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Network Configuration Example

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

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Network Configuration Example Configuring the Broadband Edge as a Service Node Within Seamless MPLS Network Designs
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About This Guide

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.

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CHAPTER

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

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

IN THIS SECTION

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

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.

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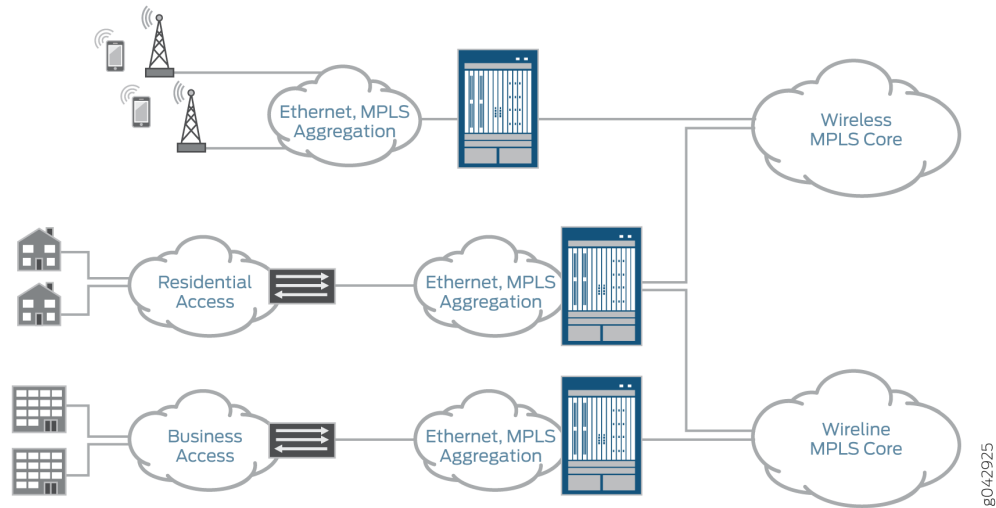
shows network convergence with seamless MPLS. Service providers are moving from the traditional access and core-facing networks to this converged residential, business, and mobile backhaul design model to manage new service introduction velocity and service node flexibility, and to ensure that end-to-end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

Figure 2: Network Convergence with Seamless MPLS
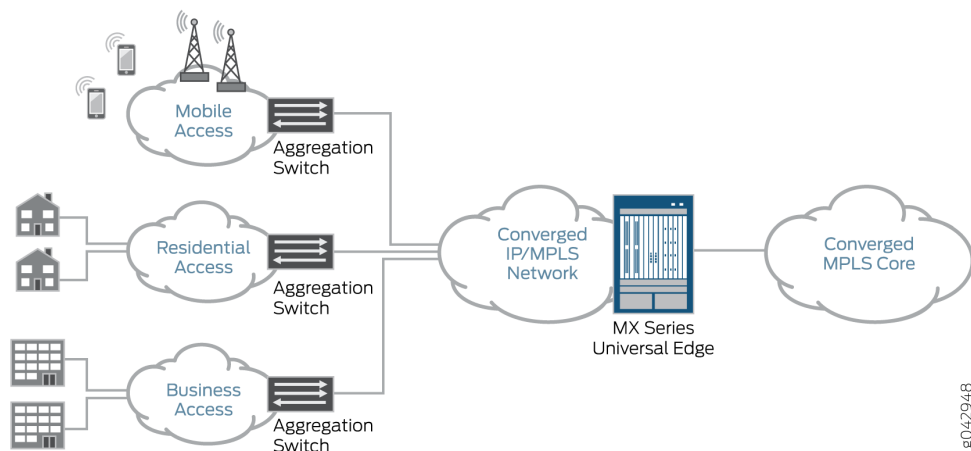
Seamless MPLS with pseudowire head-end termination offers a solution to the following technical challenges:

- 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 6.

Figure 3: Simplified Service Delivery
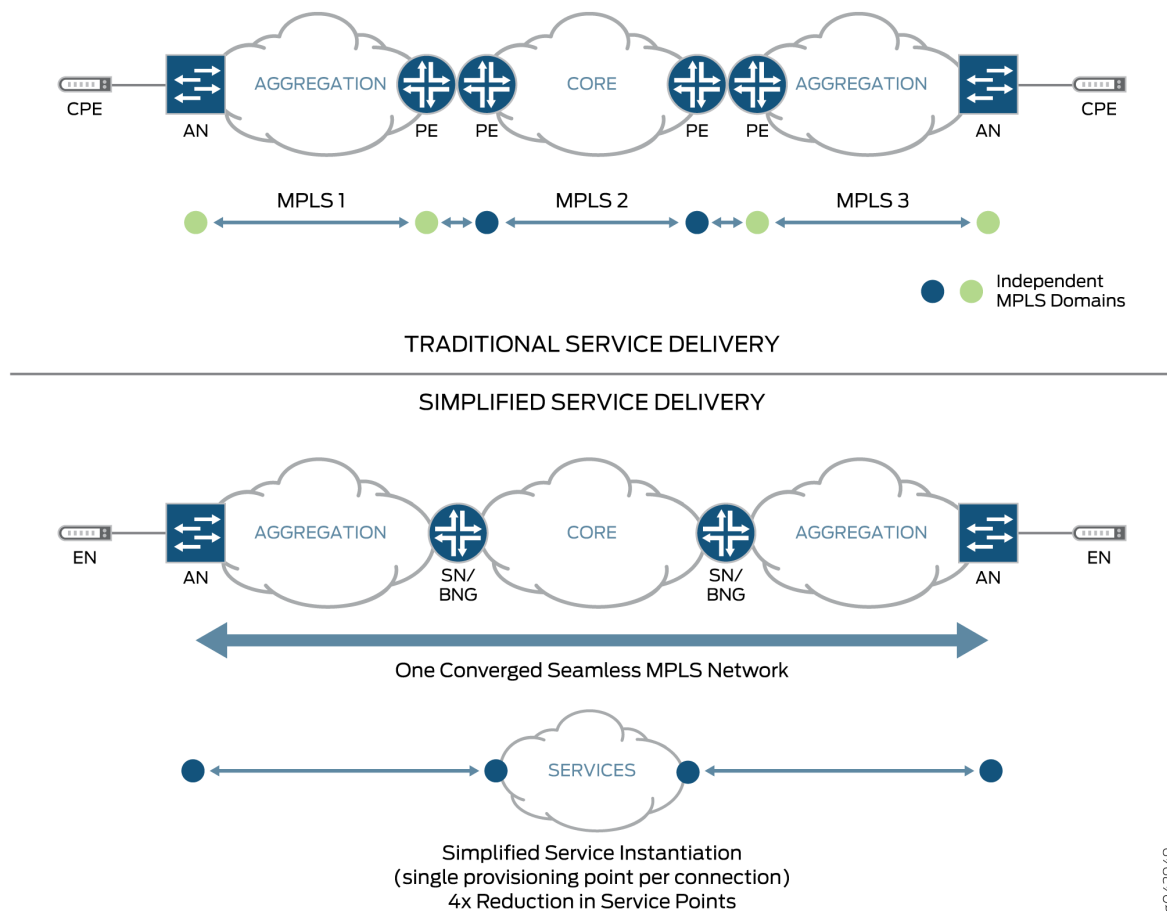
In today's Ethernet/MPLS environment, L2 and L3 functions no longer need to be separated. Seamless MPLS provides a flexible infrastructure to extend access toward service edge functions such as BNGs and mobile gateways, services that can be centralized or not, depending on scaling and services take rates.

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. 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).

Figure 4: Seamless MPLS with Pseudowire Head-End Termination
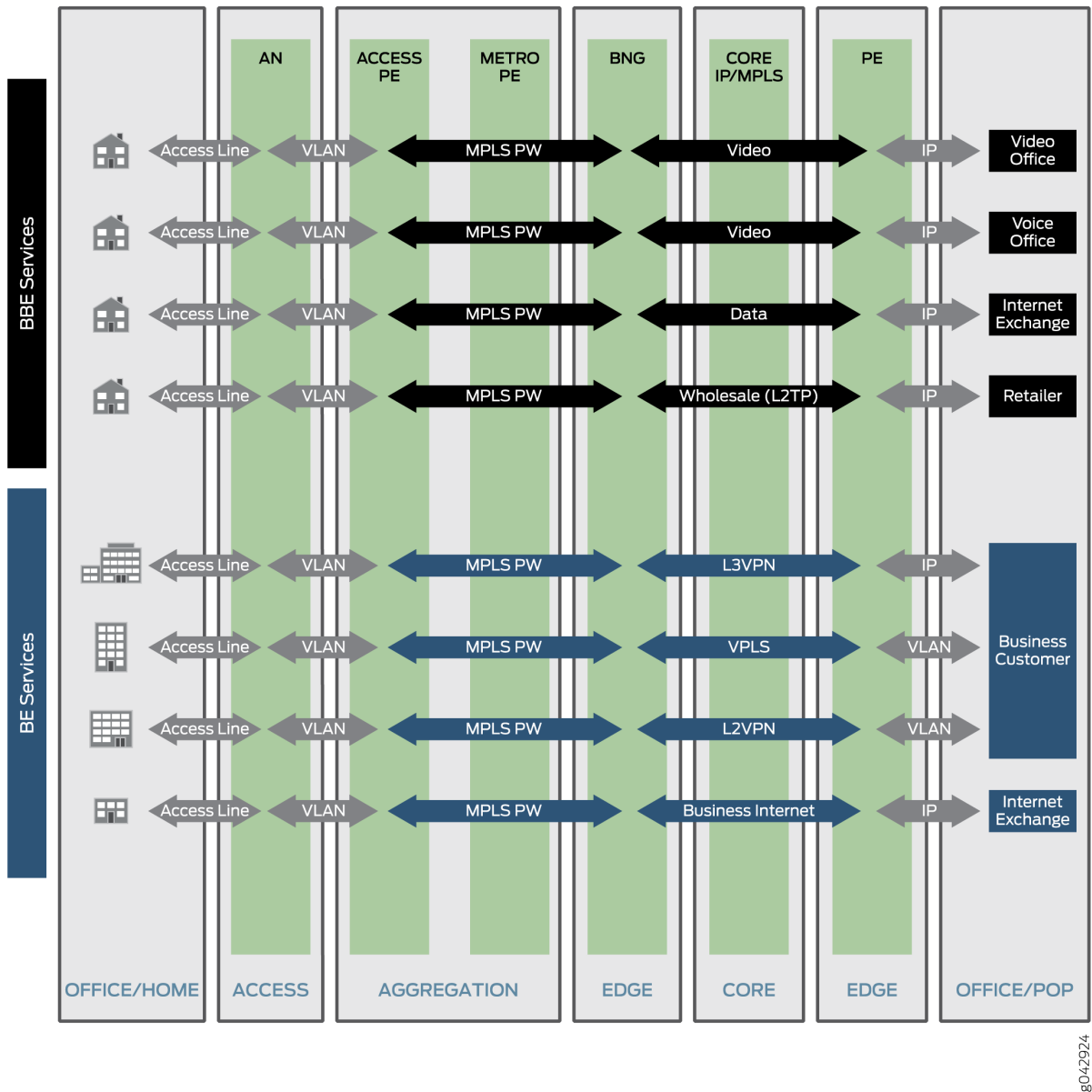
RELATED DOCUMENTATION

Solution Brief: Broadband Edge

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

IN THIS SECTION

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

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

Device	Hardware
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
	RE0-RE1: RE-A-2000
	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)*

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

Overview

IN THIS SECTION

- Topology | **13**

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 13 illustrates the topology of this example configuration, including the MPLS and dual stack scope.

Figure 5: Topology
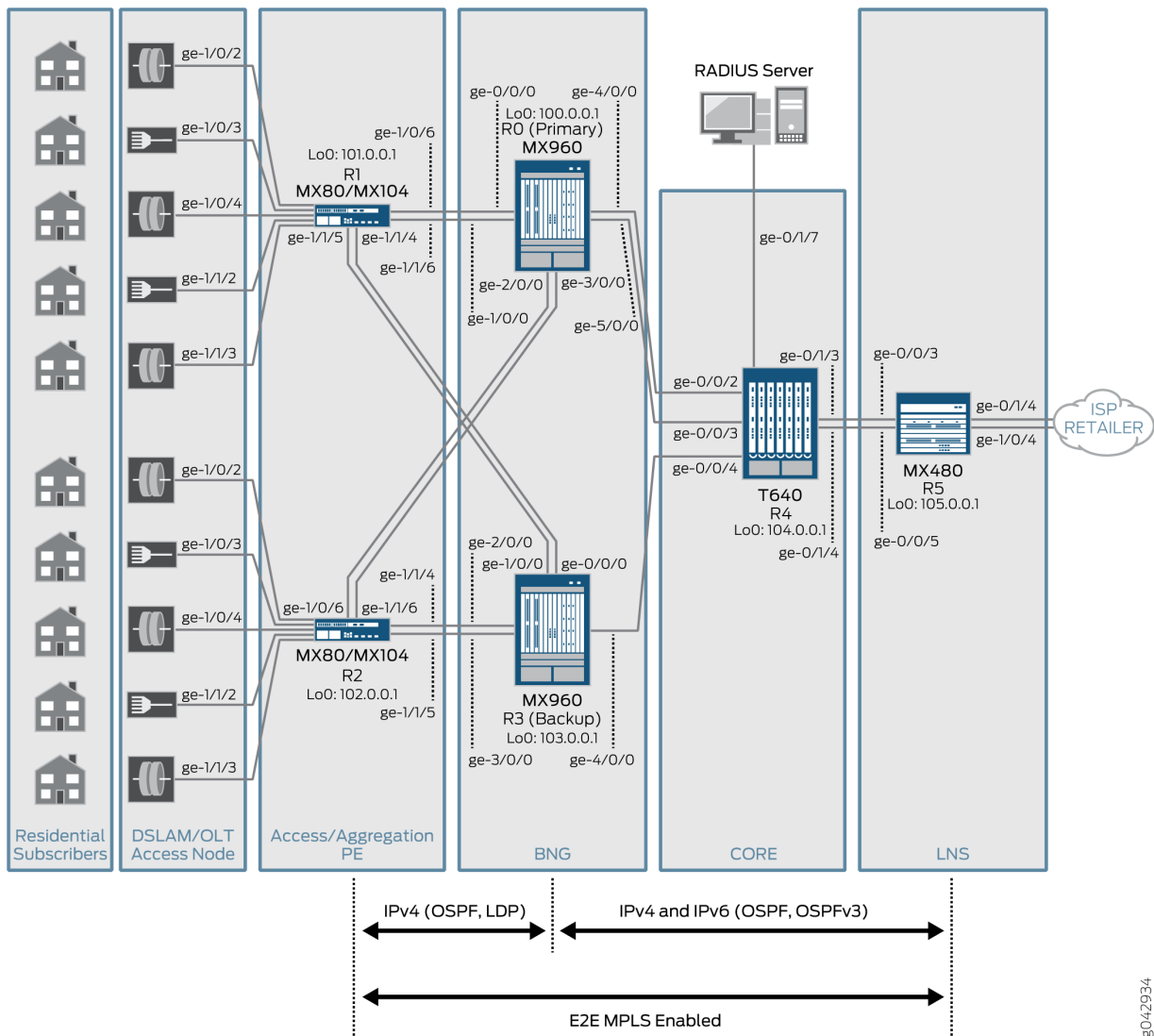
In this example, the access and aggregation provider edge (access PE) systems (R1 and R2) are directly connected and multihomed to the active and backup BNG systems. The purpose of the PE devices in

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

IN THIS SECTION

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

CLI Quick Configuration

highlights the access/aggregation routers (R1 and R2) in the context of the reference example topology.

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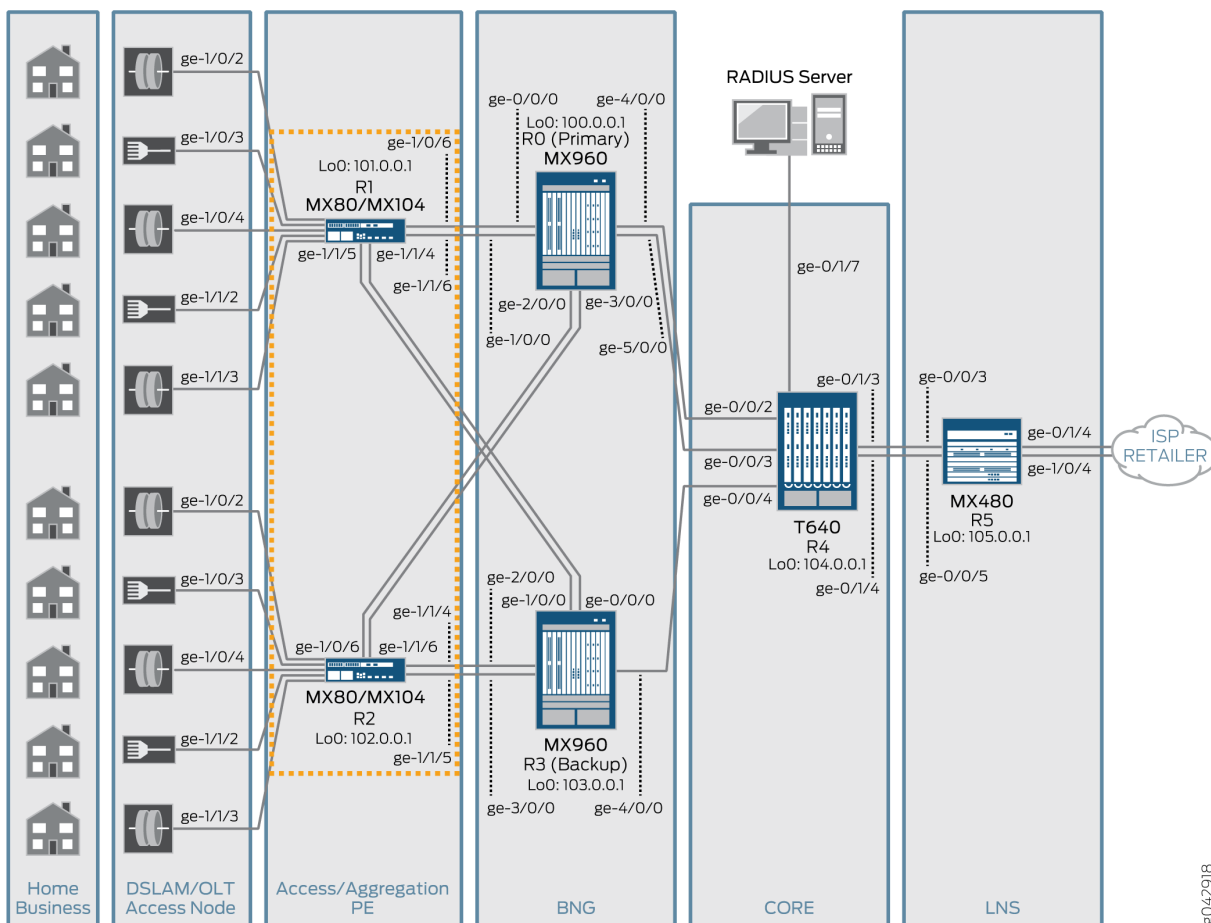
To quickly configure R1 as in this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```
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
virtual-circuit-id 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-1/0/2.1 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 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
virtual-circuit-id 2
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 Junos OS 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

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

user@host-R1# set ge-1/0/4 flexible-vlan-tagging
user@host-R1# set ge-1/0/4 encapsulation flexible-ethernet-services
user@host-R1# set ge-1/0/4 gigether-options loopback
user@host-R1# set ge-1/0/4 unit 1 encapsulation vlan-ccc
user@host-R1# set ge-1/0/4 unit 1 vlan-id-range 1-2
```

```
user@host-R1# set ge-1/0/4 unit 2 encapsulation vlan-ccc
user@host-R1# set ge-1/0/4 unit 2 vlan-id-range 3-4
user@host-R1# set ge-1/0/4 unit 3 encapsulation vlan-ccc
user@host-R1# set ge-1/0/4 unit 3 vlan-id-range 5-6

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

user@host-R1# set ge-1/1/3 flexible-vlan-tagging
user@host-R1# set ge-1/1/3 encapsulation flexible-ethernet-services
user@host-R1# set ge-1/1/3 gigether-options loopback
user@host-R1# set ge-1/1/3 unit 1 encapsulation vlan-ccc
user@host-R1# set ge-1/1/3 unit 1 vlan-id-range 1-2
user@host-R1# set ge-1/1/3 unit 2 encapsulation vlan-ccc
user@host-R1# set ge-1/1/3 unit 2 vlan-id-range 3-4
user@host-R1# set ge-1/1/3 unit 3 encapsulation vlan-ccc
user@host-R1# 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-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
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 the Access/Aggregation Router, R2

CLI Quick Configuration

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 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 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 21.21.13.2/24
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 for Junos OS.

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
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 encapsulation-type
ethernet
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 ignore-mtu-mismatch
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 backup-neighbor 103.0.0.1
virtual-circuit-id 1001
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-
detection minimum-interval 1000
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-
detection multiplier 4
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.1 oam bfd-liveness-
detection detection-time threshold 5000

user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 virtual-circuit-id 1002
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 encapsulation-type
ethernet
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 ignore-mtu-mismatch
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 backup-neighbor 103.0.0.1
virtual-circuit-id 1002
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-
detection minimum-interval 1000
user@host-R2# set l2circuit neighbor 100.0.0.1 interface ge-1/0/2.2 oam bfd-liveness-
detection multiplier 4
user@host-R2# 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-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;
    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-1/1/2

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-R2# 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 MPLS pseudowire L2 circuit connections configuration.

```
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;
}
oam {
    bfd-liveness-detection {
        minimum-interval 1000;
        multiplier 4;
        detection-time {
            threshold 5000;
        }
    }
}
```

```
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;
}
oam {
    bfd-liveness-detection {
        minimum-interval 1000;
        multiplier 4;
        detection-time {
```

```
            threshold 5000;
        }
    }
}
```

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

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 "$junos-interface-
unit" family inet unnumbered-address lo0.0
set dynamic-profiles vlan-prof-0 interfaces "$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 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
<password>
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 <password>
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 system 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 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 1000:0::1/128 primary
set interfaces lo0 unit 0 family inet6 address 1000:0::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 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 <password>
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 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 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 "$ABC123"; ## 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-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 R0-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 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
1000:0000:0000:0000:0000:0000:0000:0000/64
set access address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 prefilx-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 "$ABC123"; ## 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 for Junos OS.

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 "$junos-underlying-interface"
user@host-R0# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" 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_FC0_FC1_FC2
forwarding-class FC0 scheduler FC0_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
forwarding-class FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_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
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class
FC1 scheduler FC1_SCH
user@host-R0# set vlan-prof-0 class-of-service scheduler-maps SMAP_PS forwarding-class
FC2 scheduler FC2_SCH
user@host-R0# 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-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 <password>
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 <password>
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 primary 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 60.

Figure 8: Pseudowire Subscriber Interface Protocol Stack

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
<password>
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
```

14. Configure the L2 circuit connections.

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
```

c. 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.

```
[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
1000:0000:0000:0000:0000:0000:0000:0000/64 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.

```
[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 INPUT-V4-FILTER-01 term TERM2 then accept
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.

```
[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 "$ABC123"; ## 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 order radius
user@host-R0# set profile Access-Profile-0 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
1000:0000:0000:0000:0000:0000:0000:0000/64
user@host-R0# set address-assignment pool v6-na-pool-0 family inet6 range v6-range-0
prefilx-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 "$ABC123"; ## 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.

```
user@host-R0# show system dynamic-profile-options
versioning;
```

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
dhcpv6 {
    group v6-ppp-client-0 {
        interface pp0.0;
    }
    group v4-rtClient-0-ACCESS-0-ps0 {
        authentication {
            password <password>;
            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 <password>;
            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;

user@host-R0# show chassis pseudowire-service
device-count 2048;
```

10. Confirm the pseudowire tunnel service configuration.

```
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.

```
user@host-R0# show interfaces
lo0 {
    unit 0 {
        family inet {
            address 100.0.0.1/32 {
                primary;
                preferred;
            }
        }
        family inet6 {
            address 1000:0::1/128 {
                primary;
                preferred;
            }
        }
        family mpls;
    }
}
ge-4/0/0 {
    description "To R4 - Core";
    unit 0 {
        family inet {
            address 21.21.14.1/24;
        }
        family inet6;
        family mpls;
    }
}
ge-5/0/0 {
    description "To R4 - Core";
    unit 0 {
        family inet {
```

```
                address 21.21.15.1/24;
            }
            family inet6;
            family mpls;
        }
    }
    ge-0/0/0 {
        description "To R1 - APE1";
        unit 0 {
            family inet {
                address 21.21.11.1/24;
            }
            family mpls;
        }
    }
    ge-1/0/0 {
        description "To R1 - APE1";
        unit 0 {
            family inet {
                address 21.21.10.1/24;
            }
            family mpls;
        }
    }
    ge-2/0/0 {
        description "To R2 - APE2";
        unit 0 {
            family inet {
                address 21.21.13.1/24;
            }
            family mpls;
        }
    }
    ge-3/0/0 {
        description "To R2 - APE2";
        unit 0 {
            family inet {
                address 21.21.12.1/24;
            }
            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;
}
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;
}
```

12. Confirm the PS interface and VLAN authentication configuration.

```
user@host-R0# show interfaces ps0
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 <password>;
            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 "$ABC123"; ## 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;
        dhcp-attributes {
            maximum-lease-time 25200;
        }
    }
}

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 "$ABC123"; ## 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

CLI Quick Configuration

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 inet 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 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 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 group v4-rtClient-0-ACCESS-0-ps0 authentication password
<password>
```

```
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 <password>
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 <password>
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 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 "$ABC123"; ## 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::2/128
set access address-assignment pool v6-na-pool-0 family inet6 range v6-range-0 low
1003::ffff:ffff/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 for Junos OS.

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.

   ```
   [edit system]
   user@host-R3# set dynamic-profile-options versioning
   ```

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 "$junos-underlying-interface"
user@host-R3# set pppoe-client-profile interfaces pp0 unit "$junos-interface-unit" 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_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_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_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_FC0_FC1_FC2
forwarding-class FC0 scheduler FC0_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
forwarding-class FC1 scheduler FC1_SCH
user@host-R3# set vlan-prof-0 class-of-service scheduler-maps SMAP_FC0_FC1_FC2
forwarding-class FC2 scheduler FC2_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
user@host-R3# set vlan-prof-0 class-of-service schedulers FC1_SCH transmit-rate 20m
user@host-R3# set vlan-prof-0 class-of-service schedulers FC1_SCH priority medium-high
user@host-R3# set vlan-prof-0 class-of-service schedulers FC2_SCH priority low
user@host-R3# set vlan-prof-0 class-of-service schedulers FC3_SCH priority low
user@host-R3# set vlan-prof-0 class-of-service schedulers FC4_SCH transmit-rate 2m
user@host-R3# set vlan-prof-0 class-of-service schedulers FC4_SCH buffer-size percent 2
user@host-R3# set vlan-prof-0 class-of-service schedulers FC4_SCH priority low
user@host-R3# set vlan-prof-0 class-of-service schedulers FC4_SCH drop-profile-map loss-
priority low protocol any drop-profile DP_04
user@host-R3# set vlan-prof-0 class-of-service schedulers FC5_SCH transmit-rate 2m
user@host-R3# set vlan-prof-0 class-of-service schedulers FC5_SCH buffer-size percent 2
user@host-R3# set vlan-prof-0 class-of-service schedulers FC5_SCH priority low
user@host-R3# set vlan-prof-0 class-of-service schedulers FC5_SCH drop-profile-map loss-
priority low protocol any drop-profile DP_05
```

```
user@host-R3# set vlan-prof-0 class-of-service schedulers FC6_SCH transmit-rate 2m
user@host-R3# set vlan-prof-0 class-of-service schedulers FC6_SCH buffer-size percent 2
user@host-R3# set vlan-prof-0 class-of-service schedulers FC6_SCH priority low
user@host-R3# set vlan-prof-0 class-of-service schedulers FC6_SCH drop-profile-map loss-
priority low protocol any drop-profile DP_06
user@host-R3# set vlan-prof-0 class-of-service schedulers FC7_SCH transmit-rate 2m
user@host-R3# set vlan-prof-0 class-of-service schedulers FC7_SCH buffer-size percent 2
user@host-R3# set vlan-prof-0 class-of-service schedulers FC7_SCH priority low
user@host-R3# 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-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]
user@host-R3# set DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit
"$junos-underlying-interface-unit" family inet filter input "$I_V4_FILTER"
user@host-R3# set DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit
"$junos-underlying-interface-unit" family inet filter output "$O_V4_FILTER"
user@host-R3# set DHCP-SERVICE-PROFILE interfaces "$junos-interface-ifd-name" unit
"$junos-underlying-interface-unit" family inet6 filter input "$I_V6_FILTER"
user@host-R3# set DHCP-SERVICE-PROFILE interfaces "$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-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.

```
[edit system]
user@host-R3# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0
authentication password <password>
user@host-R3# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0
authentication username-include user-prefix SST_USER_DHCP_V4_DEFAULT
```

```
user@host-R3# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 dynamic-
profile client-profile
user@host-R3# set services dhcp-local-server group v4-rtClient-0-ACCESS-0-ps0 interface
ps0.0
user@host-R3# 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-R3# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0
authentication password <password>
user@host-R3# 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-R3# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0
dynamic-profile client-profile
user@host-R3# set services dhcp-local-server dhcpv6 group v6-dhcp-client-0-ACCESS-0-ps0
interface ps0.0
user@host-R3# 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 primary 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 authentication password
<password>
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
```

14. Configure the L2 circuit connections.

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 ospf3 export EXPORT_BNG_ACCESS_INTERNAL
    user@host-R3# set ospf3 area 0.0.0.0 interface lo0.0
    user@host-R3# set ospf3 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 "$ABC123"; ## 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
1003:0000:0000:0000:0000:0000:0000:0000/64
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;
queue 3 FC3;
queue 4 FC4;
queue 5 FC5;
queue 6 FC6;
queue 7 FC7;
```

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 <password>;
            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 <password>;
```

```
            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-R3# show chassis redundancy
graceful-switchover;

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

10. Confirm the pseudowire tunnel service configuration.

```
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.

```
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;
}
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;
    }
```

12. Confirm the PS interface and VLAN authentication configuration.

```
user@host-R3# show interfaces ps0
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 <password>;
                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;
router-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 "$ABC123"; ## 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;

user@host-R3# 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-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

CLI Quick Configuration

highlights the core router (R4) in the context of the reference example topology.

Figure 9: LNS Device in the Topology
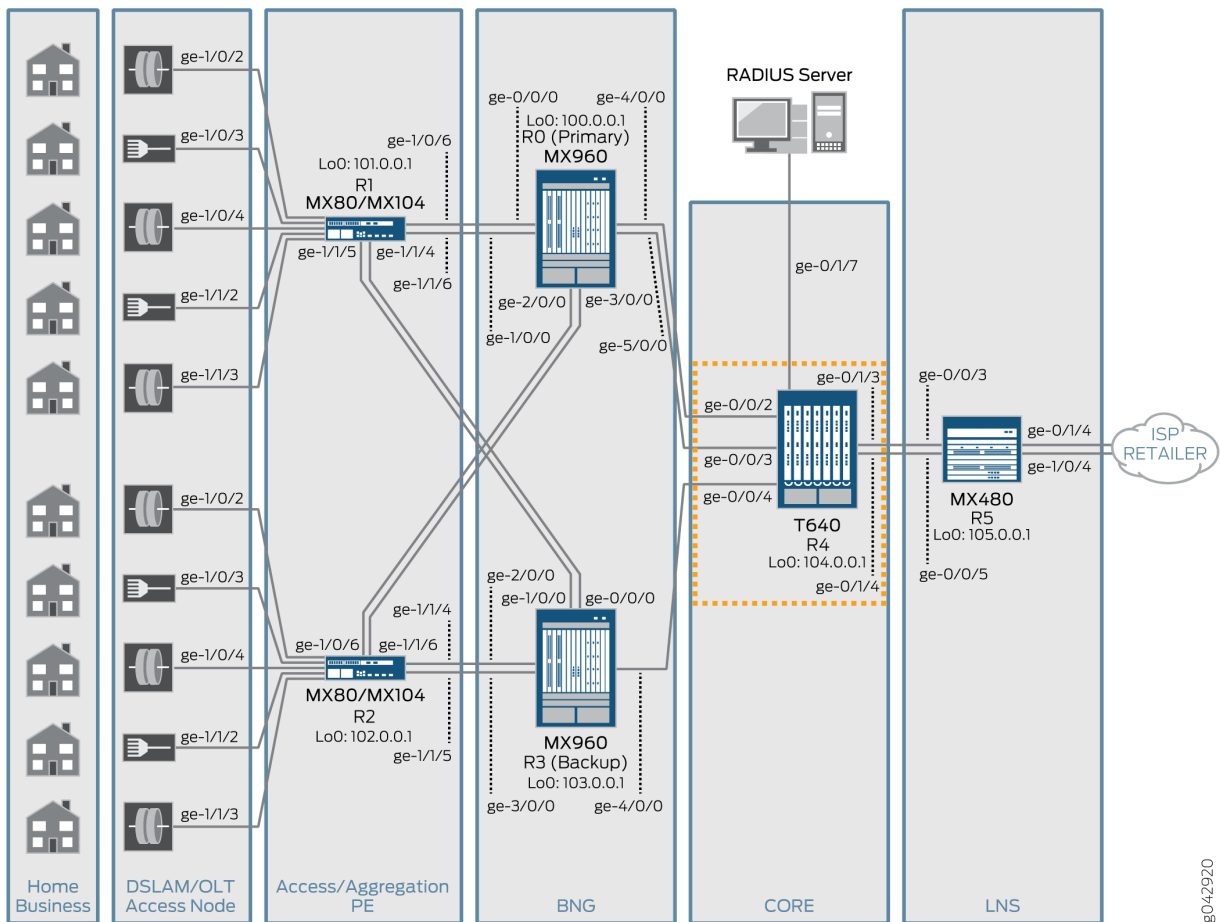
To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```
set 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 1004:0::1/128 primary
set interfaces lo0 unit 0 family inet6 address 1004:0::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 21.21.51.1/24
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
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 for Junos OS.

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 1004:0::1/128 primary
   user@host-R4# set lo0 unit 0 family inet6 address 1004:0::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
   ```

```
user@host-R4# set ge-0/0/2 unit 0 family mpls
user@host-R4# set ge-0/0/3 unit 0 family inet address 21.21.15.2/24
user@host-R4# set ge-0/0/3 unit 0 family inet6
user@host-R4# set ge-0/0/3 unit 0 family mpls
user@host-R4# set ge-0/0/4 unit 0 family inet address 21.21.40.2/24
user@host-R4# set ge-0/0/4 unit 0 family inet6
user@host-R4# set ge-0/0/4 unit 0 family mpls
user@host-R4# set ge-0/1/3 unit 0 family inet address 21.21.50.1/24
user@host-R4# set ge-0/1/3 unit 0 family inet6
user@host-R4# set ge-0/1/3 unit 0 family mpls
user@host-R4# set ge-0/1/4 unit 0 family inet address 21.21.51.1/24
user@host-R4# set ge-0/1/4 unit 0 family inet6
user@host-R4# set ge-0/1/4 unit 0 family mpls
user@host-R4# set ge-0/1/7 unit 0 family inet address 9.0.0.1/24
user@host-R4# set ge-0/1/7 unit 0 family inet6
user@host-R4# set ge-0/1/7 unit 0 family mpls
```

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
```

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

CLI Quick Configuration

highlights the LNS device (R5) in the context of the reference example topology.

Figure 10: LNS Device in the Topology
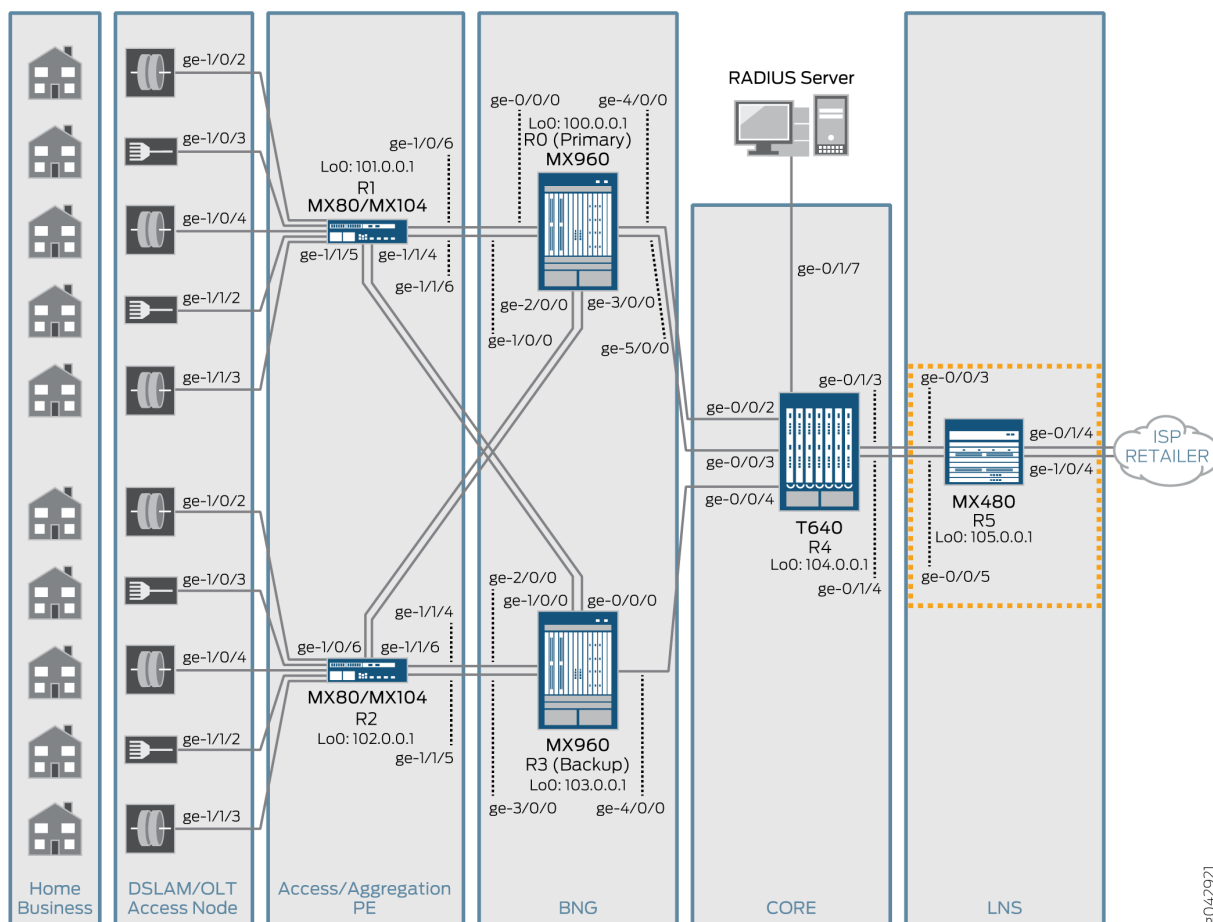
To quickly configure this example, copy the following commands, paste them into a text file, remove any line breaks, change any details necessary to match your network configuration, and then copy and paste the commands into the CLI at the [edit] hierarchy level.

```
set 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" no-keepalives
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit
"$junos-interface-unit" family inet unnumbered-address "$junos-loopback-interface"
set dynamic-profiles dynamic-profiles lns-profile interfaces "$junos-interface-ifd-name" unit
"$junos-interface-unit" family inet6 unnumbered-address "$junos-loopback-interface"
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 ppp keepalive 0
set access profile lns-profile client default l2tp lcp-renegotiation
set access profile lns-profile client default l2tp shared-secret "$ABC123"; ## SECRET-DATA
set access profile lns-profile client default user-group-profile lns-group-profile
set access radius-server 9.0.0.9 secret "$ABC123"; ## 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 1000:0000::/32
set access address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range low
1000:0000:0000:0001::/64
set access address-assignment pool v6-l2tp-pool-0 family inet6 range v6-range high
1000:0000:0000:ffff::/64
set access address-assignment pool v6-ndra-pool-0 family inet6 prefix
3000:0000:0000:0000:0000:0000:0000:0000/32
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 Junos OS 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
user@host-R5# set ospf area 0.0.0.0 interface ge-0/0/3.0
user@host-R5# set ospf area 0.0.0.0 interface ge-0/0/5.0
user@host-R5# set ospf area 0.0.0.0 interface ge-0/1/4.0
user@host-R5# set ospf area 0.0.0.0 interface ge-1/0/4.0
```

c. Configure OSPFv3 for IPv6 routing.

```
[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.

```
[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.

```
[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.

```
[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.

```
[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 "$ABC123"; ##
```

```
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 "$ABC123"; ## 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.

```
[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
```

4. Configure DHCPv6.

   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 1005:0::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 "$ABC123"; ## 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 "$ABC123"; ## 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;
    }
}
service-device-pools {
    pool lns_service_device_pool {
        interface si-0/0/0;
    }
}
```

10. Confirm the IPv4 and IPv6 address pool configuration.

```
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.

```
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.

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

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

```
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 199.99.9.1;
```

```
interfaces {
    vt-1/1/0.0;
}
```

Configuring the User Profile for the RADIUS Server

Step-by-Step Procedure

highlights the RADIUS server in the context of the reference example topology.

Figure 11: RADIUS Server in the Topology
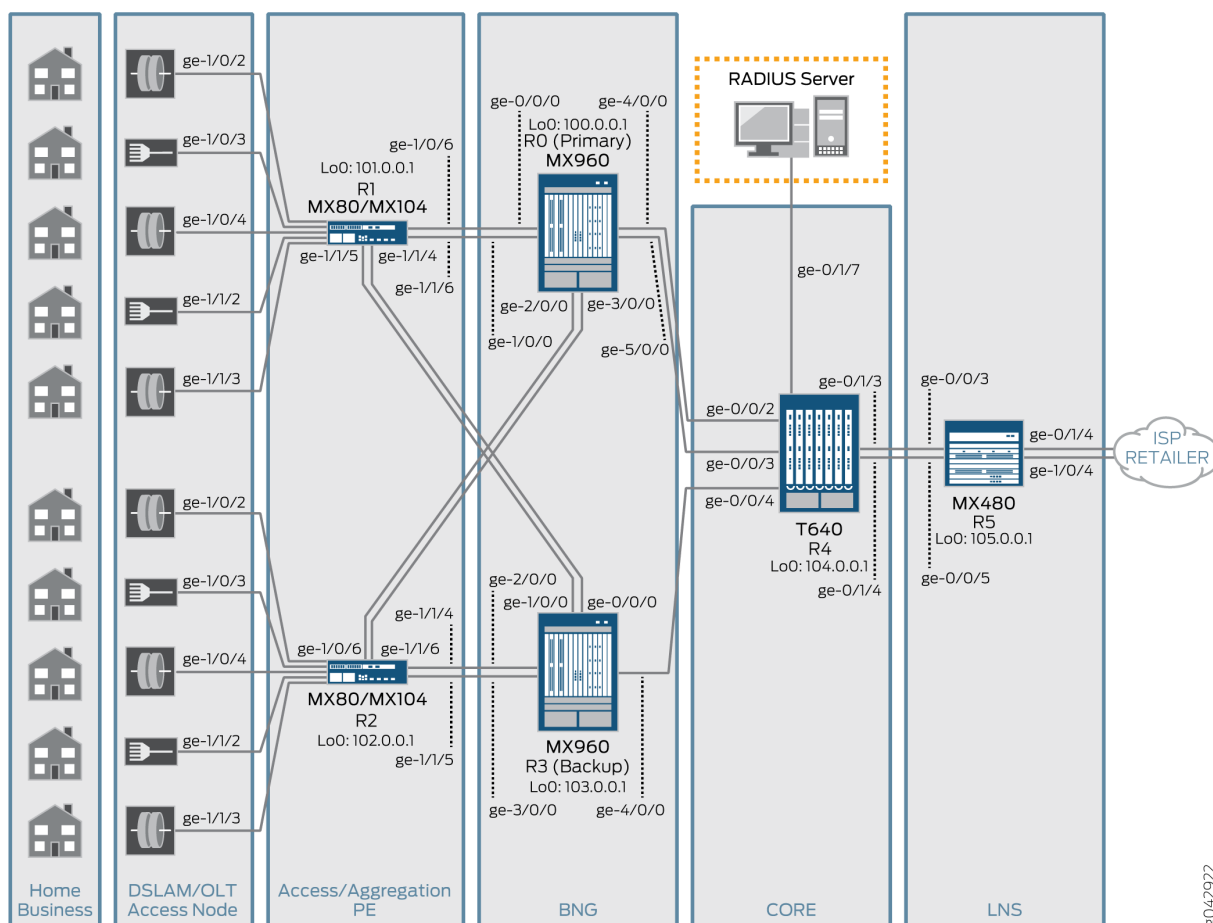
To configure the user profile for the RADIUS server:

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

```
SST_USER_DHCP_V4_DEFAULT    Auth-Type := Accept, User-Password := "<password>"
    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 := "<password>"
    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 := "<password>"
    ERX-Service-Activate:1 += "PPPOE-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01,
INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)",

SST_USER_PPPOE_LT_DEFAULT    Auth-Type := Accept, User-Password := "<password>"
    ERX-Service-Activate:1 += "PPPOE-SERVICE-PROFILE(INPUT-V4-FILTER-01, OUTPUT-V4-FILTER-01,
INPUT-V6-FILTER-01, OUTPUT-V6-FILTER-01)",

SST_USER_VLAN_DEFAULT    Auth-Type := Accept, User-Password := "<password>"
```

Verification

IN THIS SECTION

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

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.

```
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.

Action

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
                               mpls
lo0.16384            up    up   inet     127.0.0.1          --> 0/0
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
PING 21.21.11.2 (21.21.11.2): 56 data bytes
!!!!!
--- 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
PING 21.21.20.1 (21.21.20.1): 56 data bytes
!!!!!
--- 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
user@host-R1>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     21.21.21.1/24
                                   mpls
                                   multiservice
user@host-R1>ping 21.21.21.1 rapid
PING 21.21.21.1 (21.21.21.1): 56 data bytes
!!!!!
--- 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
                                   mpls
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
                                  multiservice
user@host-R2>ping 21.21.13.2 rapid
PING 21.21.13.2 (21.21.13.2): 56 data bytes
!!!!!
--- 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
                                  mpls
                                  multiservice
user@host-R2>ping 21.21.12.2 rapid
PING 21.21.12.2 (21.21.12.2): 56 data bytes
!!!!!
--- 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
                                  mpls
                                  multiservice
user@host-R2>ping 21.21.30.1 rapid
PING 21.21.30.1 (21.21.30.1): 56 data bytes
!!!!!
--- 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
```

```
PING 21.21.31.1 (21.21.31.1): 56 data bytes
!!!!!
--- 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
PING 21.21.11.1 (21.21.11.1): 56 data bytes
!!!!!
--- 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
PING 21.21.10.1 (21.21.10.1): 56 data bytes
!!!!!
--- 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
Interface            Admin Link Proto   Local                 Remote
ge-2/0/0             up    up
ge-2/0/0.0           up    up   inet    21.21.13.1/24
                                mpls
                                multiservice
user@host-R0>ping 21.21.13.1 rapid
PING 21.21.13.1 (21.21.13.1): 56 data bytes
!!!!!
--- 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
Interface            Admin Link Proto   Local                 Remote
ge-3/0/0             up    up
ge-3/0/0.0           up    up   inet    21.21.12.1/24
                                mpls
                                multiservice
user@host-R0>ping 21.21.12.1 rapid
PING 21.21.12.1 (21.21.12.1): 56 data bytes
!!!!!
--- 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
Interface            Admin Link Proto   Local                 Remote
ge-4/0/0             up    up
ge-4/0/0.0           up    up   inet    21.21.14.1/24
                                inet6   fe80::ae4b:c8ff:fe45:6800/64
                                mpls
                                multiservice
```

```
user@host-R0>ping 21.21.14.1 rapid
PING 21.21.14.1 (21.21.14.1): 56 data bytes
!!!!!
--- 21.21.14.1 ping statistics ---
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
Interface              Admin Link Proto  Local                 Remote
ge-5/0/0               up    up
ge-5/0/0.0             up    up   inet   21.21.15.1/24
                                   inet6  fe80::ae4b:c8ff:fe45:6be0/64
                                   mpls
                                   multiservice
user@host-R0>ping 21.21.15.1 rapid
PING 21.21.15.1 (21.21.15.1): 56 data bytes
!!!!!
--- 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
PING 21.21.20.2 (21.21.20.2): 56 data bytes
!!!!!
--- 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
PING 21.21.21.2 (21.21.21.2): 56 data bytes
!!!!!
--- 21.21.21.2 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
PING 21.21.30.2 (21.21.30.2): 56 data bytes
!!!!!
--- 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
PING 21.21.31.2 (21.21.31.2): 56 data bytes
!!!!!
--- 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
PING 21.21.40.1 (21.21.40.1): 56 data bytes
!!!!!
--- 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
!!!!!
--- 104.0.0.1 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
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
PING 21.21.14.2 (21.21.14.2): 56 data bytes
!!!!!
--- 21.21.14.2 ping statistics ---
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
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
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
PING 21.21.40.2 (21.21.40.2): 56 data bytes
!!!!!
--- 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
ge-0/1/3.0             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
PING 21.21.50.1 (21.21.50.1): 56 data bytes
!!!!!
--- 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
ge-0/1/4.0             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
PING 21.21.51.1 (21.21.51.1): 56 data bytes
!!!!!
--- 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:b268 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
ge-0/1/7.0             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:b280/64
                               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/stddev = 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
PING 21.21.51.2 (21.21.51.2): 56 data bytes
!!!!!
--- 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
ge-0/1/4.0          up    up   inet   10.9.46.229/24
                                      200.0.0.1/24
                               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
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
user@host-R5>ping 3000:db8:ffff:5::1 rapid
PING6(56=40+8+8 bytes) 3000:db8:ffff:5::1 --> 3000:db8:ffff:5::1
!!!!!
--- 3000:db8:ffff:5::1 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
```

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.

Action

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] 2d 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] 3d 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      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 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
105.0.0.1/32      *[OSPF/10] 2d 05:55:46, metric 2
224.0.0.5/32      *[OSPF/10] 2w1d 01:41:29, metric 1
user@host-R3>show ospf3 interface
Interface         State  Area       DR ID       BDR ID        Nbrs
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 ospf3 neighbor
ID              Interface        State    Pri  Dead
104.0.0.1       ge-4/0/0.0       Full     128   34
  Neighbor-address fe80::aad0:e5ff:fe50:b201
user@host-R3>show 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] 1d 08:49:22, metric 2
ff02::5/128       *[OSPF3/10] 3d 06:40:09, metric 1
```

```
user@host-R4>show ospf interface
Interface         State  Area         DR ID          BDR ID          Nbrs
ge-0/0/3.0        DR     0.0.0.0      104.0.0.1      100.0.0.1          1
ge-0/1/3.0        BDR    0.0.0.0      105.0.0.1      104.0.0.1          1
ge-0/1/4.0        DR     0.0.0.0      104.0.0.1      105.0.0.1          1
ge-0/1/7.0        DRother 0.0.0.0     0.0.0.0        0.0.0.0            0
lo0.0             DR     0.0.0.0      104.0.0.1      0.0.0.0            0
ge-0/0/2.0        DR     0.0.0.0      104.0.0.1      100.0.0.1          1
ge-0/0/4.0        DR     0.0.0.0      104.0.0.1      103.0.0.1          1
user@host-R4>show ospf neighbor
Address         Interface         State   ID            Pri  Dead
21.21.15.1      ge-0/0/3.0        Full    100.0.0.1     128   34
21.21.50.2      ge-0/1/3.0        Full    105.0.0.1     128   34
21.21.51.2      ge-0/1/4.0        Full    105.0.0.1     128   35
21.21.14.1      ge-0/0/2.0        Full    100.0.0.1     128   35
21.21.40.1      ge-0/0/4.0        Full    103.0.0.1     128   33
user@host-R4>show 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 00:45:41, metric 1
224.0.0.5/32     *[OSPF/10] 2d 05:43:18, metric 1
user@host-R4>show ospf3 interface
Interface         State  Area         DR ID          BDR ID          Nbrs
ge-0/0/3.0        DR     0.0.0.0      104.0.0.1      100.0.0.1          1
ge-0/1/3.0        BDR    0.0.0.0      105.0.0.1      104.0.0.1          1
ge-0/1/4.0        BDR    0.0.0.0      105.0.0.1      104.0.0.1          1
lo0.0             DR     0.0.0.0      104.0.0.1      0.0.0.0            0
ge-0/0/2.0        DR     0.0.0.0      104.0.0.1      100.0.0.1          1
ge-0/0/4.0        DR     0.0.0.0      104.0.0.1      103.0.0.1          1
user@host-R4>show ospf3 neighbor
ID              Interface         State   Pri  Dead
100.0.0.1       ge-0/0/3.0        Full    128   32
  Neighbor-address fe80::ae4b:c8ff:fe45:6be0
105.0.0.1       ge-0/1/3.0        Full    128   34
```

```
  Neighbor-address fe80::aad0:e5ff:fe50:b280
105.0.0.1        ge-0/1/4.0              Full      128    32
  Neighbor-address fe80::aad0:e5ff:fe50:b281
100.0.0.1        ge-0/0/2.0              Full      128    38
  Neighbor-address fe80::ae4b:c8ff:fe45:6800
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-1/0/4.0       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       BDR    0.0.0.0    104.0.0.1   105.0.0.1       1
lo0.0            DR     0.0.0.0    105.0.0.1   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-1/0/4.0          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 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
fe80::aad0:e5ff:fe50:b267/128
fe80::aad0:e5ff:fe50:b280/128
fe80::aad0:e5ff:fe50:b281/128
ff02::5/128        *[OSPF3/10] 2d 05:28:04, metric 1
```

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     103.0.0.1:0               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
Address          Interface        Label space ID        Hold time
101.0.0.1        lo0.0            101.0.0.1:0              33
102.0.0.1        lo0.0            102.0.0.1:0              36
21.21.21.1       ge-1/0/0.0       101.0.0.1:0              11
21.21.31.1       ge-3/0/0.0       102.0.0.1:0              10
21.21.40.2       ge-4/0/0.0       104.0.0.1:0              13
```

```
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.

Verify Circuit Cross-Connect (CCC) Interfaces and L2 Circuits on R1, R2, and R0

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               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
    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
                                           Detect   Transmit
Address               State     Interface   Time    Interval Multiplier
127.0.0.1             Up        ge-1/0/6.0  4.000   1.000     4
 Client L2CKT-OAM, TX interval 1.000, RX interval 1.000
 Session up time 00:15:06
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 Session type: VCCV BFD
                                           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 00:33:14
 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-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  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
                                          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 00:02:30
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
                                          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 00:02:36
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
                                          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 00:02:00
 Local diagnostic None, remote diagnostic None
 Remote state Up, version 1
 ...
```

```
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      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
    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
                                            Detect    Transmit
Address                 State    Interface   Time     Interval  Multiplier
127.0.0.1               Up       ge-0/0/0.0  4.000    1.000     4
 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
                                            Detect    Transmit
Address                 State    Interface   Time     Interval  Multiplier
127.0.0.1               Up       ge-3/0/0.0  4.000    1.000     4
 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
                                            Detect    Transmit
```

```
Address                State     Interface     Time    Interval  Multiplier
127.0.0.1              Up        ge-3/0/0.0    4.000   1.000     4
 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
                               multiservice
                               multiservice
```

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

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
ps0.0                   up    up   ccc
ps0.32767               up    up
ps0.1073741863          up    up   inet     100.0.0.1          --> 0/0
                                   inet6    fe80::2a0:a500:176:14de
                                   pppoe
user@host-R0>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
ps0.0                   up    up   ccc
ps0.32767               up    up
user@host-R3>show interfaces terse | match ps | match ccc | match up | count
Count: 2048 lines
```

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 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:
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-ps0.1073741855-in
Counters:
Name                                            Bytes              Packets
COUNTER11-ps0.1073741855-in                         0                    0
__junos-dyn-service-counter                         0                    0


Filter: OUTPUT-V4-FILTER-01-ps0.1073741855-out
Counters:
Name                                            Bytes              Packets
COUNTER12-ps0.1073741855-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.ps0.1073741855, 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
Interface/           Shaping Guarnteed Guaranteed/  Queue   Excess
Resource name           rate     rate     Excess  weight   weight
                        kbits    kbits    priority         high/low
lt-0/0/10            1000000
  lt-0/0/10 RTP      1000000       0                         1    1
    FC0             1000000        0     Low  Low     950
    FC3             1000000        0     Low  Low      50
  ps0.1073741855      60000    50000                       500  500
    FC0               60000  Disabled  High High       2
    FC1               60000    20000  Medium  Low     400
    FC2               60000    14950    Low  Low      299
    FC3               60000    14950    Low  Low      299
```

Meaning

DHCPv4 over dynamic VLAN interfaces are operational.

Verify DHCPv6-PD Over Dynamic VLAN Interfaces on R0

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
ps0.1073741856     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


1000::/56          *[Access/13] 00:00:35
                    > to fe80::222:68ff:fe14:84d5 via ps0.1073741856
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-V6-FILTER-01-ps0.1073741856-in
Counters:
Name                                         Bytes          Packets
```

```
COUNTER21-ps0.1073741856-in                          72                    1
__junos-dyn-service-counter                          72                    1


Filter: OUTPUT-V6-FILTER-01-ps0.1073741856-out
Counters:
Name                                            Bytes              Packets
COUNTER22-ps0.1073741856-out                         0                    0
__junos-dyn-service-counter
user@host-R0>show class-of-service traffic-control-profile
Traffic control profile: TCP_PS.o.ps0.1073741856, Index: 1337886571
  Shaping rate: 60000000
  Scheduler map: ps0.1073741856.SMAP_PS
  Guaranteed rate: 50000000
user@host-R0>show class-of-service scheduler-hierarchy interface ps0.1073741856
Interface/              Shaping Guarnteed Guaranteed/  Queue   Excess
Resource name             rate     rate      Excess   weight   weight
                          kbits    kbits    priority           high/low
lt-0/0/10               1000000
  lt-0/0/10 RTP         1000000        0                         1     1
    FC0                 1000000        0     Low  Low    950
    FC3                 1000000        0     Low  Low     50
  ps0.1073741856          60000    50000                       500   500
    FC0                   60000 Disabled    High High      2
    FC1                   60000    20000  Medium  Low    400
    FC2                   60000    14950     Low  Low    299
    FC3                   60000    14950     Low  Low    299
```

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                  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
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
Login Time: 2015-02-15 22:09:55 PST

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/                      Shaping Guarnteed  Guaranteed/  Queue   Excess
```

```
Resource name                    rate       rate      Excess  weight   weight
                                 kbits      kbits    priority          high/low
lt-0/0/10                      1000000
  lt-0/0/10 RTP                1000000         0                         1   1
    FC0                        1000000         0    Low  Low      950
    FC3                        1000000         0    Low  Low       50
  ps0.1073741859                 60000     50000                       500  500
    FC0                          60000  Disabled    High High        2
    FC1                          60000     20000  Medium  Low      400
    FC2                          60000     14950    Low  Low      299
    FC3                          60000     14950    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
Login Time: 2015-02-15 22:09:55 PST

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
Login Time: 2015-02-15 22:09:55 PST

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
Login Time: 2015-02-15 22:15:20 PST
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 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: Tunneled
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
Login Time: 2015-02-15 22:19:59 PST
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
                       Packets       Bytes
      Data Tx            589       122.5k
      Data Rx            446        24.1k
```

Meaning

LAC PPP over dynamic VLAN interfaces are operational.

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

Purpose

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 authentication detail`, `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
    Authentication retransmissions: 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
user@host-R0>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:
  Counter                                   Value
  engine created                            1
  initial config: inactive                  1
  recovery: cold-boot                       1
  diameter-app initial config: success      1

Gx-plus sync-event counters:
  Sync-Event    Counter                     Value
```

```
    cold-boot       activated                                    1

Gx-plus general counters:
  Counter                                          Value
  engine created                                   1
  initial config: inactive                         1
  recovery: cold-boot                              1
  diameter-app initial config: success             1

Gx-plus sync-event counters:
  Sync-Event    Counter                            Value
  cold-boot       activated                        1

user@host-R0>show network-access requests pending
Information about pending authentication entries
  Total pending authentication requests: 0
user@host-R0>show network-access aaa statistics pending-accounting-stops detail
  Pending accounting stops: 0
user@host-R0>show network-access aaa statistics radius
Outstanding Requests
  RADIUS Server     Profile            Configured  Current  Peak  Exceeded
  9.0.0.9           Access-Profile-0        1000        1     3         0
```

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 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
    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    Session-ID
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        off
user@host-R5>show network-access aaa subscribers session-id 9 detail
Type: l2tp
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: 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
  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
    Statistics since: Sun Feb 15 23:44:31 2015
                      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
    Statistics since: Sun Feb 15 23:44:31 2015
```

```
                        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 = "<password>"
        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 = 0x506f72742053706565643a20313030303030306b
         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
         Acct-Output-Packets = 0
         Acct-Terminate-Cause = Admin-Reset
         Service-Type = Framed-User
         ERX-Attr-177 = 0x506f72742053706565643a20313030303030306b
         Acct-Authentic = RADIUS
         Acct-Delay-Time = 0
         ERX-Dhcp-Mac-Addr = "0000.0000.0000"
         Event-Timestamp = "Feb 16 2015 00:53:33 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 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 = "<password>"
        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\006w\014,/\032y*"
        ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
        Framed-IP-Address = 100.16.0.3
        NAS-Identifier = "R0-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"
        Service-Type = Framed-User
        ERX-Attr-177 = 0x506f72742053706565643a20313030303030306b
        Acct-Authentic = RADIUS
        Acct-Delay-Time = 0
        ERX-Dhcp-Options = "5\001\0012\004d\020\000\003\014\026fireback-ThinkPad-T4007\r
\001\034\002\003\017\006w\014,/\032y*"
        ERX-Dhcp-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 = "R0-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 = 0x506f72742053706565643a20313030303030306b
         Acct-Authentic = RADIUS
         Acct-Delay-Time = 0
         ERX-Dhcp-Options = "5\001\0012\004d\020\000\003\014\026fireback-ThinkPad-T4007\r
\001\034\002\003\017\006w\014,/\032y*"
         ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
         Event-Timestamp = "Feb 16 2015 00:53:33 EST"
         Framed-IP-Address = 100.16.0.3
         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 = "ps0.1073741855:1-100"
         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 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 = "<password>"
        Service-Type = Framed-User
        Chargeable-User-Identity = ""
        Acct-Session-Id = "58"
        ERX-Dhcp-Options = "\000\001\000\016\000\001\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\000\001\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 = 0x506f72742053706565643a20313030303030306b
        Delegated-IPv6-Prefix = 1000::/56
        Acct-Authentic = RADIUS
        Acct-Delay-Time = 0
        ERX-Dhcp-Options = "\000\001\000\016\000\001\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\000\
001\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 = 0x506f72742053706565643a20313030303030306b
            Acct-Authentic = RADIUS
            Acct-Delay-Time = 0
            ERX-Dhcp-Mac-Addr = "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 = 0x9c35da48d9c6351050ccf15141901947968a4a56ebf0690ab64291240c6f3b
        Chargeable-User-Identity = ""
        Acct-Session-Id = "64"
        ERX-Dhcp-Mac-Addr = "0022.6814.84d5"
        NAS-Identifier = "R0-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 = 0x506f72742053706565643a20313030303030306b
        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 = "R0-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 = 0x506f72742053706565643a20313030303030306b
        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 = 0x506f72742053706565643a20313030303030306b
        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
        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 = 0xce86862897f89c3e6d20ef40c3f0295e669d1649c7a8180c828a
        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 = 0x506f72742053706565643a20313030303030306b
        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 = 0x506f72742053706565643a20313030303030306b
        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

IN THIS SECTION

- MPLS L2 Circuit Pseudowire | **231**
- Subscriber Sessions | **241**

This troubleshooting section focuses on pseudowire head-end termination and subscriber management on the BNG platform. To troubleshoot these functions, see the following sections.

NOTE: For information on using traceoptions, see Junos OS Tracing and Logging Operations.

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: None, MAC-
REWRITE Error: None, Loopback: Disabled,
  Source filtering: Disabled, Flow control: Enabled, Auto-negotiation: Enabled, Remote fault:
Online
  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
  Last flapped   : 2015-03-24 16:34:13 PDT (22:13:47 ago)
  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                 0
   1                            0                   0                 0
   2                            0                   0                 0
   3                       735288              735288                 0
   4                            0                   0                 0
   5                            0                   0                 0
   6                            0                   0                 0
   7                            0                   0                 0
  Queue number:       Mapped forwarding classes
   0                  FC0
   1                  FC1
   2                  FC2
   3                  FC3
   4                  FC4
   5                  FC5
   6                  FC6
   7                  FC7
  Active alarms  : None
  Active defects : None
  MAC statistics:                    Receive        Transmit
    Total octets                   51466725        49001759
    Total packets                    750906          737115
    Unicast packets                  731162          699812
    Broadcast packets                    35              38
    Multicast packets                 19709           37265
    CRC/Align errors                      0               0
    FIFO errors                           0               0
```

```
    MAC control frames                          0                0
    MAC pause frames                            0                0
    Oversized frames                            0
    Jabber frames                               0
    Fragment frames                             0
    VLAN tagged frames                          0
    Code violations                             0
    Total errors                                0                0
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              Bandwidth            Buffer Priority   Limit
                        %             bps     %          usec
  0 FC0                 95     950000000     95             0     low     none
  3 FC3                  5      50000000      5             0     low     none
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
      Destination: 21.21.11/24, Local: 21.21.11.1, Broadcast: 21.21.11.255, 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 <password>;
            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
  Last flapped   : 2015-03-24 16:33:23 PDT (22:55:56 ago)
  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
ge-2/0/0.0               up    up   inet    21.21.11.1/24
                                    mpls
                                    multiservice

user@host-BNG>ping 21.21.11.2 rapid count 1000
PING 21.21.11.2 (21.21.11.2): 56 data bytes
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
--- 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      0x80000010   768  0x22 0x135e 108
Router   105.0.0.1        105.0.0.1      0x80000033  1096  0x22 0xbdf6  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
105.0.0.1/32       *[OSPF/10] 00:35:33, metric 2
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


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.

```
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-3/0/0.0    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.

```
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
!!!!!
--- 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: -4752393.831 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
    Interface                 Type  St    Time last up          # Up trans
    ps0.0(vc 1)               rmt   Up    Mar 25 14:26:50 2015            1
      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
    Interface                Type  St     Time last up           # Up trans
    ge-1/1/9.1(vc 1)         rmt   Up     Mar 25 15:46:05 2015           1
      Remote PE: 100.0.0.1, Negotiated control-word: Yes (Null)
      Incoming label: 338624, Outgoing label: 360336
      Negotiated PW status TLV: No
      Local interface: ge-1/1/9.1, Status: Up, Encapsulation: ETHERNET
      Flow Label Transmit: No, Flow Label Receive: No
    Connection History:
      Mar 25 15:46:05 2015  status update timer
      Mar 25 15:46:01 2015  PE route changed
      Mar 25 15:46:01 2015  Out lbl Update                    360336
      Mar 25 15:46:01 2015  In lbl Update                     338624
      Mar 25 15:46:01 2015  loc intf up                     ge-1/1/9.1
Neighbor: 103.0.0.1
    ge-1/1/9.1(vc 1)         rmt   BK
```

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 <password>
    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 -                    <password>
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
Framed Ip Route Tag -              not set
Ignore DF Bit -                    disabled
IGMP Access Group Name -           not set
IGMP Access Source Group Name -    not set
MLD Access Group Name -            not set
MLD Access Source Group Name -     not set
IGMP Version -                     not set
MLD Version -                      not set
IGMP Immediate Leave -             disabled
MLD Immediate Leave -              disabled
IPv6 Ingress Policy Name -         not set
IPv6 Egress Policy Name -          not set
Acct Session ID-                   10
Acct Interim Interval -            600
Acct Type -                        2
Ingress Statistics                 disabled
```

```
        Egress Statistics                          disabled
        Chargeable user identity -                 0
        NAS Port Id -                              not set
        NAS Port -                                 4095
        NAS Port Type -                            15
        Framed Protocol -                          0
    ****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 <password>
    Authentication Grant
    ************User Attributes***********
        User Name -                                SST_USER_PPPOE_LT_DEFAULT
        Client IP Address -                        100.16.0.9
        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 -                            <password>
        CHAP Password -                            NULL
        Mac Address -                              AB:CD:00:00:00:01
        Service tag -                              1
        Service Name -                             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)
        Framed Route -                      not set
        Ingress Policy Name -               not set
        Egress Policy Name -                not set
        IGMP -                              disabled
        Redirect VR Name -                  default
        Service Bundle -                    Null
        Framed Ip Route Tag -               not set
        Ignore DF Bit -                     disabled
        IGMP Access Group Name -            not set
        IGMP Access Source Group Name -     not set
        MLD Access Group Name -             not set
        MLD Access Source Group Name -      not set
        IGMP Version -                      not set
        MLD Version -                       not set
        IGMP Immediate Leave -              disabled
        MLD Immediate Leave -               disabled
        IPv6 Ingress Policy Name -          not set
        IPv6 Egress Policy Name -           not set
        Acct Session ID-                    28
        Acct Interim Interval -             600
        Acct Type -                         2
        Ingress Statistics                  disabled
        Egress Statistics                   disabled
        Chargeable user identity -          0
        NAS Port Id -                       not set
        NAS Port -                          4095
        NAS Port Type -                     15
        Framed Protocol -                   0
    ****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_L2TP_DEFAULT@ABC1.COM password <password>
    Authentication Grant with Tunnel Attributes
    ************Tunnel Attributes***********
        ****Tunnel Definiton -              1
            Tunnel Medium        -          1
            Tunnel Type          -          3
            Tunnel Max Sessions  -          0
            Tunnel Server Endpoint -        105.0.0.1
```

```
            Tunnel Client Endpoint  -              100.0.0.1
            Tunnel Server AuthId    -
            Tunnel Client AuthId    -
            Tunnel Password         -              juniper
            Tunnel Assignment Id    -              Tunnel-ID-1
            Tunnel Logical System   -
            Tunnel Routing Instance -
    ****Pausing 10 seconds before disconnecting the test user*********
    Logging out subscriber
        Terminate Id -                            not set
    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

RADIUS Servers
  9.0.0.9
    Round Trip Time: 1
    Authentication requests: 9
    Authentication rollover requests: 0
    Authentication retransmissions: 25
    Accepts: 4
    Rejects: 0
    Challenges: 0
    Authentication malformed responses: 0
    Authentication bad authenticators: 0
    Authentication requests pending: 0
    Authentication request timeouts: 30
    Authentication unknown responses: 0
    Authentication packets dropped: 0
    Accounting start requests: 4
    Accounting interim requests: 1
    Accounting stop requests: 8
    Accounting rollover requests: 0
    Accounting retransmissions: 30
    Accounting start responses: 4
```

```
        Accounting interim responses: 1
        Accounting stop responses: 3
        Accounting malformed responses: 0
        Accounting bad authenticators: 0
        Accounting requests pending: 0
        Accounting request timeouts: 36
        Accounting unknown responses: 0
        Accounting packets dropped: 0
```

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
Address resolution is OFF.
Listening on ps0, capture size 96 bytes

15:10:51.505345  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 "R0"] [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 141, length 21
15:10:56.593708  In PPPoE  [ses 1]LCP, Conf-Ack (0x02), id 141, 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
15:10:56.594771  In PPPoE  [ses 1]CHAP, Response (0x02), id 32, Value
117cf30ec090ee60ba642403955fa37d, Name SST_USER_PPPOE_LT[|chap]
15:10:56.594772  In PPPoE  [ses 1]CHAP, Response (0x02), id 32, Value
117cf30ec090ee60ba642403955fa37d, Name SST_USER_PPPOE_LT[|chap]
15:10:56.800192 Out PPPoE  [ses 1]CHAP, Success (0x03), id 32, Msg
15:10:56.800193 Out PPPoE  [ses 1]CHAP, Success (0x03), id 32, Msg
15:10:56.800866  In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 1, length 24
15:10:56.800867  In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 1, length 24
15:10:56.800870  In PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 1, length 16
```

```
15:10:56.800871  In PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 1, length 16
15:10:56.801043 Out PPPoE  [ses 1]IPCP, Conf-Nack (0x03), id 1, length 24
15:10:56.801044 Out PPPoE  [ses 1]IPCP, Conf-Nack (0x03), id 1, length 24
15:10:56.801234 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 1, length 16
15:10:56.801235 Out PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 1, length 16
15:10:56.801533  In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 2, length 24
15:10:56.801534  In PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 2, length 24
15:10:56.801580 Out PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 2, length 24
15:10:56.801581 Out PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 2, length 24
15:10:56.872600 Out PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 126, length 12
15:10:56.872601 Out PPPoE  [ses 1]IPCP, Conf-Request (0x01), id 126, length 12
15:10:56.872683 Out PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 146, length 16
15:10:56.872683 Out PPPoE  [ses 1]IP6CP, Conf-Request (0x01), id 146, length 16
15:10:56.873141  In PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 126, length 12
15:10:56.873141  In PPPoE  [ses 1]IPCP, Conf-Ack (0x02), id 126, length 12
15:10:56.878193  In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:10:56.878194  In PPPoE  [ses 1]IP6CP, Conf-Ack (0x02), id 146, length 16
15:11:03.085120 Out PPPoE  [ses 1][|ip6]
15:11:03.085121 Out PPPoE  [ses 1][|ip6]
15:11:03.469052 Out PPPoE  [ses 1][|ip6]
15:11:03.469053 Out PPPoE  [ses 1][|ip6]


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


15:11:51.631290  In 00:22:68:14:84:d5 > ff:ff:ff:ff:ff:ff, ethertype 802.1Q (0x8100), length
40: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE D, PPPoE PADI [Service-
Name] [Host-Uniq UTF8]
15:11:56.634347  In 00:22:68:14:84:d5 > ff:ff:ff:ff:ff:ff, ethertype 802.1Q (0x8100), length
40: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE D, PPPoE PADI [Service-
Name] [Host-Uniq UTF8]
15:11:56.634596 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length
66: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE D, PPPoE PADO [AC-Name
"R0"] [Host-Uniq UTF8] [Service-Name] [AC-Cookie UTF8]
15:11:56.635054  In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length
```

```
60: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE D, PPPoE PADR [Service-
Name] [Host-Uniq UTF8] [AC-Cookie UTF8]
15:11:56.663820  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]LCP
(0xc021), length 16: LCP, Conf-Request (0x01), id 1, length 16
15:11:56.663821  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]LCP
(0xc021), length 16: LCP, Conf-Request (0x01), id 1, length 16
15:11:56.663924 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length
49: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), 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, ethertype 802.1Q (0x8100), length
49: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), 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, ethertype 802.1Q (0x8100), length
44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), 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, ethertype 802.1Q (0x8100), length
44: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), length 16: LCP, Conf-Ack (0x02), id 1, length 16
15:11:56.664432  In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length
49: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), 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, ethertype 802.1Q (0x8100), length
49: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE  [ses 1]LCP
(0xc021), 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, ethertype 802.1Q (0x8100), length
66: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), length 38: CHAP, Challenge (0x01), id 103, Value
29df1053315de91c31adc72e60f6aa1fa892ba1fc737082abd9d, Name JUNOS
15:11:56.664615 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length
66: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), length 38: CHAP, Challenge (0x01), id 103, Value
29df1053315de91c31adc72e60f6aa1fa892ba1fc737082abd9d, Name JUNOS
15:11:56.666088  In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length
68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), length 48: CHAP, Response (0x02), id 103, Value a28ce2e6abc62d6fb129888792f0914c,
Name SST_USER_PPPOE_LT[|chap]
15:11:56.666089  In 00:22:68:14:84:d5 > ac:4b:c8:45:68:00, ethertype 802.1Q (0x8100), length
68: vlan 1, p 0, ethertype 802.1Q, vlan 100, p 0, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), length 48: CHAP, Response (0x02), id 103, Value a28ce2e6abc62d6fb129888792f0914c,
Name SST_USER_PPPOE_LT[|chap]
15:11:56.870223 Out ac:4b:c8:45:68:00 > 00:22:68:14:84:d5, ethertype 802.1Q (0x8100), length
```

```
34: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), 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, ethertype 802.1Q (0x8100), length
34: vlan 1, p 6, ethertype 802.1Q, vlan 100, p 6, ethertype PPPoE S, PPPoE  [ses 1]CHAP
(0xc223), 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, 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 1, length 24
15:11:56.870893  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 1, length 24
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
15:11:56.870897  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 (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

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