200/128
fe80::aad0:e5ff:fe50:b201/128
fe80::aad0:e5ff:fe50:b262/128
fe80::aad0:e5ff:fe50:b268/128
fe80::aad0:e5ff:fe50:b269/128
ff02::5/128        *[OSPF3/10] 2d 05:43:34, metric 1

user@host-R5> show ospf interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-0/1/4.0          DR      0.0.0.0         105.0.0.1       0.0.0.0            0
ge-0/1/4.0          DR      0.0.0.0         105.0.0.1       0.0.0.0            0
ge-0/0/3.0          DR      0.0.0.0         105.0.0.1       104.0.0.1          1
ge-0/0/5.0          DR      0.0.0.0         105.0.0.1       104.0.0.1          1
lo0.0               DR      0.0.0.0         105.0.0.1       0.0.0.0            0

user@host-R5> show ospf neighbor
Address          Interface              State     ID               Pri   Dead
21.21.50.1       ge-0/0/3.0             Full      104.0.0.1        128    35
21.21.51.1       ge-0/0/5.0             Full      104.0.0.1        128    34

user@host-R5> show route protocol ospf | match /32
100.0.0.1/32       *[OSPF/10] 2d 00:29:58, metric 2
101.0.0.1/32       *[OSPF/10] 2d 00:29:58, metric 3
102.0.0.1/32       *[OSPF/10] 01:15:59, metric 3
103.0.0.1/32       *[OSPF/10] 2d 00:29:58, metric 2
104.0.0.1/32       *[OSPF/10] 2d 00:29:58, metric 1
224.0.0.5/32       *[OSPF/10] 2d 05:27:36, metric 1

user@host-R5> show ospf3 interface
Interface           State   Area            DR ID           BDR ID          Nbrs
ge-0/1/4.0          DR      0.0.0.0         105.0.0.1       0.0.0.0            0
ge-0/0/3.0          DR      0.0.0.0         105.0.0.1       104.0.0.1          1
lo0.0               DR      0.0.0.0         105.0.0.1       0.0.0.0            0

user@host-R5> show ospf3 neighbor
ID               Interface          State   Pri   Dead
104.0.0.1        ge-0/0/3.0             Full      128    32
Neighbor-address fe80::aad0:e5ff:fe50:b268
104.0.0.1        ge-0/0/5.0             Full      128    35
Neighbor-address fe80::aad0:e5ff:fe50:b269

user@host-R5> show route table inet6.0 | match /128
1000::1/128        *[OSPF3/10] 1d 08:18:18, metric 2
1003::1/128        *[OSPF3/10] 1d 08:18:18, metric 2
1004::1/128        *[OSPF3/10] 1d 08:18:18, metric 1
1005::1/128        *[Direct/0] 2d 05:27:59
3000:db8:ffff:4::1/128
3000:db8:ffff:5::1/128
fe80::aad0:e50f:fc50:b2ff/128
fe80::aad0:e510:50:b2ff/128
fe80::aad0:e5ff:fe50:b260/128

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Meaning  OSPF and OSPF3 interfaces, neighbors, and routes are functioning properly.

Verify LDP Functionality

Purpose  On each device, display LDP interface and neighbor information to confirm the entities are functioning correctly.
Action  
On each device, run the `show ldp interface` and `show ldp neighbor` commands from operational mode.

```
user@host-R1> show ldp interface
Interface            Label space ID        Nbr count   Next hello
lo0.0                101.0.0.1:0              2           0
ge-1/0/6.0           101.0.0.1:0              1           2
ge-1/1/6.0           101.0.0.1:0              1           0
ge-1/1/5.0           101.0.0.1:0              1           2

user@host-R1> show ldp neighbor
Address            Interface          Label space ID         Hold time
100.0.0.1          lo0.0              100.0.0.1:0              34
103.0.0.1          lo0.0              103.0.0.1:0              32
21.21.11.1         ge-1/0/6.0         100.0.0.1:0              12
21.21.10.1         ge-1/1/6.0         100.0.0.1:0              11
21.21.21.2         ge-1/1/5.0         103.0.0.1:0              12

user@host-R2> show ldp interface
Interface            Label space ID        Nbr count   Next hello
lo0.0                102.0.0.1:0              2           0
ge-1/1/6.0           102.0.0.1:0              1           2
ge-1/1/5.0           102.0.0.1:0              1           1

user@host-R2> show ldp neighbor
Address            Interface          Label space ID         Hold time
100.0.0.1          lo0.0              100.0.0.1:0              42
103.0.0.1          lo0.0              103.0.0.1:0              36
21.21.12.1         ge-1/1/6.0         100.0.0.1:0              11
21.21.31.2         ge-1/1/5.0         102.0.0.1:0              10
21.21.15.2         ge-1/1/5.0         104.0.0.1:0              11

user@host-R0> show ldp interface
Interface            Label space ID        Nbr count   Next hello
lo0.0                100.0.0.1:0              2           0
ge-4/0/0.0           100.0.0.1:0              1           0
ge-0/0/0.0           100.0.0.1:0              1           0
ge-2/0/0.0           100.0.0.1:0              0           3
ge-1/0/0.0           100.0.0.1:0              1           2
ge-3/0/0.0           100.0.0.1:0              1           3
ge-5/0/0.0           100.0.0.1:0              1           1

user@host-R0> show ldp neighbor
Address            Interface          Label space ID         Hold time
101.0.0.1          lo0.0              101.0.0.1:0              43
102.0.0.1          lo0.0              102.0.0.1:0              41
21.21.14.2         ge-4/0/0.0         104.0.0.1:0              14
21.21.11.2         ge-0/0/0.0         101.0.0.1:0              14
21.21.10.2         ge-1/0/0.0         101.0.0.1:0              13
21.21.12.2         ge-3/0/0.0         102.0.0.1:0              10
21.21.15.2         ge-5/0/0.0         104.0.0.1:0              11

user@host-R3> show ldp interface
Interface            Label space ID        Nbr count   Next hello
lo0.0                103.0.0.1:0              2           0
ge-0/0/0.0           103.0.0.1:0              0           3
ge-2/0/0.0           103.0.0.1:0              0           2
ge-1/0/0.0           103.0.0.1:0              1           3
ge-3/0/0.0           103.0.0.1:0              1           1
ge-4/0/0.0           103.0.0.1:0              1           3

user@host-R3> show ldp neighbor
```
<table>
<thead>
<tr>
<th>Address</th>
<th>Interface</th>
<th>Label space ID</th>
<th>Hold time</th>
</tr>
</thead>
<tbody>
<tr>
<td>101.0.0.1</td>
<td>lo0.0</td>
<td>101.0.0.1:0</td>
<td>33</td>
</tr>
<tr>
<td>102.0.0.1</td>
<td>lo0.0</td>
<td>102.0.0.1:0</td>
<td>36</td>
</tr>
<tr>
<td>21.21.21.1</td>
<td>ge-1/0/0.0</td>
<td>101.0.0.1:0</td>
<td>11</td>
</tr>
<tr>
<td>21.21.31.1</td>
<td>ge-3/0/0.0</td>
<td>102.0.0.1:0</td>
<td>10</td>
</tr>
<tr>
<td>21.21.40.2</td>
<td>ge-4/0/0.0</td>
<td>104.0.0.1:0</td>
<td>13</td>
</tr>
</tbody>
</table>

```
user@host-R4>show ldp interface
Interface | Label space ID | Nbr count | Next hello |
---------|---------------|-----------|------------|
lo0.1    | 104.0.0.1:0   | 0         | 0          |
ge-0/0/2.0 | 104.0.0.1:0 | 1         | 0          |
ge-0/0/4.0 | 104.0.0.1:0 | 1         | 4          |
ge-0/0/3.0 | 104.0.0.1:0 | 1         | 3          |
ge-0/1/3.0 | 104.0.0.1:0 | 1         | 1          |
ge-0/1/4.0 | 104.0.0.1:0 | 1         | 2          |
```

```
user@host-R4>show ldp neighbor
Address | Interface | Label space ID | Hold time |
--------|-----------|---------------|-----------|
21.21.14.1 | ge-0/0/2.0 | 100.0.0.1:0 | 13        |
21.21.40.1 | ge-0/0/4.0 | 103.0.0.1:0 | 11        |
21.21.15.1 | ge-0/0/3.0 | 100.0.0.1:0 | 14        |
21.21.50.2 | ge-0/1/3.0 | 105.0.0.1:0 | 14        |
21.21.51.2 | ge-0/1/4.0 | 105.0.0.1:0 | 14        |
```

```
user@host-R5>show ldp interface
Interface | Label space ID | Nbr count | Next hello |
---------|---------------|-----------|------------|
lo0.0    | 105.0.0.1:0   | 0         | 0          |
ge-0/0/3.0 | 105.0.0.1:0 | 1         | 0          |
ge-0/0/5.0 | 105.0.0.1:0 | 1         | 2          |
```

```
user@host-R5>show ldp neighbor
Address | Interface | Label space ID | Hold time |
--------|-----------|---------------|-----------|
21.21.50.1 | ge-0/0/3.0 | 104.0.0.1:0 | 14        |
21.21.51.1 | ge-0/0/5.0 | 104.0.0.1:0 | 10        |
```

**Meaning**
LDP interfaces and neighbors are operational.

**Verify MPLS Interfaces**

**Purpose**
On each device, display MPLS interface information to confirm the interfaces are Up.
### Action
On each device, run the `show mpls interface` command from operational mode.

```
user@host-R1>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-1/0/6.0       Up          none
ge-1/1/6.0       Up          none
ge-1/1/4.0       Up          none
ge-1/1/5.0       Up          none

user@host-R2>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-1/1/6.0       Up          none
ge-1/1/4.0       Up          none
ge-1/1/5.0       Up          none

user@host-R0>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-4/0/0.0       Up          none
ge-0/0/0.0       Up          none
ge-2/0/0.0       Up          none
ge-1/0/0.0       Up          none
ge-3/0/0.0       Up          none
ge-5/0/0.0       Up          none

user@host-R3>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-0/0/0.0       Up          none
ge-2/0/0.0       Up          none
ge-1/0/0.0       Up          none
ge-3/0/0.0       Up          none
ge-4/0/0.0       Up          none

user@host-R4>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-0/0/2.0       Up          none
ge-0/0/4.0       Up          none
ge-0/0/3.0       Up          none
ge-0/1/3.0       Up          none
ge-0/1/4.0       Up          none

user@host-R5>show mpls interface
Interface        State       Administrative groups (x: extended)
ge-0/0/3.0       Up          none
ge-0/0/5.0       Up          none
```

### Meaning
MPLS interfaces are operational.

### Purpose
Display L2 circuit and BFD session information to confirm the interfaces and sessions are functioning properly.
Action

On R1, R2, and R0, run the `show interfaces terse | match ccc | count`, `show l2circuit connections summary`, `show l2circuit connections interface ge-1/0/2.1`, `show bfd session summary`, and `show bfd session detail` commands from operational mode. The output of the `show bfd session detail` command is truncated in this example.

```
user@host-R1> show interfaces terse | match ccc | count
Count: 1000 lines

user@host-R1> show l2circuit connections summary
Layer-2 Circuit Connections Summary:
Neighbor: 100.0.0.1
  Total VCs up: 1000, Total VCs down: 0
Neighbor: 103.0.0.1
  Total VCs up: 0, Total VCs down: 1000

user@host-R1> show l2circuit connections interface ge-1/0/2.1
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid      NP -- interface h/w not present
MM -- mtu mismatch               VC-Dn -- Virtual circuit Down
CM -- control-word mismatch      Dn -- down
EM -- encapsulation mismatch     Up -- operational
VM -- vlan id mismatch           CF -- Call admission control failure
OL -- no outgoing label          IB -- TDM incompatible bitrate
NC -- intf caps not CCC/TCC      TM -- TDM misconfiguration
BK -- Backup Connection         ST -- Standby Connection
CB -- rcvd cell-bundle size bad  SP -- Static Pseudowire
LD -- local site signaled down   RS -- remote site standby
RD -- remote site signaled down  HS -- Hot-standby Connection
XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 100.0.0.1
Interface                 Type  St     Time last up          # Up trans
ge-1/0/2.1(vc 1)          rmt   Up     Feb 13 23:12:57 2015           1
Remote PE: 100.0.0.1, Negotiated control-word: Yes (Null)
Incoming label: 667712, Outgoing label: 299776
Negotiated PW status TLV: No
Local interface: ge-1/0/2.1, Status: Up, Encapsulation: ETHERNET
Flow Label Transmit: No, Flow Label Receive: No

Neighbor: 103.0.0.1
ge-1/0/2.1(vc 1)          rmt   BK

user@host-R1> show bfd session summary
1000 sessions, 1000 clients
Cumulative transmit rate 999.8 pps, cumulative receive rate 999.8 pps

user@host-R1> show bfd session detail

Detect | Transmit
Address  State  Interface  Time  Interval  Multiplier
127.0.0.1 | Up     ge-1/1/6.0  4.000  1.000        4
Client L2CKT-OAM, TX interval 1.000, RX interval 1.000
Session up time 00:06:09
Local diagnostic None, remote diagnostic None
Remote state Up, version 1
Session type: VCCV BFD

```

user@host-R2> show interfaces terse | match ccc | count
Count: 1048 lines

user@host-R2> show l2circuit connections summary
Layer-2 Circuit Connections Summary:
Neighbor: 100.0.0.1
Total VCs up: 1048, Total VCs down: 0
Neighbor: 103.0.0.1
Total VCs up: 0, Total VCs down: 1048

user@host-R2> show l2circuit connections interface ge-1/0/2.1
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid      NP -- interface h/w not present
MM -- mtu mismatch              Dn -- down
EM -- encapsulation mismatch    VC-Dm -- Virtual circuit Down
CM -- control-word mismatch     Up -- operational
VM -- vlan id mismatch          IB -- TDM incompatible bitrate
NC -- intf encap not CCC/TCC    TM -- TDM misconfiguration
BK -- Backup Connection         ST -- Standby Connection
CB -- rcvd cell-bundle size bad SP -- Static Pseudowire
LD -- local site signaled down  RS -- remote site standby
RD -- remote site signaled down  XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 100.0.0.1
Interface        Type  St    Time last up     # Up trans
ge-1/0/2.1(vc 1001)  rmt  Up    Feb 15 22:42:21 2015    1
Remote PE: 100.0.0.1, Negotiated control-word: Yes (Null)
Incoming label: 299776, Outgoing label: 315776
Negotiated PW status TLV: No
Local interface: ge-1/0/2.1, Status: Up, Encapsulation: ETHERNET
Neighbor: 103.0.0.1
ge-1/0/2.1(vc 1001)  rmt  BK

user@host-R2> show bfd session summary
1048 sessions, 1048 clients
Cumulative transmit rate 1047.8 pps, cumulative receive rate 1047.8 pps

user@host-R2> show bfd session detail

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user@host-R0>show interfaces terse | match ccc | count
Count: 2048 lines

user@host-R0>show l2circuit connections summary
Layer-2 Circuit Connections Summary:
Neighbor: 101.0.0.1
   Total VCs up: 1000, Total VCs down: 0
Neighbor: 102.0.0.1
   Total VCs up: 1048, Total VCs down: 0

user@host-R0>show l2circuit connections interface ps0.0
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid
MM -- mtu mismatch
EM -- encapsulation mismatch
CM -- control-word mismatch
VM -- vlan id mismatch
OL -- no outgoing label
NC -- intf encaps not CCC/TCC
BK -- Backup Connection
LD -- local site signaled down
RD -- remote site signaled down
XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 101.0.0.1
Interface Type St Time last up # Up trans
ps0.0(vc 1) rmt Up Feb 13 22:13:18 2015 1
   Remote PE: 101.0.0.1, Negotiated control-word: Yes (Null)
   Incoming label: 299776, Outgoing label: 667712
   Negotiated PW status TLV: No
   Local interface: ps0.0, Status: Up, Encapsulation: ETHERNET

user@host-R0>show bfd session summary
2048 sessions, 2048 clients
Cumulative transmit rate 2047.5 pps, cumulative receive rate 2047.5 pps

user@host-R0> show bfd session detail

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>127.0.0.1</td>
<td>Up</td>
<td>ge-0/0/0.0</td>
<td>4.000</td>
<td>1.000</td>
<td>4</td>
</tr>
</tbody>
</table>

Client L2CKT-OAM, TX interval 1.000, RX interval 1.000
Session up time 00:00:39
Local diagnostic None, remote diagnostic None
Remote state Up, version 1
Replicated
Session type: VCCV BFD

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>127.0.0.1</td>
<td>Up</td>
<td>ge-3/0/0.0</td>
<td>4.000</td>
<td>1.000</td>
<td>4</td>
</tr>
</tbody>
</table>

Client L2CKT-OAM, TX interval 1.000, RX interval 1.000
Session up time 00:13:29
Local diagnostic None, remote diagnostic None
Remote state Up, version 1
Replicated
Session type: VCCV BFD

<table>
<thead>
<tr>
<th>Address</th>
<th>State</th>
<th>Interface</th>
<th>Detect Time</th>
<th>Transmit Interval</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>127.0.0.1</td>
<td>Up</td>
<td>ge-3/0/0.0</td>
<td>4.000</td>
<td>1.000</td>
<td>4</td>
</tr>
</tbody>
</table>

Client L2CKT-OAM, TX interval 1.000, RX interval 1.000
Session up time 00:13:07
Local diagnostic None, remote diagnostic None
Remote state Up, version 1
Replicated
Session type: VCCV BFD

... 

**Meaning**  
CCC and L2 circuit interfaces are operational.

**Verify Logical Tunnel (LT) Interfaces on R0 and R3**

**Purpose**  
Display logical tunnel interfaces to ensure they are Up.
Action  On R0 and R3 (from operational mode), run the `show interfaces terse | match lt` command to confirm the LT interfaces are Up. Then run the `show interfaces terse` command for each individual interface to display more detailed information. One interface for each device is shown here. Repeat for additional interfaces as needed.

```
user@host-R0> show interfaces terse | match lt
lt-0/0/10               up    up
lt-0/1/10               up    up
lt-0/2/10               up    up
lt-0/3/10               up    up
lt-1/0/10               up    up
lt-1/1/10               up    up
lt-1/2/10               up    up
lt-1/3/10               up    up
lt-2/0/10               up    up
lt-2/1/10               up    up
lt-2/2/10               up    up
lt-2/3/10               up    up
lt-3/0/10               up    up
lt-3/1/10               up    up
lt-3/2/10               up    up
lt-3/3/10               up    up
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice

user@host-R0> show interfaces lt-0/0/10 terse
Interface               Admin Link Proto    Local                 Remote
lt-0/0/10               up    up

user@host-R3> show interfaces terse | match lt
multiservice

lt-0/0/10               up    up
lt-0/1/10               up    up
lt-0/2/10               up    up
lt-0/3/10               up    up
lt-1/0/10               up    up
lt-1/1/10               up    up
lt-1/2/10               up    up
lt-1/3/10               up    up
lt-2/0/10               up    up
lt-2/1/10               up    up
lt-2/2/10               up    up
lt-2/3/10               up    up
lt-3/0/10               up    up
lt-3/1/10               up    up
lt-3/2/10               up    up
lt-3/3/10               up    up
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice
multiservice

user@host-R3> show interfaces lt-0/0/10 terse
Interface               Admin Link Proto    Local                 Remote
lt-0/0/10               up    up

Meaning   LT interfaces are all confirmed to be Up.
Verify Pseudoservice (PS) Interfaces on R0 and R3

**Purpose**
Display pseudoservice interfaces to ensure they are Up.

**Action**
On R0 and R3, run the `show interfaces ps0 terse` command from operational mode to confirm the PS interfaces are Up.

```
user@host-R0> show interfaces ps0 terse
Interface       Admin Link Proto Local               Remote
ps0             up    up    ccc
ps0.0           up    up    inet     100.0.0.1           --> 0/0
ps0.32767       up    up    inet6 fe80::2a0:a500:176:14de
ps0.1073741863  up    up    inet6 fe80::2a0:a500:176:14de

user@host-R0> show interfaces terse | match ps | match ccc | match up | count
Count: 2048 lines

user@host-R0> show interfaces ps0 terse
Interface       Admin Link Proto Local               Remote
ps0             up    up    ccc
ps0.0           up    up    inet6 fe80::2a0:a500:176:14de
ps0.32767       up    up    inet6 fe80::2a0:a500:176:14de

user@host-R3> show interfaces terse | match ps | match ccc | match up | count
Count: 2048 lines

user@host-R3> show interfaces ps0 terse
Interface       Admin Link Proto Local               Remote
ps0             up    up    ccc
ps0.0           up    up    inet6 fe80::2a0:a500:176:14de
ps0.32767       up    up
```

**Meaning**
PS interfaces are up and running.

Verify DHCPv4 Over Dynamic VLAN Interfaces on R0

**Purpose**
Display DHCPv4 subscriber and other DHCPv4 over dynamic VLAN information to ensure the interfaces are functioning.
Action

From operational mode, run the show subscribers, show dhcp server binding, show subscribers detail, show route protocol access-internal, show firewall, show class-of-service traffic-control-profile, and show class-of-service scheduler-hierarchy interface ps0.1073741855 commands.

```
user@host-R0>show subscribers
Interface           IP Address/VLAN ID          User Name
LS:RI
ps0.1073741855      0x8100.1 0x8100.100                     SST_USER_VLAN_DEFAULT
default:default
ps0.1073741855      100.16.0.3
SST_USER_DHCP_V4_DEFAULT       default:default

user@host-R0>show dhcp server binding
IP address        Session Id  Hardware address   Expires     State      Interface
100.16.0.3        55          00:22:68:14:84:d5  25191       BOUND    ps0.1073741855

user@host-R0>show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741855
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 54
Session ID: 54
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100
Login Time: 2015-02-15 21:47:47 PST

Type: DHCP
User Name: SST_USER_DHCP_V4_DEFAULT
IP Address: 100.16.0.3
IP Netmask: 255.0.0.0
Logical System: default
Routing Instance: default
Interface: ps0.1073741855
Interface type: Static
Underlying Interface: ps0.1073741855
Dynamic Profile Name: client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 55
Session ID: 55
Stacked VLAN Id: 1
VLAN Id: 100
Login Time: 2015-02-15 21:47:51 PST
Service Sessions: 1
DHCP Options: len 48
  35 01 01 32 04 64 10 00 03 0c 16 66 69 72 65 62 61 63 6b 2d
  54 68 69 6e 6b 50 61 64 2d 54 34 30 37 0d 01 1c 02 03 0f
  06 77 0c 2c 2f 1a 79 2a
```

user@host-R0>show route protocol access-internal
inet.0: 34 destinations, 35 routes (34 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100.16.0.3/32  *[Access-internal/12] 00:04:41
> to #0 0.22.68.14.84.d5 via ps0.1073741855

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

mpls.0: 4110 destinations, 4110 routes (4110 active, 0 holddown, 0 hidden)
__mpls-oam__.mpls.0: 2048 destinations, 2048 routes (2048 active, 0 holddown, 0 hidden)

inet6.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)

inet6.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

l2circuit.0: 4096 destinations, 4096 routes (4096 active, 0 holddown, 0 hidden)

user@host-R0> show firewall
Filter: RPF-PASS-DHCP-V4
Counters:

<table>
<thead>
<tr>
<th>Name</th>
<th>Bytes</th>
<th>Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPF-DHCP-V4-TRAFFIC</td>
<td>1968</td>
<td>6</td>
</tr>
</tbody>
</table>

Filter: RPF-PASS-DHCP-V6
Counters:

<table>
<thead>
<tr>
<th>Name</th>
<th>Bytes</th>
<th>Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPF-DHCP-V6-TRAFFIC</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Filter: __default_bpdu_filter__

Filter: INPUT-V4-FILTER-01-ps0.1073741855-in
Counters:

<table>
<thead>
<tr>
<th>Name</th>
<th>Bytes</th>
<th>Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTER11-ps0.1073741855-in</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>__junos-dyn-service-counter</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Filter: OUTPUT-V4-FILTER-01-ps0.1073741855-out
Counters:

<table>
<thead>
<tr>
<th>Name</th>
<th>Bytes</th>
<th>Packets</th>
</tr>
</thead>
<tbody>
<tr>
<td>COUNTER12-ps0.1073741855-out</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>__junos-dyn-service-counter</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

user@host-R0> show class-of-service traffic-control-profile
Traffic control profile: TCP_PS.o.ps0.1073741855, Index: 1337886568
  Shaping rate: 60000000
  Scheduler map: ps0.1073741855.SMAP_PS
  Guaranteed rate: 50000000

user@host-R0> show class-of-service scheduler-hierarchy interface ps0.1073741855

<table>
<thead>
<tr>
<th>Interface/Resource name</th>
<th>Shaping rate</th>
<th>Guaranteed rate</th>
<th>Guaranteed/Queue</th>
<th>Excess weight</th>
<th>Excess weight high/low</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kbts</td>
<td>kbps</td>
<td>priority</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lt-0/0/10</td>
<td>1000000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>lt-0/0/10 RTP</td>
<td>1000000</td>
<td>0</td>
<td></td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>FC0</td>
<td>1000000</td>
<td>0</td>
<td>Low Low</td>
<td>950</td>
<td></td>
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<tr>
<td>FC3</td>
<td>1000000</td>
<td>0</td>
<td>Low Low</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>ps0.1073741855</td>
<td>60000</td>
<td>50000</td>
<td>Low Low</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FC0</td>
<td>60000</td>
<td>Disabled</td>
<td>High High</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>FC1</td>
<td>60000</td>
<td>20000</td>
<td>Medium Low</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>FC2</td>
<td>60000</td>
<td>14950</td>
<td>Low Low</td>
<td>299</td>
<td></td>
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<tr>
<td>Meaning</td>
<td>DHCPv4 over dynamic VLAN interfaces are operational.</td>
<td></td>
<td></td>
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<tr>
<td>-------------</td>
<td>-------------------------------------------------------</td>
<td></td>
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</tr>
</tbody>
</table>

**Purpose**
Display DHCPv6-PD subscriber and other DHCPv6-PD over dynamic VLAN information to ensure the interfaces are functioning.
Action

From operational mode, run the `show subscribers`, `show dhcpv6 server binding`, `show subscribers detail`, `show route table inet6.0 protocol access`, `show firewall`, `show class-of-service traffic-control-profile`, and `show class-of-service scheduler-hierarchy` interface ps0.1073741856 commands.

```
user@host-R0>show subscribers
Interface          IP Address/VLAN ID              User Name
LS:RI              0x8100.1 0x8100.100            SST_USER_VLAN_DEFAULT
 default:default
ps0.1073741856      1000::/56                    SST_USER_DHCP_V6_DEFAULT     default:default
user@host-R0>show dhcpv6 server binding
Prefix          Session Id  Expires  State    Interface    Client DUID
1000::/56        58          25178    BOUND    ps0.1073741856
LL_TIME0x1-0x1c0fbbe9-00:22:68:14:84:d5
user@host-R0>show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741856
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 57
Session ID: 57
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100
Login Time: 2015-02-15 21:54:47 PST

Type: DHCP
User Name: SST_USER_DHCP_V6_DEFAULT
IPv6 Prefix: 1000::/56
Logical System: default
Routing Instance: default
Interface: ps0.1073741856
Interface type: Static
Underlying Interface: ps0.1073741856
Dynamic Profile Name: client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 58
Session ID: 58
Stacked VLAN Id: 1
VLAN Id: 100
Login Time: 2015-02-15 21:54:48 PST
Service Sessions: 1
DHCP Options: len 48
00 01 00 0e 00 01 00 01 1c 0f bb e9 00 22 68 14 84 d5 00 08
00 02 00 64 00 06 00 04 00 17 00 18 00 19 00 0c 00 00 00 01
00 00 00 00 00 00 00 00

user@host-R0>show route table inet6.0 protocol access
inet6.0: 13 destinations, 14 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
```
Meaning  DHCPv6-PD over dynamic VLAN interfaces are operational.

Verify PPPoE Over Dynamic VLAN Interfaces on R0

Purpose  Display PPPoE subscriber and other PPPoE over dynamic VLAN information to ensure the interfaces are functioning.
Action

From operational mode, run the `show subscribers`, `show subscriber summary`, `show subscribers detail`, `show pppoe interfaces`, `show route protocol access-internal`, `show firewall`, `show class-of-service traffic-control-profile`, and `show class-of-service scheduler-hierarchy` interface ps0.1073741859 commands.

```
user@host-R0> show subscribers
Interface   IP Address/VLAN ID               User Name
ps0.1073741859 0x8100.1 0x8100.100          SST_USER_VLAN_DEFAULT
default:default

user@host-R0> show subscribers summary
Subscribers by State
Active: 2
Total: 2

Subscribers by Client Type
VLAN: 1
PPPoE: 1
Total: 2

user@host-R0> show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741859
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 63
Session ID: 63
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100

Type: PPPoE
User Name: SST_USER_PPPOE_LT_DEFAULT
IP Address: 100.16.0.7
IP Netmask: 255.0.0.0
Primary DNS Address: 9.0.0.100
Secondary DNS Address: 9.0.0.101
Logical System: default
Routing Instance: default
Interface: pp0.1073741860
Interface type: Dynamic
Underlying Interface: ps0.1073741859
Dynamic Profile Name: pppoe-client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 64
Session ID: 64
Stacked VLAN Id: 1
VLAN Id: 100
Login Time: 2015-02-15 22:10:00 PST
```
Service Sessions: 1

user@host-R0> show pppoe interfaces
pp0.1073741860 Index 586
  State: Session Up, Session ID: 1, Type: Dynamic,
  Service name: (empty), Remote MAC address: 00:22:68:14:84:D5,
  Session AC name: petrel,
  Session uptime: 00:03:23 ago,
  Dynamic Profile: pppoe-client-profile,
  Underlying interface: ps0.1073741859 Index 585

user@host-R0> show route protocol access-internal
inet.0: 34 destinations, 35 routes (34 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
  100.16.0.7/32  *[Access-internal/12] 00:03:31
    > via pp0.1073741860

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

mpls.0: 4110 destinations, 4110 routes (4110 active, 0 holddown, 0 hidden)
  __mpls-oam__.mpls.0: 2048 destinations, 2048 routes (2048 active, 0 holddown, 0 hidden)

inet6.0: 12 destinations, 13 routes (12 active, 0 holddown, 0 hidden)

inet6.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

l2circuit.0: 4096 destinations, 4096 routes (4096 active, 0 holddown, 0 hidden)

user@host-R0> show firewall
Filter: RPF-PASS-DHCP-V4
  Counters:
  Name                                                Bytes              Packets
  RPF-DHCP-V4-TRAFFIC                                  1968                    6

Filter: RPF-PASS-DHCP-V6
  Counters:
  Name                                                Bytes              Packets
  RPF-DHCP-V6-TRAFFIC                                  0                    0

Filter: __default_bpdu_filter__

Filter: INPUT-V4-FILTER-01-pp0.1073741860-in
  Counters:
  Name                                                Bytes              Packets
  COUNTER11-pp0.1073741860-in                         40698                  238
  __junos-dyn-service-counter                         40698                  238

Filter: OUTPUT-V4-FILTER-01-pp0.1073741860-out
  Counters:
  Name                                                Bytes              Packets
  COUNTER12-pp0.1073741860-out                            0                    0
  __junos-dyn-service-counter                             0                    0

Filter: INPUT-V6-FILTER-01-pp0.1073741860-in
  Counters:
  Name                                                Bytes              Packets
  COUNTER21-pp0.1073741860-in                          152                     2
  __junos-dyn-service-counter                           152                     2
Filter: OUTPUT-V6-FILTER-01-pp0.1073741860-out
Counters:
Name                                      Bytes  Packets
COUNTER22-pp0.1073741860-out             0       0
__junos-dyn-service-counter               0       0

user@host-R0>show class-of-service traffic-control-profile
Traffic control profile: TCP_PS.o.ps0.1073741859, Index: 1337886564
  Shaping rate: 60000000
  Scheduler map: ps0.1073741859.SMAP_PS
  Guaranteed rate: 50000000

user@host-R0>show class-of-service scheduler-hierarchy interface ps0.1073741859
Interface/Resource name Shaping rate Guaranteed rate Guaranteed/Queue weight Excess weight
Resource name         kbits         kbits     priority    high/low     weight
lt-0/0/10             1000000
lt-0/0/10 RTP          1000000 0         Low  Low      1   1
FC0                    1000000 0         Low  Low      950
FC3                    1000000 0         Low  Low      50
ps0.1073741859         600000 50000     High High    500 500
FC0                    600000 Disabled High High    2
FC1                    600000 200000 Medium Low     400
FC2                    600000 149500 Low Low      299
FC3                    600000 149500 Low Low      299

Meaning  PPPoE over dynamic VLAN interfaces are operational.

Verify DHCP-PD Over PPPoE Over Dynamic VLAN Interfaces on R0

Purpose  Display PPPoE subscriber, DHCPv6 server binding, and inet6 route table information to ensure the interfaces are functioning.
Action  From operational mode, run the show subscribers, show subscriber summary, show dhcpv6
server binding, show subscribers detail, and show route table inet6.0 protocol access
commands.

user@host-R0>show subscribers
Interface           IP Address/VLAN ID                      User Name
LS:RI
ps0.1073741859      0x8100.1 0x8100.100                     SST_USER_VLAN_DEFAULT
default:default
pp0.1073741860      100.16.0.7       SST_USER_PPPOE_LT_DEFAULT       default:default
*                   1000::/56
pp0.1073741860      1000::/56
                    default:default

user@host-R0>show subscribers summary
Subscribers by State
    Active: 3
    Total: 3

Subscribers by Client Type
    DHCP: 1
    VLAN: 1
    PPPoE: 1
    Total: 3

user@host-R0>show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741859
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 63
Session ID: 63
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100

Type: PPPoE
User Name: SST_USER_PPPOE_LT_DEFAULT
IP Address: 100.16.0.7
IP Netmask: 255.0.0.0
Primary DNS Address: 9.0.0.100
Secondary DNS Address: 9.0.0.101
Logical System: default
Routing Instance: default
Interface: pp0.1073741860
Interface type: Dynamic
Underlying Interface: ps0.1073741859
Dynamic Profile Name: pppoe-client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 64
Session ID: 64
Stacked VLAN Id: 1
VLAN Id: 100
Login Time: 2015-02-15 22:10:00 PST
Service Sessions: 1

user@host-R0> show dhcpv6 server binding
Prefix                  Session Id  Expires  State    Interface    Client DUID
1000::/56               66          25102    BOUND    pp0.1073741860
LL_TIME0x1-0x1c0fbbe9-00:22:68:14:84:d5

user@host-R0> show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741859
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 63
Session ID: 63
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100

Type: PPPoE
User Name: SST_USER_PPPOE_LT_DEFAULT
IP Address: 100.16.0.7
IP Netmask: 255.0.0.0
Primary DNS Address: 9.0.0.100
Secondary DNS Address: 9.0.0.101
IPv6 Prefix: 1000::/56
Logical System: default
Routing Instance: default
Interface: pp0.1073741860
Interface type: Dynamic
Underlying Interface: ps0.1073741859
Dynamic Profile Name: pppoe-client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 64
Session ID: 64
Stacked VLAN Id: 1
VLAN Id: 100
Login Time: 2015-02-15 22:10:00 PST
Service Sessions: 1

Type: DHCP
IPv6 Prefix: 1000::/56
Logical System: default
Routing Instance: default
Interface: pp0.1073741860
Interface type: Static
Underlying Interface: ps0.1073741859
MAC Address: 00:22:68:14:84:d5
State: Active
Radius Accounting ID: 66
Session ID: 66
Underlying Session ID: 64
DHCP Options: len 48
00 01 00 0e 00 01 00 01 1c 0f bb e9 00 22 68 14 84 d5 00 08
00 02 00 00 00 06 00 04 00 00 17 00 18 00 19 00 0c 00 00 00 01
00 00 00 00 00 00 00 00

user@host-R0>show route table inet6.0 protocol access
inet6.0: 13 destinations, 14 routes (13 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

1000::/56          *[Access/13] 00:02:02
> via pp0.1073741860

Meaning  DHCPv6-PD over PPPoE over dynamic VLAN interfaces are operational.

Verify LAC PPP over Dynamic Interfaces on R0

Purpose  Display subscriber, network access AAA, and L2TP services information to ensure the interfaces are functioning.
Action
From operational mode, run the `show subscribers`, `show subscriber summary`, `show subscribers detail`, `show network-access aaa subscribers`, `show network-access aaa subscribers session-id 67`, `show network-access aaa subscribers session-id 67 detail`, `show network-access aaa subscribers session-id 68`, `show network-access aaa subscribers session-id 68 detail`, `show services l2tp summary`, `show services l2tp destination`, `show services l2tp tunnel`, `show services l2tp session`, `show services l2tp destination extensive`, `show services l2tp tunnel extensive`, and `show services l2tp session extensive` commands.

```
user@host-R0# show subscribers
Interface           IP Address/VLAN ID                      User Name
LS:RI
ps0.1073741861      0x8100.1 0x8100.100                     SST_USER_VLAN_DEFAULT
default:default
pp0.1073741862      Tunneled
SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM       default:default

user@host-R0# show subscribers summary
Subscribers by State
  Active: 2
  Total: 2

Subscribers by Client Type
  VLAN: 1
  PPPoE: 1
  Total: 2

user@host-R0# show subscribers detail
Type: VLAN
User Name: SST_USER_VLAN_DEFAULT
Logical System: default
Routing Instance: default
Interface: ps0.1073741861
Interface type: Dynamic
Underlying Interface: ps0
Dynamic Profile Name: vlan-prof-0
Dynamic Profile Version: 2
State: Active
Radius Accounting ID: 67
Session ID: 67
Stacked VLAN Id: 0x8100.1
VLAN Id: 0x8100.100
Login Time: 2015-02-15 22:19:54 PST

Type: PPPoE
User Name: SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM
Logical System: default
Routing Instance: default
Interface: pp0.1073741862
Interface type: Dynamic
Underlying Interface: ps0.1073741861
Dynamic Profile Name: pppoe-client-profile
Dynamic Profile Version: 1
MAC Address: 00:22:68:14:84:d5
State: Active
PPP State: Tunnelled
Local IP Address: 100.0.0.1
Remote IP Address: 105.0.0.1
Radius Accounting ID: 68
Session ID: 68
```
Stacked VLAN Id: 1
VLAN Id: 100

```
user@host-R0> show network-access aaa subscribers
Username                 Logical system/Routing instance   Client type
Session-ID
SST_USER_VLAN_DEFAULT    default:default                   vlan           67
SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM default:default       pppoe          68
```

```
user@host-R0> show network-access aaa subscribers session-id 67
Logical system/Routing instance   Client type    Session-ID     Session uptime
Accounting
default:default                   vlan           67             00:09:43
on/volume+time
```

```
user@host-R0> show network-access aaa subscribers session-id 67 detail
Type: vlan
Stripped username: SST_USER_VLAN_DEFAULT
AAA Logical system/Routing instance: default:default
Target Logical system/Routing instance: default:default
Access-profile: Access-Profile-0
Session ID: 67
Accounting Session ID: 67
Multi Accounting Session ID: 0
Authentication State: AuthStateActive
Accounting State: Acc-Interim-Sent
Provisioning Type: None
```

```
user@host-R0> show network-access aaa subscribers session-id 68
Logical system/Routing instance   Client type    Session-ID     Session uptime
Accounting
default:default                   pppoe          68             00:09:48
on/volume+time
```

```
user@host-R0> show network-access aaa subscribers session-id 68 detail
Type: pppoe
Username: SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM
Stripped username: SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM
AAA Logical system/Routing instance: default:default
Target Logical system/Routing instance: default:default
Access-profile: Access-Profile-0
Session ID: 68
Accounting Session ID: 68
Multi Accounting Session ID: 0
Authentication State: AuthStateActive
Accounting State: Acc-Interim-Sent
Provisioning Type: None
```

```
user@host-R0> show services l2tp summary
Failover within a preference level is Disabled
Weighted load balancing is Disabled
Tunnel authentication challenge is Enabled
Calling number avp is Enabled
Failover Protocol is Enabled
Tx Connect speed method is static
Rx speed avp when equal is Disabled
Tunnel assignment id format is assignment-id
Tunnel Tx Address Change is Accept
Max Retransmissions for Established Tunnel is 7
Max Retransmissions for Not Established Tunnel is 5
Tunnel Idle Timeout is 60 seconds
```
Destruct Timeout is 300 seconds
Destination Lockout Timeout is 300 seconds
Destinations: 1, Tunnels: 1, Sessions: 1, Switched sessions: 0

user@host-R0> show services l2tp destination
Local Name    Remote IP        Tunnels       Sessions  State
3             105.0.0.1        1             1         Enabled

user@host-R0> show services l2tp tunnel
Local ID  Remote ID  Remote IP               Sessions  State
26595     30823      105.0.0.1:1701                 1  Established

user@host-R0> show services l2tp session
Tunnel local ID: 26595
Local  Remote   State                Interface         Interface
ID     ID                            unit              Name
8956   1214     Established          1073741862        pp0

user@host-R0> show services l2tp destination extensive
Waiting for statistics...
Local name: 3
Remote IP: 105.0.0.1
Tunnels: 1, Sessions: 1
State: Enabled
Local IP: 100.0.0.1
Transport: ipUdp, Logical System: default, Router Instance: default
Lockout State: not locked
Connections    Totals    Active    Failed
Tunnels         1         1         0
Sessions         1         1         0
Packets               Bytes
Control Tx       16          591
Control Rx       16          438
Data Tx          584         122.2K
Data Rx          441         23.8K
Errors Tx        0
Errors Rx        0

user@host-R0> show services l2tp tunnel extensive
Waiting for statistics...
Tunnel local ID: 26595, Tunnel remote ID: 30823
Remote IP: 105.0.0.1:1701
Sessions: 1, State: Established
Tunnel Name: 3/Tunnel-ID-1
Local IP: 100.0.0.1:1701
Local name: petrel, Remote name: R5
Effective Peer Resync Mechanism: failover protocol
Nas Port Method: none
Tunnel Logical System: default, Tunnel Routing Instance: default
Max sessions: 128100, Window size: 4, Hello interval: 60
Create time: Sun Feb 15 22:20:00 2015, Up time: 00:13:52
Idle time: 00:00:00
Statistics since: Sun Feb 15 22:20:00 2015
Packets               Bytes
Control Tx       16          591
Control Rx       16          438
Data Tx          584         122.2K
Data Rx          441         23.8K
Errors Tx        0
Errors Rx        0

user@host-R0> show services l2tp session extensive
Tunnel local ID: 26595
Session local ID: 8956, Session remote ID: 1214
Interface unit: 1073741862
State: Established
Interface: pp0
Mode: Dedicated
Local IP: 100.0.0.1:1701, Remote IP: 105.0.0.1:1701
Local name: petrel, Remote name: R5
Bearer type: 1, Framing type: 1
LCP renegotiation: N/A, Authentication: None, Interface ID: N/A
Call serial number: 7
Tx speed: 0, Rx speed: 0
Create time: Sun Feb 15 22:20:00 2015, Up time: 00:13:57
Idle time: N/A
Statistics since: Sun Feb 15 22:20:00 2015

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<tr>
<th>Packets</th>
<th>Bytes</th>
</tr>
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<td>589</td>
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<tr>
<td></td>
<td>122.5k</td>
</tr>
<tr>
<td>Data Rx</td>
<td>446</td>
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<tr>
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<td>24.1k</td>
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**Meaning**  
LAC PPP over dynamic VLAN interfaces are operational.

**Purpose**  
Verify the AAA Access and RADIUS Server Configuration and Statistics on R0

Display RADIUS server, domain map, and AAA information to ensure that AAA and RADIUS are functioning as expected.
Action

From operational mode, run the `show network-access aaa accounting`, `show network-access aaa radius-servers detail`, `show network-access domain-map statistics`, `show network-access aaa statistics authentication`, `show network-access aaa statistics accounting`, `show network-access aaa statistics accounting detail`, `show network-access requests statistics`, `show network-access requests pending`, `show network-access aaa statistics pending-accounting-stops detail`, and `show network-access aaa statistics radius` commands.

```
user@host-R0> show network-access aaa accounting
Profile Logical System Routing Instance
Acct-On-Response
Access-Profile-0 default default ACK

user@host-R0> show network-access aaa radius-servers detail
Profile: Access-Profile-0
  Server address: 9.0.0.9
  Authentication port: 1812
  Accounting port: 1813
  Status: UP

RADIUS Servers
  9.0.0.9
    Round Trip Time: 0
    Authentication requests: 51
    Authentication rollover requests: 0
    Accepts: 51
    Rejects: 0
    Challenges: 0
    Authentication malformed responses: 0
    Authentication bad authenticators: 0
    Authentication requests pending: 0
    Authentication request timeouts: 0
    Authentication unknown responses: 0
    Authentication packets dropped: 0
    Accounting start requests: 59
    Accounting interim requests: 389
    Accounting stop requests: 59
    Accounting rollover requests: 0
    Accounting retransmissions: 10
    Accounting start responses: 59
    Accounting interim responses: 389
    Accounting stop responses: 59
    Accounting malformed responses: 0
    Accounting bad authenticators: 0
    Accounting requests pending: 0
    Accounting request timeouts: 11
    Accounting unknown responses: 0
    Accounting packets dropped: 0

user@host-R0> show network-access domain-map statistics
General domain mapping statistics
  Matched domains: 8
  Unmatched domains: 43
  Missing domain names: 43
  Stripped usernames: 0
  Domain statistics for domain-name: default
    Default used: 0
```
user@host-R0> show network-access aaa statistics authentication
Authentication module statistics
  Requests received: 51
  Accepts: 51
  Rejects: 0
  Challenges: 0
  Timed out requests: 0

user@host-R0> show network-access aaa statistics authentication detail
Authentication module statistics
  Requests received: 51
  Accepts: 51
  Rejects: 0
  RADIUS authentication failures: 0
    Queue request deleted: 0
    Malformed reply: 0
    No server configured: 0
    Access Profile configuration not found: 0
    Unable to create client record: 0
    Unable to create client request: 0
    Unable to build authentication request: 0
    No available server: 0
    Unable to create handle: 0
    Unable to queue request: 0
    Invalid credentials: 0
    Malformed request: 0
    License unavailable: 0
    Redirect requested: 0
    Internal failure: 0
    Local authentication failures: 0
    LDAP lookup failures: 0
  Challenges: 0
  Timed out requests: 0

user@host-R0> show network-access aaa statistics accounting
Accounting module statistics
  Requests received: 511
  Accounting response failures: 0
  Accounting response success: 508
  Timed out requests: 1

user@host-R0> show network-access aaa statistics accounting detail
Accounting module statistics
  Requests received: 511
  Account on requests: 4
    Accounting start requests: 59
    Accounting interim requests: 389
    Accounting stop requests: 59
  Accounting response failures: 0
  Accounting response success: 508
    Account on responses: 1
      Accounting start responses: 59
      Accounting interim responses: 389
      Accounting stop responses: 59
  Timed out requests: 1
  Accounting rollover requests: 0
  Accounting unknown responses: 0
  Accounting pending account requests: 0
  Accounting malformed responses: 0
  Accounting retransmissions: 10
  Accounting bad authenticators: 0
  Accounting packets dropped: 0
### show network-access requests statistics

**General authentication statistics**
- Total requests received: 240
- Total responses sent: 284

**Radius authentication statistics**
- Total requests received: 51
- Success responses: 51
- Failure responses: 0

**Local authentication statistics**
- Total requests received: 0
- Success responses: 0
- Failure responses: 0

**LDAP authentication statistics**
- Total requests received: 0
- Success responses: 0
- Failure responses: 0

**Securid authentication statistics**
- Total requests received: 0
- Success responses: 0
- Failure responses: 0

**Gx-plus general counters:**

<table>
<thead>
<tr>
<th>Counter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>engine created</td>
<td>1</td>
</tr>
<tr>
<td>initial config: inactive</td>
<td>1</td>
</tr>
<tr>
<td>recovery: cold-boot</td>
<td>1</td>
</tr>
<tr>
<td>diameter-app initial config: success</td>
<td>1</td>
</tr>
</tbody>
</table>

**Gx-plus sync-event counters:**

<table>
<thead>
<tr>
<th>Sync-Event</th>
<th>Counter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>cold-boot</td>
<td>activated</td>
<td>1</td>
</tr>
</tbody>
</table>

### show network-access requests pending

Information about pending authentication entries
- Total pending authentication requests: 0

### show network-access aaa statistics pending-accounting-stops detail

Pending accounting stops: 0

### show network-access aaa statistics radius

<table>
<thead>
<tr>
<th>RADIUS Server</th>
<th>Profile</th>
<th>Configured</th>
<th>Current</th>
<th>Peak</th>
<th>Exceeded</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.0.0.9</td>
<td>Access-Profile-0</td>
<td>1000</td>
<td>1</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>

**Meaning**

AAA and RADIUS server functions are correct.

**Verify That on R3, No L2 Circuits Are Up and No BFD Sessions Are Running**

**Purpose**

Display L2 circuit and BFD session information to confirm nothing is running on the backup BNG (R3).
**Action**

From operational mode, run the `show interfaces terse | match ccc | count`, `show l2circuit connections summary`, `show l2circuit connections interface ps0.0`, `show bfd session summary`, and `show bfd session detail` commands.

```
user@host-R3> show interfaces terse | match ccc | count
Count: 2048 lines
```

```
user@host-R3> show l2circuit connections summary
Layer-2 Circuit Connections Summary:
Neighbor: 101.0.0.1
   Total VCs up: 0, Total VCs down: 1000
Neighbor: 102.0.0.1
   Total VCs up: 0, Total VCs down: 1048
```

```
user@host-R3> show l2circuit connections interface ps0.0
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid      NP -- interface h/w not present
MM -- mtu mismatch               Dn -- down
EM -- encapsulation mismatch     VC-Dn -- Virtual circuit Down
CM -- control-word mismatch      Up -- operational
VM -- vlan id mismatch           CF -- Call admission control failure
OL -- no outgoing label          IB -- TDM incompatible bitrate
NC -- intf encap not CCC/TCC     TM -- TDM misconfiguration
BK -- Backup Connection         ST -- Standby Connection
CB -- rcvd cell-bundle size bad  SP -- Static Pseudowire
LD -- local site signaled down   RS -- remote site standby
RD -- remote site signaled down  HS -- Hot-standby Connection
XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 101.0.0.1
Interface     Type St     Time last up          # Up trans
ps0.0(vc 1)   rmt OL
```

```
user@host-R3> show bfd session summary
0 sessions, 0 clients
Cumulative transmit rate 0.0 pps, cumulative receive rate 0.0 pps
```

```
user@host-R3> show bfd session detail
0 sessions, 0 clients
Cumulative transmit rate 0.0 pps, cumulative receive rate 0.0 pps
```

**Meaning**

No L2 circuits or BFD sessions are running on the backup BNG.

**Verify L2TP Functionality on R5**

**Purpose**

Display subscriber, network access AAA, and L2TP services information to ensure the interfaces are functioning.
Action  From operational mode, run the `show subscribers`, `show subscriber summary`, `show subscribers detail`, `show network-access aaa subscribers`, `show network-access aaa subscribers session-id 9`, `show network-access aaa subscribers session-id 9 detail`, `show route protocol access internal`, `show firewall`, `show services l2tp summary`, `show services l2tp destination`, `show services l2tp tunnel`, `show services l2tp session`, `show services l2tp destination extensive`, `show services l2tp tunnel extensive`, and `show services l2tp session extensive` commands.

```
user@host-R5> show subscribers
Interface         IP Address/VLAN ID                  User Name
LS:RI             si-1/0/0.1073741832 100.48.0.9     SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM     default:default

user@host-R5> show subscribers summary
Subscribers by State
  Active: 1
  Total: 1

Subscribers by Client Type
  L2TP: 1
  Total: 1

user@host-R5> show subscribers detail
Type: L2TP
User Name: SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM
IP Address: 100.48.0.9
IP Netmask: 255.0.0.0
Logical System: default
Routing Instance: default
Interface: si-1/0/0.1073741832
Interface type: Dynamic
Underlying Interface: si-1/0/0.1073741832
Dynamic Profile Name: lns-profile
State: Active
Radius Accounting ID: 9
Session ID: 9
Login Time: 2015-02-15 23:44:31 PST

user@host-R5> show network-access aaa subscribers
Username                   Logical system/Routing instance   Client type
SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM default:default       l2tp           9

user@host-R5> show network-access aaa subscribers session-id 9
Logical system/Routing instance   Client type   Session-ID   Session uptime
Accounting
  default:default       l2tp           9         00:11:39

user@host-R5> show network-access aaa subscribers session-id 9 detail
Type: l2tp
Striped username: SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM
AAA Logical system/Routing instance: default:default
Target Logical system/Routing instance: default:default
Access-profile: AccProf-LNS
Session ID: 9
```
Accounting Session ID: 9
Multi Accounting Session ID: 0
IP Address: 100.48.0.9
Authentication State: AuthStateActive
Accounting State: Acc-Init
Converted to time accounting: no
Provisioning Type: None

user@host-R5> show route protocol access-internal
inet.0: 35 destinations, 35 routes (35 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both

100.48.0.9/32 * [Access-internal/12] 00:11:50
  > via si-1/0/0.1073741832

inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)

mpls.0: 12 destinations, 12 routes (12 active, 0 holddown, 0 hidden)

inet6.0: 17 destinations, 22 routes (17 active, 0 holddown, 0 hidden)

user@host-R5> show firewall
Filter: __default_bpdu_filter__

user@host-R5> show services l2tp summary
Failover within a preference level is Disabled
Weighted load balancing is Disabled
Tunnel authentication challenge is Enabled
Calling number avp is Enabled
Failover Protocol is Enabled
Tx Connect speed method is static
Rx speed avp when equal is Disabled
Tunnel assignment id format is assignment-id
Tunnel Tx Address Change is Accept
Min Retransmission Timeout for control packets is 1 seconds
Max Retransmissions for Established Tunnel is 7
Max Retransmissions for Not Established Tunnel is 5
Tunnel Idle Timeout is 60 seconds
Destruct Timeout is 300 seconds
Destination Lockout Timeout is 300 seconds
Max Packets processed per iteration is 64
Access Line Information is Disabled, Speed Updates is Disabled
Destinations: 1, Tunnels: 1, Sessions: 1, Switched sessions: 0

user@host-R5> show services l2tp destination
Local Name | Remote IP | Tunnels | Sessions | State
-----------|-----------|---------|----------|-------
6          | 100.0.0.1  | 1       | 1        | Enabled

user@host-R5> show services l2tp tunnel
Local ID | Remote ID | Remote IP | Sessions | State
---------|-----------|-----------|----------|-------
30823    | 26595     | 100.0.0.1:1701 | 1 | Established

user@host-R5> show services l2tp session
Tunnel local ID: 30823
Local | Remote | State | Interface | Interface
ID   | ID     | unit | Name      | Name
1214 | 8956   | Established | 1073741832 | si-1/0/0

user@host-R5> show services l2tp destination extensive
Waiting for statistics...
Local name: 6
Remote IP: 100.0.0.1
Tunnels: 1, Sessions: 1
State: Enabled
Local IP: 105.0.0.1
Transport: ipUdp, Logical System: default, Router Instance: default
Lockout State: not locked
Access Line Information: disabled, Speed Updates: disabled

Connections     Totals        Active       Failed
Tunnels              1             1            0
Sessions             1             1            0

Packets     Bytes
Control Tx             15          418
Control Rx             15          579
Data Tx               722        40.4k
Data Rx               244        14.4k
Errors Tx               0
Errors Rx               0

user@host-R5$ show services l2tp tunnel extensive
Waiting for statistics...
Tunnel local ID: 30823, Tunnel remote ID: 26595
Remote IP: 100.0.0.1:1701
Sessions: 1, State: Established
Tunnel Name: 6/15
Local IP: 105.0.0.1:1701
Local name: R5, Remote name: petrel
Effective Peer Resync Mechanism: failover protocol
Nas Port Method: none
Tunnel Logical System: default, Tunnel Routing Instance: default
Max sessions: 128100, Window size: 4, Hello interval: 60
Create time: Sun Feb 15 23:44:31 2015, Up time: 00:12:29
Idle time: 00:00:00, ToS Reflect: Disabled
Tunnel Group Name: lns-tunnel-group
Packets     Bytes
Control Tx             15          418
Control Rx             15          579
Data Tx               734        41.1k
Data Rx               244        14.4k
Errors Tx               0
Errors Rx               0

user@host-R5$ show services l2tp session extensive
Tunnel local ID: 30823
Session local ID: 1214, Session remote ID: 8956
Interface unit: 1073741832
State: Established
Interface: si-1/0/0
Mode: Dedicated
Local IP: 105.0.0.1:1701, Remote IP: 100.0.0.1:1701
Local name: R5, Remote name: petrel
Bearer type: 1, Framing type: 1
LCP renegotiation: On, Authentication: None
Call serial number: 7
Tx speed: 0, Rx speed: 0
Create time: Sun Feb 15 23:44:31 2015, Up time: 00:12:16
Idle time: N/A, ToS Reflect: Disabled
Packets     Bytes
Data Tx               718        40.2k
Data Rx               244        14.4k

Meaning  L2TP LAC PPP over dynamic VLAN interfaces are operational.
Verify Dynamic VLAN Authentication and Accounting on the RADIUS Server

**Purpose**
Determine whether or not RADIUS messages sent by the BNG arrive at the RADIUS server and are accepted.

**Action**
Review the RADIUS server debug log messages to confirm whether RADIUS messages arrive and are processed. If a subscriber username and password match the user profile on the RADIUS server, the RADIUS server should return an access-accept message response back to the BNG system. If the RADIUS server returns an access-reject message, check the username and password configuration on both the RADIUS server and the BNG DHCP local server, and check the PPPoE client's username and password.

The following debug log messages are related to straight dynamic VLAN authentication and accounting requests.

```
rad_recv: Access-Request packet from host 100.0.0.1 port 53274, id=29, length=134
  User-Name = "SST_USER_VLAN_DEFAULT"
  User-Password = "joshua"
  Service-Type = Framed-User
  Chargeable-User-Identity = ""
  Acct-Session-Id = "54"
  ERX-Dhcp-Mac-Addr = "0000.0000.0000"
  NAS-Identifier = "R0-BNG1"
  NAS-Port = 100
  NAS-Port-Id = "ps0:1-100"
  NAS-Port-Type = Ethernet
  NAS-IP-Address = 100.0.0.1

  Sending Access-Accept of id 29 to 100.0.0.1 port 53274
  Service-Type = Framed-User

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=30, length=165
  User-Name = "SST_USER_VLAN_DEFAULT"
  Acct-Status-Type = Start
  Acct-Session-Id = "54"
  Service-Type = Framed-User
  ERX-Attr-177 = 0x506f72742053706565643a203130303030306b
  Acct-Authentic = RADIUS
  Acct-Delay-Time = 0
  ERX-Dhcp-Mac-Addr = "0000.0000.0000"
  Event-Timestamp = "Feb 16 2015 00:47:48 EST"
  NAS-Identifier = "R0-BNG1"
  NAS-Port = 100
  NAS-Port-Id = "ps0:1-100"
  NAS-Port-Type = Ethernet
  NAS-IP-Address = 100.0.0.1

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=34, length=309
  User-Name = "SST_USER_VLAN_DEFAULT"
  Acct-Status-Type = Stop
  Acct-Session-Id = "54"
  Acct-Input-Octets = 0
  Acct-Output-Octets = 0
  Acct-Session-Time = 345
  Acct-Input-Packets = 0
```
The following debug log messages are related to DHCPv4 over dynamic VLAN authentication and accounting requests.

**rad_recv:** Access-Request packet from host 100.0.0.1 port 53274, id=31, length=210

```
User-Name = "SST_USER_DHCP_V4_DEFAULT"
User-Password = "joshua"
Service-Type = Framed-User
Chargeable-User-Identity = ""
Acct-Session-Id = "55"
```

```
ERX-Dhcp-Options = 
"5\001\0012\004d\020\000\003\014\026fireback-ThinkPad-T4007\r\001\034\002\003\017\006\014,://032y"
```

```
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
Framed-IP-Address = 100.16.0.3
NAS-Identifier = "RO-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741855:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1
```

Sending Access-Accept of id 31 to 100.0.0.1 port 53274

```
Service-Type = Framed-User
ERX-Service-Activate:1 += "DHCP-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)"
```

**rad_recv:** Accounting-Request packet from host 100.0.0.1 port 53274, id=32, length=247

```
User-Name = "SST_USER_DHCP_V4_DEFAULT"
Acct-Status-Type = Start
Acct-Session-Id = "55"
```

```
ERX-Dhcp-Options = 
"5\001\0012\004d\020\000\003\014\026fireback-ThinkPad-T4007\r\001\034\002\003\017\006\014,://032y"
```

```
ERX-Dhcp-Mac-Addr = "0000.0000.0000"
Event-Timestamp = "Feb 16 2015 00:53:33 EST"
Acct-Terminate-Cause = Admin-Reset
Service-Type = Framed-User
```

```
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Attr-177 = 0x506f72742053706565643a203130303030306b
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Attr-177 = 0x506f72742053706565643a2031303030306b
```
ERX-Dhc-Mac-Addr = "0022.6814.84d5"
Event-Timestamp = "Feb 16 2015 00:47:51 EST"
Framed-IP-Address = 100.16.0.3
Framed-IP-Netmask = 255.0.0.0
NAS-Identifier = "RO-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741855:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=33, length=391
User-Name = "SST_USER_DHCP_V4_DEFAULT"
Acct-Status-Type = Stop
Acct-Session-Id = "55"
Acct-Input-Octets = 0
Acct-Output-Octets = 0
Acct-Session-Time = 342
Acct-Input-Packets = 0
Acct-Output-Packets = 0
Acct-Terminate-Cause = NAS-Request
Service-Type = Framed-User
ERX-Attr-177 = 0x506f72742053706565643a203130303030306b
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Options = "5\001\001\000\016\000\001\034\017\273\351\000\"h"

The following debug log messages are related to DHCPv6 over dynamic VLAN authentication and accounting requests.

rad_recv: Access-Request packet from host 100.0.0.1 port 53274, id=37, length=204
User-Name = "SST_USER_DHCP_V6_DEFAULT"
User-Password = "joshua"
Service-Type = Framed-User
Chargeable-User-Identity = ""
Acct-Session-Id = "58"
ERX-Dhcp-Options = "5\001\001\000\016\000\001\034\017\273\351\000\"h"
024\204\325\000\010\000\002\000d\000\006\000\004\000\027\000\030\000\031\000\014\000\000\001\000\000\000\000\000\000\000\000
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741856:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1

Sending Access-Accept of id 37 to 100.0.0.1 port 53274
Service-Type = Framed-User
ERX-Service-Activate:1 += "DHCP-SERVICE-PROFILE(INPUT-V4-FILTER-01,
OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)"

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=38,
length=254
User-Name = "SST_USER_DHCP_V6_DEFAULT"
Acct-Status-Type = Start
Acct-Session-Id = "58"
Service-Type = Framed-User
ERX-Attr-177 = 0x506f72742053706565643a203130303030306b
Delegated-IPv6-Prefix = 1000::/56
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Options = "000\001\000\016\000\001\001\000\000\000\000\034\017\273\351\000\000\024\204\325\000\010\000\002\000d\000\006\000\004\000\027\000\030\000\031\000\014\000\000\000\000\001\000\000\000\000\000\000\000\000"
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
Event-Timestamp = "Feb 16 2015 00:54:49 EST"
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741856:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=40,
length=309
User-Name = "SST_USER_VLAN_DEFAULT"
Acct-Status-Type = Stop
Acct-Session-Id = "57"
Acct-Input-Octets = 0
Acct-Output-Octets = 0
Acct-Session-Time = 265
Acct-Input-Packets = 0
Acct-Output-Packets = 0
Acct-Terminate-Cause = Admin-Reset
Service-Type = Framed-User
ERX-Attr-177 = 0x506f72742053706565643a2031303030306b
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Options = "0000.0000.0000"
Event-Timestamp = "Feb 16 2015 00:59:12 EST"
ERX-Input-Gigapkts = 0
Acct-Input-Gigawords = 0
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0:1-100"
NAS-Port-Type = Ethernet
ERX-Output-Gigapkts = 0
Acct-Output-Gigawords = 0
ERX-IPv6-Acct-Input-Octets = 0
ERX-IPv6-Acct-Output-Octets = 0
ERX-IPv6-Acct-Input-Packets = 0
ERX-IPv6-Acct-Output-Packets = 0
ERX-IPv6-Acct-Input-Gigawords = 0
ERX-IPv6-Acct-Output-Gigawords = 0
NAS-IP-Address = 100.0.0.1

The following debug log messages are related to PPPoE over dynamic VLAN authentication and accounting requests.

rad_recv: Access-Request packet from host 100.0.0.1 port 53274, id=49, length=189

  User-Name = "SST_USER_PPPOE_LT_DEFAULT"
  Service-Type = Framed-User
  Framed-Protocol = PPP
  CHAP-Password = 0x341c1103d16b6d5a56a3eacef911e227ca
  CHAP-Challenge = 0x9c35da48d9c6351050ccf15141901947968a4a56ebf0690a664291240c6f3b
  Chargeable-User-Identity = ""
  Acct-Session-Id = "64"
  ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
  NAS-Identifier = "RO-BNG1"
  NAS-Port = 100
  NAS-Port-Id = "ps0.1073741859:1-100"
  NAS-Port-Type = Ethernet
  NAS-IP-Address = 100.0.0.1

Sending Access-Accept of id 49 to 100.0.0.1 port 53274

  Service-Type = Framed-User
  ERX-Service-Activate:1 += "PPPOE-SERVICE-PROFILE(INPUT-V4-FILTER-01,
OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)"

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=50, length=208

  User-Name = "SST_USER_PPPOE_LT_DEFAULT"
  Acct-Status-Type = Start
  Acct-Session-Id = "64"
  Service-Type = Framed-User
  Framed-Protocol = PPP
  ERX-Attr-177 = 0x506f72742053706565643a2031303030306b
  Framed-Interface-Id = 2473:3f40:86ef:c3b3
  Acct-Authentic = RADIUS
  Acct-Delay-Time = 0
  ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
  Event-Timestamp = "Feb 16 2015 01:10:01 EST"
  Framed-IP-Address = 100.16.0.7
  Framed-IP-Netmask = 255.0.0.0
  NAS-Identifier = "RO-BNG1"
  NAS-Port = 100
  NAS-Port-Id = "ps0.1073741859:1-100"
  NAS-Port-Type = Ethernet
  NAS-IP-Address = 100.0.0.1

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=52, length=309

  User-Name = "SST_USER_VLAN_DEFAULT"
  Acct-Status-Type = Stop
  Acct-Session-Id = "63"
  Acct-Input-Octets = 86662
  Acct-Output-Octets = 256
Acct-Session-Time = 495
Acct-Input-Packets = 557
Acct-Output-Packets = 32
Acct-Terminate-Cause = Admin-Reset
Service-Type = Framed-User
ERX-Attr-177 = 0x506f727420537065643a20313030303030306b
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Mac-Addr = "0000.0000.0000"
Event-Timestamp = "Feb 16 2015 01:18:11 EST"
ERX-Input-Gigapkts = 0
Acct-Input-Gigawords = 0
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0:1-100"
NAS-Port-Type = Ethernet
ERX-Output-Gigapkts = 0
Acct-Output-Gigawords = 0
ERX-IPv6-Acct-Input-Octets = 93
ERX-IPv6-Acct-Output-Octets = 0
ERX-IPv6-Acct-Input-Packets = 1
ERX-IPv6-Acct-Output-Packets = 0
ERX-IPv6-Acct-Input-Gigawords = 0
ERX-IPv6-Acct-Output-Gigawords = 0
NAS-IP-Address = 100.0.0.1

rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=51,
length=352
User-Name = "SST_USER_PPPOE_LT_DEFAULT"
Acct-Status-Type = Stop
Acct-Session-Id = "64"
Acct-Input-Octets = 14356
Acct-Output-Octets = 0
Acct-Session-Time = 490
Acct-Input-Packets = 239
Acct-Output-Packets = 0
Acct-Terminate-Cause = User-Request
Service-Type = Framed-User
Framed-Protocol = PPP
ERX-Attr-177 = 0x506f727420537065643a20313030303030306b
Framed-Interface-Id = 2473:3f40:86ef:c3b3
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
Event-Timestamp = "Feb 16 2015 01:18:11 EST"
Framed-IP-Address = 100.16.0.7
Framed-IP-Netmask = 255.0.0.0
ERX-Input-Gigapkts = 0
Acct-Input-Gigawords = 0
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741859:1-100"
NAS-Port-Type = Ethernet
ERX-Output-Gigapkts = 0
Acct-Output-Gigawords = 0
ERX-IPv6-Acct-Input-Octets = 0
ERX-IPv6-Acct-Output-Octets = 0
ERX-IPv6-Acct-Input-Packets = 0
ERX-IPv6-Acct-Output-Packets = 0
ERX-IPv6-Acct-Input-Gigawords = 0
ERX-IPv6-Acct-Output-Gigawords = 0
ERX-IPv6-Acct-Output-Gigawords = 0  
NAS-IP-Address = 100.0.0.1

The following debug log messages are related to LAC PPP over dynamic VLAN interface requests.

**rad_recv: Access-Request packet from host 100.0.0.1 port 53274, id=55, length=195**

User-Name = "SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM"
Service-Type = Framed-User
Framed-Protocol = PPP
CHAP-Password = 0x3b1b159a8dd20e71fc05178bde237a3f18
CHAP-Challenge = 0xce86862897f993e6d20ef40c3f0295e669d1649c7a8180c828a
Chargeable-User-Identity = ""
Acct-Session-Id = "68"
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741861:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1

Sending Access-Accept of id 55 to 100.0.0.1 port 53274
Service-Type = Framed-User

**rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=56, length=256**

User-Name = "SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM"
Acct-Status-Type = Start
Acct-Session-Id = "68"
Service-Type = Framed-User
Framed-Protocol = PPP
ERX-Attr-177 = 0x506f72742053706565643a2031303030306b
Tunnel-Type:0 = L2TP
Tunnel-Medium-Type:0 = IPv4
Tunnel-Client-Endpoint:0 = "100.0.0.1"
Tunnel-Server-Endpoint:0 = "105.0.0.1"
Tunnel-Assignment-Id:0 = "Tunnel-ID-1"
Acct-Tunnel-Connection = "0000000007"
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
Event-Timestamp = "Feb 16 2015 01:20:00 EST"
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741861:1-100"
NAS-Port-Type = Ethernet
NAS-IP-Address = 100.0.0.1

**rad_recv: Accounting-Request packet from host 100.0.0.1 port 53274, id=59, length=400**

User-Name = "SST_USER_PPPOE_L2TP_DEFAULT@ABC1.COM"
Acct-Status-Type = Stop
Acct-Session-Id = "68"
Acct-Input-Octets = 128977
Acct-Output-Octets = 24940
Acct-Session-Time = 874
Acct-Input-Packets = 589
Acct-Output-Packets = 446
Acct-Terminate-Cause = NAS-Request
Service-Type = Framed-User
Framed-Protocol = PPP
ERX-Attr-177 = 0x506f72742053706565643a203130303030306b
Tunnel-Type:0 = L2TP
Tunnel-Medium-Type:0 = IPv4
Tunnel-Client-Endpoint:0 = "100.0.0.1"
Tunnel-Server-Endpoint:0 = "105.0.0.1"
Tunnel-Assignment-Id:0 = "Tunnel-ID-1"
Acct-Tunnel-Connection = "0000000007"
Acct-Authentic = RADIUS
Acct-Delay-Time = 0
ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
Event-Timestamp = "Feb 16 2015 01:34:34 EST"
ERX-Input-Gigapkts = 0
Acct-Input-Gigawords = 0
NAS-Identifier = "R0-BNG1"
NAS-Port = 100
NAS-Port-Id = "ps0.1073741861:1-100"
NAS-Port-Type = Ethernet
ERX-Output-Gigapkts = 0
Acct-Output-Gigawords = 0
ERX-IPv6-Acct-Input-Octets = 460
ERX-IPv6-Acct-Output-Octets = 0
ERX-IPv6-Acct-Input-Packets = 6
ERX-IPv6-Acct-Output-Packets = 0
ERX-IPv6-Acct-Input-Gigawords = 0
ERX-IPv6-Acct-Output-Gigawords = 0
NAS-IP-Address = 100.0.0.1

Meaning  Dynamic VLAN authentication and accounting functionality is confirmed.

Troubleshooting

This troubleshooting section focuses on pseudowire head-end termination and subscriber management on the BNG platform. To troubleshoot these functions, see the following sections.

- MPLS L2 Circuit Pseudowire on page 178
- Subscriber Sessions on page 186

MPLS L2 Circuit Pseudowire

Problem  MPLS L2 circuit pseudowires are not being established.

Solution  1. On the BNG device, investigate each network layer’s operational status and error count. Start by ensuring that the operational status is Up for both Layer 1 (L1) and L2, and that the error count is not increasing.

    user@host-BNG> show interfaces ge-2/0/0 extensive
    Physical interface: ge-2/0/0, Enabled, Physical link is Up
    Interface index: 2359, SNMP ifIndex: 579, Generation: 2362
    Description: To R1 - APE1
    Link-level type: Ethernet, MTU: 1514, MRU: 1522, Speed: 1000mbps, BPDU Error:
Pad to minimum frame size: Disabled
Device flags : Present Running
Interface flags: SNMP-Traps Internal: 0x4000
Link flags : None
CoS queues : 8 supported, 8 maximum usable queues
Schedulers : 0
Hold-times : Up 0 ms, Down 0 ms
Current address: ac:4b:c8:45:6a:94, Hardware address: ac:4b:c8:45:6a:94
Statistics last cleared: Never
Traffic statistics:
   Input bytes : 37913131 234088 bps
   Output bytes : 27109253 150976 bps
   Input packets: 750139 595 pps
   Output packets: 736385 588 pps
IPv6 transit statistics:
   Input bytes : 0
   Output bytes : 0
   Input packets: 0
   Output packets: 0
Label-switched interface (LSI) traffic statistics:
   Input bytes : 0 0 bps
   Input packets: 0 0 pps
Dropped traffic statistics due to STP State:
   Input bytes : 0
   Output bytes : 0
   Input packets: 0
   Output packets: 0
Input errors:
   Errors: 0, Drops: 0, Framing errors: 0, Runts: 0, Policed discards: 0, L3 incompletes: 0, L2 channel errors: 0, L2 mismatch timeouts: 0, FIFO errors: 0, Resource errors: 0
Output errors:
   Carrier transitions: 1, Errors: 0, Drops: 0, Collisions: 0, Aged packets: 0, FIFO errors: 0, HS link CRC errors: 0, MTU errors: 0, Resource errors: 0
Egress queues: 8 supported, 8 in use
Queue counters:Queued packets Transmitted packets Dropped packets
  0 2082 2082
  1 0 0
  2 0 0
  3 735288 735288
  4 0 0
  5 0 0
  6 0 0
  7 0 0
Queue number: Mapped forwarding classes
  0 FC0
  1 FC1
Active alarms: None
Active defects: None
MAC statistics:

<table>
<thead>
<tr>
<th></th>
<th>Receive</th>
<th>Transmit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total octets</td>
<td>51466725</td>
<td>49001759</td>
</tr>
<tr>
<td>Total packets</td>
<td>750906</td>
<td>737115</td>
</tr>
<tr>
<td>Unicast packets</td>
<td>731162</td>
<td>699812</td>
</tr>
<tr>
<td>Broadcast packets</td>
<td>35</td>
<td>38</td>
</tr>
<tr>
<td>Multicast packets</td>
<td>19709</td>
<td>37265</td>
</tr>
<tr>
<td>CRC/Align errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>FIFO errors</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC control frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MAC pause frames</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Oversized frames</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Jabber frames</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Fragment frames</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>VLAN tagged frames</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Code violations</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Total errors</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Filter statistics:

- Input packet count: 750316
- Input packet rejects: 0
- Input DA rejects: 0
- Input SA rejects: 0
- Output packet count: 736542
- Output packet pad count: 0
- Output packet error count: 0
- CAM destination filters: 0, CAM source filters: 0

Autonegotiation information:
- Negotiation status: Complete
- Link partner:
  - Link mode: Full-duplex, Flow control: Symmetric/Asymmetric, Remote fault: OK
- Local resolution:
  - Flow control: Symmetric, Remote fault: Link OK
- Packet Forwarding Engine configuration:
  - Destination slot: 0 (0x00)
- CoS information:
  - Direction: Output
  - CoS transmit queue
    | Limit | Bandwidth | Buffer Priority |
    |-------|-----------|-----------------|
    | FC0   | 95%       | 950000000 bps   | low usec 0   |
    | FC3   | 5%        | 50000000 bps    | low usec 0   |

Interface transmit statistics: Disabled

Logical interface ge-2/0/0.0 (Index 4447) (SNMP ifIndex 14264) (Generation 4256)

- Flags: Up SNMP-Traps 0x4004000 Encapsulation: ENET2
- Traffic statistics:
  - Input bytes: 41421857
  - Output bytes: 27287563
  - Input packets: 786945
  - Output packets: 736385
- Local statistics:
Input bytes : 8105510
Output bytes : 5342123
Input packets: 102278
Output packets: 50590
Transit statistics:
Input bytes : 33316347               230800 bps
Output bytes : 21945440               150624 bps
Input packets: 684667                  591 pps
Output packets: 685795                  588 pps
Protocol inet, MTU: 1500, Generation: 2247, Route table: 0
  Flags: Sendbcast-pkt-to-re
  Addresses, Flags: Is-Preferred Is-Primary
    Generation: 155
  Protocol mpls, MTU: 1488, Maximum labels: 3, Generation: 2248, Route table: 0
  Protocol multiservice, MTU: Unlimited, Generation: 2249, Route table: 0
  Policer: Input: __default_arp_policer__

2. If the interface is a PS interface, check the status of the anchor interface as well.

user@host-BNG> show configuration interfaces ps0 | display inheritance no-comments
anchor-point {
  lt-0/0/10;
}
flexible-vlan-tagging;
  auto-configure {
    stacked-vlan-ranges {
      dynamic-profile vlan-prof-0 {
        accept [ inet inet6 pppoe ];
        ranges {
          1-256,1-4094;
        } }
      authentication {
        password joshua;
        username-include {
          user-prefix SST_USER_VLAN_DEFAULT;
        }
      } }
    remove-when-no-subscribers;
  }
  no-gratuitous-arp-request;
unit 0 {
  encapsulation ethernet-ccc;
}

user@host-BNG> show interfaces lt-0/0/10 media
Physical interface: lt-0/0/10, Enabled, Physical link is Up
  Interface index: 159, SNMP ifIndex: 12719
  Type: Logical-tunnel, Link-level type: Logical-tunnel, MTU: Unlimited, Speed: 1000mbps
  Device flags   : Present Running
  Interface flags: Point-To-Point SNMP-Traps Internal: 0x4000
  Physical info  : 13
  Current address: ac:4b:c8:45:68:00, Hardware address: ac:4b:c8:45:68:00
  Input rate     : 0 bps (0 pps)
  Output rate    : 0 bps (0 pps)
user@host-BNG> show interfaces ps0 media
Physical interface: ps0, Enabled, Physical link is Up
Interface index: 160, SNMP ifIndex: 12720
Type: Software-Pseudo, Link-level type: 90, MTU: 1522, Clocking: 1, Speed: 1000mbps
Device flags : Present Running
Interface flags: Point-To-Point Internal: 0x4000
Current address: ac:4b:c8:45:68:00, Hardware address: ac:4b:c8:45:68:00
Last flapped : Never
Input rate : 0 bps (0 pps)
Output rate : 0 bps (0 pps)

user@host-BNG> show interfaces ps0.0
Logical interface ps0.0 (Index 332) (SNMP ifIndex 18023)
  Flags: Up Point-To-Point 0x4000 Encapsulation: Ethernet-CCC
  Input packets : 272
  Output packets: 459
  Protocol ccc, MTU: 1514
  Flags: Is-Primary

user@host-BNG> show interfaces ps0.0 extensive
Logical interface ps0.0 (Index 332) (SNMP ifIndex 18023) (Generation 141)
  Flags: Up Point-To-Point 0x4000 Encapsulation: Ethernet-CCC
  Traffic statistics:
    Input  bytes  :                17251
    Output bytes  :                37799
    Input packets:                  272
    Output packets:                  459
    Local statistics:
      Input  bytes  :                    0
      Output bytes  :                    0
      Input packets:                    0
      Output packets:                    0
    Transit statistics:
      Input  bytes  :                17251                    0 bps
      Output bytes  :                37799                    0 bps
      Input packets:                  272                    0 pps
      Output packets:                  459                    0 pps
  Protocol ccc, MTU: 1514, Generation: 169, Route table: 0
  Flags: Is-Primary

3. Next, check the IP connectivity of the directly connected interface.

user@host-BNG> show interfaces ge-2/0/0 terse
Interface               Admin Link Proto    Local                 Remote
ge-2/0/0                up    up   inet     21.21.11.1/24
mpls                     multiservice

user@host-BNG> ping 21.21.11.2 rapid count 1000
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
--- 21.21.11.2 ping statistics ---
1000 packets transmitted, 1000 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.460/0.748/16.578/0.820 ms
4. Determine whether the IGP is stable, without any route flapping. The OSPF neighbor state should be Full and the age of the OSPF database and route table should increase consistently without resetting to be zero. The IP connectivity to the neighbor router’s loopback interface should be intact.

```
user@host-BNG> show ospf neighbor
Address          Interface              State     ID               Pri  Dead
21.21.11.2       ge-2/0/0.0             Full      101.0.0.1        128    35
21.21.13.2       ge-2/0/1.0             Full      102.0.0.1        128    30
21.21.10.2       ge-3/0/0.0             Full      101.0.0.1        128    36
21.21.12.2       ge-3/0/1.0             Full      102.0.0.1        128    36
21.21.15.2       ge-3/0/2.0             Full      104.0.0.1        128    37
21.21.14.2       xe-0/0/0.0             Full      104.0.0.1        128    34

user@host-BNG> show ospf database router
OSPF database, Area 0.0.0.0
Type       ID               Adv Rtr           Seq      Age  Opt  Cksum  Len
Router  *100.0.0.1        100.0.0.1        0x8000000b  1721  0x22 0xac4b 108
Router   101.0.0.1        101.0.0.1        0x80000005  1699  0x22 0x6180  84
Router   102.0.0.1        102.0.0.1        0x80000006  1712  0x22 0x7736  84
Router   103.0.0.1        103.0.0.1        0x8001452e  1727  0x22 0x134c  96
Router   104.0.0.1        104.0.0.1        0x800000000 768  0x22 0x135e 108
Router   105.0.0.1        105.0.0.1        0x800000033 1096  0x22 0xadb6 96

user@host-BNG> show route protocol ospf | match /32
101.0.0.1/32       *[OSPF/10] 00:28:53, metric 1
102.0.0.1/32       *[OSPF/10] 00:29:01, metric 1
103.0.0.1/32       *[OSPF/10] 00:28:53, metric 2
104.0.0.1/32       *[OSPF/10] 00:35:33, metric 1
224.0.0.5/32       *[OSPF/10] 22:21:18, metric 1

user@host-BNG> ping 101.0.0.1 rapid count 1000
PING 101.0.0.1 (101.0.0.1): 56 data bytes
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
--- 101.0.0.1 ping statistics ---
1000 packets transmitted, 1000 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.480/0.830/11.262/0.771 ms

user@host-BNG> show ldp route 101.0.0.1
Destination         Next-hop intf/lsp/table           Next-hop address
101.0.0.1/32       ge-2/0/0.0                        21.21.11.2
                  ge-3/0/0.0                        21.21.10.2
101.0.0.1/32       ge-2/0/0.0                        21.21.11.2
                  ge-3/0/0.0                        21.21.10.2

user@host-BNG> show route 101.0.0.1
inet.0: 33 destinations, 34 routes (33 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
101.0.0.1/32       *[OSPF/10] 00:30:48, metric 1
                  to 21.21.11.2 via ge-2/0/0.0
                  > to 21.21.10.2 via ge-3/0/0.0
inet.3: 5 destinations, 5 routes (5 active, 0 holddown, 0 hidden)
+ = Active Route, - = Last Active, * = Both
101.0.0.1/32       *[LDP/9] 00:30:48, metric 1
                  to 21.21.11.2 via ge-2/0/0.0
                  > to 21.21.10.2 via ge-3/0/0.0
```
5. Next, check the BFD session status for MPLS L2 circuit pseudowires.

```plaintext
user@host-BNG> show bfd session
Address                  State     Interface      Time     Interval  Multiplier
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-3/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-3/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-3/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-3/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-3/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
127.0.0.1                Up        ge-2/0/0.0     4.000     1.000        4
```

6. Examine the MPLS pseudowire datapath.

```plaintext
user@host-BNG> ping mpls l2circuit interface ps0.0
!!!!!
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss

user@host-BNG> ping mpls l2circuit virtual-circuit 1 count 10 destination 127.0.0.1 neighbor 101.0.0.1
!!!!!!!!
--- lsping statistics ---
10 packets transmitted, 10 packets received, 0% packet loss

user@host-PE1> ping mpls l2circuit interface ge-1/1/9.1
!!!!!
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss

user@host-PE1> ping mpls l2circuit interface ge-1/1/9.1 detail
Request for seq 1, to interface 329, label 360336, packet size 88
Reply for seq 1, return code: Egress-ok, time: -4752393.948 ms
  Local transmit time: 2015-03-25 17:21:25 PDT 394.073 ms
  Remote receive time: 2015-03-25 16:02:13 PDT 0.125 ms

Request for seq 2, to interface 329, label 360336, packet size 88
Reply for seq 2, return code: Egress-ok, time: -4752393.851 ms
  Local transmit time: 2015-03-25 17:21:26 PDT 393.976 ms
  Remote receive time: 2015-03-25 16:02:14 PDT 0.125 ms

Request for seq 3, to interface 329, label 360336, packet size 88
Reply for seq 3, return code: Egress-ok, time: -4752393.839 ms
  Local transmit time: 2015-03-25 17:21:27 PDT 393.964 ms
  Remote receive time: 2015-03-25 16:02:15 PDT 0.125 ms

Request for seq 4, to interface 329, label 360336, packet size 88
Reply for seq 4, return code: Egress-ok, time: -4752393.823 ms
  Local transmit time: 2015-03-25 17:21:28 PDT 393.956 ms
  Remote receive time: 2015-03-25 16:02:16 PDT 0.125 ms

Request for seq 5, to interface 329, label 360336, packet size 88
Reply for seq 5, return code: Egress-ok, time: -4752393.823 ms
  Local transmit time: 2015-03-25 17:21:29 PDT 393.948 ms
  Remote receive time: 2015-03-25 16:02:17 PDT 0.125 ms
```
--- lsping statistics ---
5 packets transmitted, 5 packets received, 0% packet loss

7. Finally, verify that the MPLS L2 circuit status is Up. If it is not, consult the connection status code legend provided in the show command output for the reason.

```
user@host-BNG>show l2circuit connections interface ps0.0 extensive
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid      NP -- interface h/w not present
MM -- mtu mismatch               Dn -- down
EM -- encapsulation mismatch     VC-Dn -- Virtual circuit Down
CM -- control-word mismatch      Up -- operational
VM -- vlan id mismatch           CF -- Call admission control failure
OL -- no outgoing label          IB -- TDM incompatible bitrate
NC -- intf encaps not CCC/TCC    TM -- TDM misconfiguration
BK -- Backup Connection          ST -- Standby Connection
CB -- rcvd cell-bundle size bad  SP -- Static Pseudowire
LD -- local site signaled down   RS -- remote site standby
RD -- remote site signaled down  HS -- Hot-standby Connection
XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 101.0.0.1
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Type</th>
<th>St</th>
<th>Time last up</th>
<th># Up trans</th>
</tr>
</thead>
<tbody>
<tr>
<td>ps0.0(vc 1)</td>
<td>rmt</td>
<td>Up</td>
<td>Mar 25 14:26:50 2015</td>
<td>1</td>
</tr>
</tbody>
</table>
```
Remote PE: 101.0.0.1, Negotiated control-word: Yes (Null)
Incoming label: 360336, Outgoing label: 338624
Negotiated PW status TLV: No
Local interface: ps0.0, Status: Up, Encapsulation: ETHERNET
```

Connection History:
```
Mar 25 14:26:50 2015  status update timer
Mar 25 14:26:50 2015  PE route changed
Mar 25 14:26:50 2015  Out lbl Update                   338624
Mar 25 14:26:50 2015  In lbl Update                     360336
Mar 25 14:26:50 2015  loc intf up                        ps0.0
```

```
user@host-PE1>show l2circuit connections interface ge-1/1/9.1 extensive
Layer-2 Circuit Connections:

Legend for connection status (St)
EI -- encapsulation invalid      NP -- interface h/w not present
MM -- mtu mismatch               Dn -- down
EM -- encapsulation mismatch     VC-Dn -- Virtual circuit Down
CM -- control-word mismatch      Up -- operational
VM -- vlan id mismatch           CF -- Call admission control failure
OL -- no outgoing label          IB -- TDM incompatible bitrate
NC -- intf encaps not CCC/TCC    TM -- TDM misconfiguration
BK -- Backup Connection          ST -- Standby Connection
CB -- rcvd cell-bundle size bad  SP -- Static Pseudowire
LD -- local site signaled down   RS -- remote site standby
RD -- remote site signaled down  HS -- Hot-standby Connection
XX -- unknown

Legend for interface status
Up -- operational
Dn -- down

Neighbor: 100.0.0.1
```

<table>
<thead>
<tr>
<th>Interface</th>
<th>Type</th>
<th>St</th>
<th>Time last up</th>
<th># Up trans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Subscriber Sessions

Problem  Subscriber sessions are not being established.

Solution  1. First, check the AAA status. Start by using the test aaa command to ascertain the authentication and address assignment operational status.

```
user@host-BNG> test aaa ppp user SST_USER_VLAN_DEFAULT password joshua
Authentication Grant

***********User Attributes***********
User Name - SST_USER_VLAN_DEFAULT
Client IP Address - 100.16.0.2
Client IP Netmask - 255.0.0.0
Virtual Router Name - default
Reply Message - NULL
Primary DNS IP Address - 0.0.0.0
Secondary DNS IP Address - 0.0.0.0
Primary WINS IP Address - 0.0.0.0
Secondary WINS IP Address - 0.0.0.0
Primary DNS IPv6 Address - ::
Secondary DNS IPv6 Address - ::
Framed Pool - v4-pool-0
Class Attribute - not set
Service Type - 0
Client IPv6 Address - ::
Client IPv6 Mask - null
Framed IPv6 Prefix - ::/0
Framed IPv6 Pool - not-set
NDRA IPv6 Prefix - not-set
Login IPv6 Host - ::
Framed Interface Id: - 0:0:0:0
Delegated IPv6 Prefix - ::/0
Delegated IPv6 Pool - not-set
User Password - joshua
CHAP Password - NULL
Mac Address - AB:CD:00:00:00:01
Filter Id - not set
Framed MTU - (null)
Framed Route - not set
Ingress Policy Name - not set
Egress Policy Name - not set
IGMP - disabled
Redirect VR Name - default
Service Bundle - Null
```
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framed Ip Route Tag</td>
<td>not set</td>
</tr>
<tr>
<td>Ignore DF Bit</td>
<td>disabled</td>
</tr>
<tr>
<td>IGMP Access Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Access Source Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Access Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Access Source Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Version</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Version</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Immediate Leave</td>
<td>disabled</td>
</tr>
<tr>
<td>MLD Immediate Leave</td>
<td>disabled</td>
</tr>
<tr>
<td>IPv6 Ingress Policy Name</td>
<td>not set</td>
</tr>
<tr>
<td>IPv6 Egress Policy Name</td>
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</tr>
<tr>
<td>Acct Session ID</td>
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</tr>
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<td>Acct Interim Interval</td>
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<td>Acct Type</td>
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</tr>
<tr>
<td>Ingress Statistics</td>
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</tr>
<tr>
<td>Egress Statistics</td>
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</tr>
<tr>
<td>Chargeable user identity</td>
<td>0</td>
</tr>
<tr>
<td>NAS Port Id</td>
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</tr>
<tr>
<td>NAS Port</td>
<td>4095</td>
</tr>
<tr>
<td>NAS Port Type</td>
<td>15</td>
</tr>
<tr>
<td>Framed Protocol</td>
<td>0</td>
</tr>
</tbody>
</table>

**Pausing 10 seconds before disconnecting the test user**********

Logging out subscriber

Terminate Id - not set

Test complete. Exiting

user@host-BNG> test aaa ppp user SST_USER_PPPOE_LT_DEFAULT password joshua

Authentication Grant

***************User Attributes**************

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>User Name -</td>
<td>SST_USER_PPPOE_LT_DEFAULT</td>
</tr>
<tr>
<td>Client IP Address -</td>
<td>100.16.0.9</td>
</tr>
<tr>
<td>Client IP Netmask -</td>
<td>255.0.0.0</td>
</tr>
<tr>
<td>Virtual Router Name -</td>
<td>default</td>
</tr>
<tr>
<td>Reply Message -</td>
<td>NULL</td>
</tr>
<tr>
<td>Primary DNS IP Address -</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>Secondary DNS IP Address -</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>Primary WINS IP Address -</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>Secondary WINS IP Address -</td>
<td>0.0.0.0</td>
</tr>
<tr>
<td>Primary DNS IPv6 Address -</td>
<td>::</td>
</tr>
<tr>
<td>Secondary DNS IPv6 Address -</td>
<td>::</td>
</tr>
<tr>
<td>Framed Pool -</td>
<td>v4-pool-0</td>
</tr>
<tr>
<td>Class Attribute -</td>
<td>not set</td>
</tr>
<tr>
<td>Service Type -</td>
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</tr>
<tr>
<td>Client Ipv6 Address -</td>
<td>::</td>
</tr>
<tr>
<td>Client Ipv6 Mask -</td>
<td>null</td>
</tr>
<tr>
<td>Framed Ipv6 Prefix -</td>
<td>::/0</td>
</tr>
<tr>
<td>Framed Ipv6 Pool -</td>
<td>not-set</td>
</tr>
<tr>
<td>NDRA Ipv6 Prefix -</td>
<td>not-set</td>
</tr>
<tr>
<td>Login Ipv6 Host -</td>
<td>::</td>
</tr>
<tr>
<td>Framed Interface Id: -</td>
<td>0:0:0:0:0</td>
</tr>
<tr>
<td>Delegated Ipv6 Prefix -</td>
<td>::/0</td>
</tr>
<tr>
<td>Delegated Ipv6 Pool -</td>
<td>not-set</td>
</tr>
<tr>
<td>User Password -</td>
<td>joshua</td>
</tr>
<tr>
<td>CHAP Password -</td>
<td>NULL</td>
</tr>
<tr>
<td>Mac Address -</td>
<td>AB:CD:00:00:00:01</td>
</tr>
<tr>
<td>Service tag -</td>
<td>1</td>
</tr>
<tr>
<td>Service Name -</td>
<td></td>
</tr>
</tbody>
</table>

PPPOE-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01, INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)

Filter Id - not set
Framed MTU - (null)
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Framed Route</td>
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</tr>
<tr>
<td>Ingress Policy Name</td>
<td>not set</td>
</tr>
<tr>
<td>Egress Policy Name</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP</td>
<td>disabled</td>
</tr>
<tr>
<td>Redirect VR Name</td>
<td>default</td>
</tr>
<tr>
<td>Service Bundle</td>
<td>Null</td>
</tr>
<tr>
<td>Framed Ip Route Tag</td>
<td>not set</td>
</tr>
<tr>
<td>Ignore DF Bit</td>
<td>disabled</td>
</tr>
<tr>
<td>IGMP Access Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Access Source Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Access Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Access Source Group Name</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Version</td>
<td>not set</td>
</tr>
<tr>
<td>MLD Version</td>
<td>not set</td>
</tr>
<tr>
<td>IGMP Immediate Leave</td>
<td>disabled</td>
</tr>
<tr>
<td>MLD Immediate Leave</td>
<td>disabled</td>
</tr>
<tr>
<td>IPv6 Ingress Policy Name</td>
<td>not set</td>
</tr>
<tr>
<td>IPv6 Egress Policy Name</td>
<td>not set</td>
</tr>
<tr>
<td>Acct Session ID</td>
<td>28</td>
</tr>
<tr>
<td>Acct Interim Interval</td>
<td>600</td>
</tr>
<tr>
<td>Acct Type</td>
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</tr>
<tr>
<td>Ingress Statistics</td>
<td>disabled</td>
</tr>
<tr>
<td>Egress Statistics</td>
<td>disabled</td>
</tr>
<tr>
<td>Chargeable user identity</td>
<td>0</td>
</tr>
<tr>
<td>NAS Port Id</td>
<td>not set</td>
</tr>
<tr>
<td>NAS Port</td>
<td>4095</td>
</tr>
<tr>
<td>NAS Port Type</td>
<td>15</td>
</tr>
<tr>
<td>Framed Protocol</td>
<td>0</td>
</tr>
</tbody>
</table>

****Pausing 10 seconds before disconnecting the test user**********

Logging out subscriber

Test complete. Exiting

2. Check the RADIUS server's operational status and statistics.

```
user@host-BNG> show network-access aaa radius-servers detail
Profile: Access-Profile-0
 Server address: 9.0.0.9
 Authentication port: 1812
 Accounting port: 1813
 Status: UP
```
3. Monitor incoming and outgoing subscriber protocol control traffic via the PS interface. Start by checking the subscriber access protocol negotiation status.

```
user@host-BNG> monitor traffic interface ps0 no-resolve
```

verbose output suppressed, use (detail) or (extensive) for full protocol decode
Listening on ps0, capture size 96 bytes

```
15:10:51.503545 In PPPoE PADI [Service-Name] [Host-Uniq UTF8]
15:10:56.507188 In PPPoE PADI [Service-Name] [Host-Uniq UTF8]
15:10:56.507566 Out PPPoE PADO [AC-Name "RO"] [Host-Uniq UTF8] [Service-Name] [AC-Cookie UTF8]
15:10:56.508055 In PPPoE PADR [Service-Name] [Host-Uniq UTF8] [AC-Cookie UTF8]
15:10:56.592436 In PPPoE [ses 1]LCP, Conf-Request (0x01), id 1, length 16
15:10:56.592437 In PPPoE [ses 1]LCP, Conf-Request (0x01), id 1, length 16
15:10:56.592511 Out PPPoE [ses 1]LCP, Conf-Request (0x01), id 141, length 21
15:10:56.592511 Out PPPoE [ses 1]LCP, Conf-Request (0x01), id 141, length 21
15:10:56.592560 Out PPPoE [ses 1]LCP, Conf-Ack (0x02), id 1, length 16
15:10:56.592560 Out PPPoE [ses 1]LCP, Conf-Ack (0x02), id 1, length 16
15:10:56.593707 In PPPoE [ses 1]LCP, Conf-Ack (0x02), id 1, length 21
15:10:56.593708 In PPPoE [ses 1]LCP, Conf-Ack (0x02), id 1, length 21
15:10:56.593899 Out PPPoE [ses 1]CHAP, Challenge (0x01), id 32, Value 13bf1f6f74448948130f8648c8c14a49b46125, Name JUNOS
15:10:56.593899 Out PPPoE [ses 1]CHAP, Challenge (0x01), id 32, Value 13bf1f6f74448948130f8648c8c14a49b46125, Name JUNOS
15:10:56.800192 Out PPPoE [ses 1]CHAP, Success (0x03), id 32, Msg
```
To monitor L2 header information, use the `monitor traffic` command with the `layer2` option.

```
user@host-BNG> monitor traffic interface ps0 layer2-headers no-resolve
```

Verbose output suppressed, use (detail) or (extensive) for full protocol decode. Address resolution is OFF.

Listening on ps0, capture size 96 bytes

```text
15:15:56.80193 Out PPPoE  [ses 1]CHAP, Success (0x03), id 32, Msg
15:15:56.800866 In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 1, length 24
15:15:56.800867 In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 1, length 24
15:15:56.800870 In PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 1, length 16
15:15:56.800871 In PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 1, length 16
15:15:56.801043 Out PPPoE  [ses 1]IPCP, Conf-Nack (0x03), id 1, length 24
15:15:56.801044 Out PPPoE  [ses 1]IPCP, Conf-Nack (0x03), id 1, length 24
15:15:56.801234 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 1, length 16
15:15:56.801235 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 1, length 16
15:15:56.801580 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 2, length 24
15:15:56.801581 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 2, length 24
15:15:56.872600 Out PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 126, length 12
15:15:56.872601 Out PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 126, length 12
15:15:56.872683 Out PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 146, length 16
15:15:56.872683 Out PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 146, length 16
15:15:56.873141 In PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 126, length 12
15:15:56.873141 In PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 126, length 12
15:15:56.878193 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.878194 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.878193 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.878193 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.879819 In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.880720 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:15:56.880720 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
51 packets received by filter
0 packets dropped by kernel
```

4. To monitor L2 header information, use the `monitor traffic` command with the `layer2` option.

user@host-BNG> monitor traffic interface ps0 layer2-headers no-resolve

Verbose output suppressed, use (detail) or (extensive) for full protocol decode.
Address resolution is OFF.

Listening on ps0, capture size 96 bytes

```text
15:15:51.631290 In 00:22:68:14:84:d5 > ff:ff:ff:ff:ff:ff, ethtype 802.1Q (0x8100), length 40: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE D, PPPoE PADI [Service-Name] [Host-Uniq UTF8] [Host-Uniq UTF8]
15:15:51.634347 In 00:22:68:14:84:d5 > ff:ff:ff:ff:ff:ff, ethtype 802.1Q (0x8100), length 40: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE D, PPPoE PADI [Service-Name] [Host-Uniq UTF8] [Host-Uniq UTF8]
15:15:51.634596 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8100), length 66: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE D, PPPoE PADO [AC-Name "RO"] [Host-Uniq UTF8] [Service-Name] [AC-Cookie UTF8]
15:15:51.653054 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8100), length 60: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE D, PPPoE PADO [Service-Name] [Host-Uniq UTF8][AC-Cookie UTF8]
15:15:51.663820 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8100), length 44: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]LCP (0xc021), length 16: LCP, Conf-Request (0x01), id 1, length 16
15:15:51.663821 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8100), length 44: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]LCP (0xc021), length 16: LCP, Conf-Request (0x01), id 1, length 16
```
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15:11:56.663924 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 49: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 21: LCP, Conf-Request (0x01), id 8, length 21

15:11:56.663925 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 49: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 21: LCP, Conf-Request (0x01), id 8, length 21

15:11:56.663973 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 44: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 16: LCP, Conf-Ack (0x02), id 1, length 16

15:11:56.663974 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 44: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 16: LCP, Conf-Ack (0x02), id 8, length 16

15:11:56.664432 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 49: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 21: LCP, Conf-Ack (0x02), id 8, length 21

15:11:56.664433 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 49: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]LCP (0x0201), length 21: LCP, Conf-Ack (0x02), id 8, length 21

15:11:56.664614 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 66: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]CHAP (0x0223), length 38: CHAP, Challenge (0x01), id 103, Value 29df1053315de91c31adc72e60f6aaf892ba1fc737082abd9d, Name JUNOS

15:11:56.664615 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 66: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]CHAP (0x0223), length 38: CHAP, Challenge (0x01), id 103, Value 29df1053315de91c31adc72e60f6aaf892ba1fc737082abd9d, Name JUNOS

15:11:56.666088 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 68: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 1, length 16

15:11:56.666089 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 68: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 1, length 16

15:11:56.870223 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 34: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]CHAP (0x0223), length 6: CHAP, Success (0x03), id 103, Msg

15:11:56.870224 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethtype 802.1Q (0x8800), length 34: vlan 1, p 6, ethtype 802.1Q, vlan 100, p 6, ethtype PPPoE S, PPPoE [ses 1]CHAP (0x0223), length 6: CHAP, Success (0x03), id 103, Msg

15:11:56.870893 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 52: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 1, length 24

15:11:56.870893 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 52: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 1, length 24

15:11:56.870897 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethtype 802.1Q (0x8800), length 44: vlan 1, p 0, ethtype 802.1Q, vlan 100, p 0, ethtype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IPv6CP, Conf-Request (0x01), id 1, length 16
Configuring the Broadband Edge as a Service Node Within Seamless MPLS Network Designs

15:11:56.870897 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 44: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Request (0x01), id 1, length 16
15:11:56.871071 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 52: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Nack (0x03), id 1, length 24
15:11:56.871071 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 52: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Nack (0x03), id 1, length 24
15:11:56.871247 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Ack (0x02), id 1, length 16
15:11:56.871247 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Ack (0x02), id 1, length 16
15:11:56.871616 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 52: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 2, length 24
15:11:56.871617 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 52: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Request (0x01), id 2, length 24
15:11:56.871662 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 52: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Ack (0x02), id 2, length 24
15:11:56.871663 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 52: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 24: IPCP, Conf-Ack (0x02), id 2, length 24
15:11:56.959681 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 40: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 12: IPCP, Conf-Request (0x01), id 244, length 12
15:11:56.959681 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 40: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 12: IPCP, Conf-Request (0x01), id 244, length 12
15:11:56.959763 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Request (0x01), id 242, length 16
15:11:56.959764 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Request (0x01), id 242, length 16
15:11:56.960192 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 40: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 12: IPCP, Conf-Ack (0x02), id 244, length 12
15:11:56.960193 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 40: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IPCP (0x8021), length 12: IPCP, Conf-Ack (0x02), id 244, length 12
15:11:56.963905 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q
Chapter 1: Configuring Broadband Edge as a Service Node Within Seamless MPLS Network Designs

(0x8100), length 44: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Ack (0x02), id 242, length 16
15:11:56.963906 In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length 44: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6CP (0x8057), length 16: IP6CP, Conf-Ack (0x02), id 242, length 16
15:11:58.634264 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6 (0x0057), length 74: [ip6]
15:11:58.634265 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6 (0x0057), length 74: [ip6]
15:12:00.323994 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6 (0x0057), length 74: [ip6]
15:12:00.323995 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length 68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE [ses 1]IP6 (0x0057), length 74: [ip6]
^C
54 packets received by filter
0 packets dropped by kernel

Related Documentation
- Solution Brief: Broadband Edge
- Reference Architecture: Broadband Edge Network Design

Conclusion

Deploying an MX Series BNG as an IP/MPLS service node within a seamless MPLS network architecture enables the convergence of residential services together with mobile, business, and other services. This convergence maximizes service placement flexibility while minimizing operational costs. The single converged packet network and the de-coupling of infrastructure and service architectures ensure that service delivery points can be easily added or changed in rapid response to changing network requirements.

Related Documentation
- Network Configuration Example: Configuring MX Series Universal Edge Routers for Service Convergence