Junos Layer 2 VPNs

COURSE OVERVIEW

This three-day, advanced-level course provides students with the detailed knowledge required to design, configure, and troubleshoot every flavor of Layer 2 VPN available within Junos.

The course begins with a refresher of the concepts behind VPNs and MPLS. The course then introduces each type of Layer 2 VPN in turn, such as BGP-signaled and LDP-signaled pseudowires, circuit cross-connect (CCC), VPLS, and EVPN. We've included use cases for each technology, along with elements of consideration when choosing an appropriate solution, and extensive clarification of technical terms that have multiple meanings.

After this introduction, the course dives deep into each individual technology, offering extensive control plane and data plane explanations of how the VPN is built and maintained. After viewing a simple configuration, the student will learn how to monitor and troubleshoot the VPN, before moving on to some more advanced features of each VPN type.

The course is based on Junos 24.2R1.15.

COURSE LEVEL

Junos Layer 2 VPNs is an advanced-level course.

AUDIENCE

This course benefits individuals responsible for configuring and monitoring devices running the Junos OS in a service provider environment, in MPLS-based data centers, and in larger enterprises.

PREREQUISITES

The prerequisites for this course include:

- Intermediate-level networking knowledge.
- An understanding of OSPF, IS-IS, BGP, and Junos routing policy.
- Experience configuring MPLS label-switched paths using Junos.
- Completion of the following courses, or equivalent knowledge:
    - *Introduction to the Junos Operating System*
    - *Junos Service Provider Switching*
    - *Junos Intermediate Routing*
    - *Junos MPLS Fundamentals*

RELATED CERTIFICATION

JNCIP-SP Certification | Juniper Networks US

RELATED JUNIPER PRODUCTS

Junos OS, Juniper Networks® MX Series Universal Routers, Juniper Networks® EX Series Switches, Juniper Networks® QFX Series Switches

RECOMMENDED NEXT COURSE

Junos Layer 3 VPNs

OBJECTIVES

- Describe some of the different kinds of VPNs, their mechanics, and their use cases.
- Describe the types of MPLS VPNs that operate at Layer 2.
- Describe the mechanics of BGP-signaled pseudowires, also known as L2VPNs.
- Configure BGP-signaled L2VPNs with Ethernet and Ethernet-VLAN encapsulations.
- Demonstrate how to troubleshoot some of the most common BGP-signaled L2VPN configuration problems.
- Describe how BGP-signaled L2VPNs use a block of labels to bring efficiency to hub-and-spoke advertisements.
- Configure advanced BGP-signaled L2VPN features, such as multihoming, VLAN normalization, and route target constraint.
- Describe the mechanics of LDP-signaled pseudowires, also known as Layer 2 Circuits.
- Describe the causes and solutions of some of the most common L2Circuit configuration problems.

- Configure advanced LDP-signaled L2Circuit features, such as multihoming and local switching.
- Explain how the FEC 129 pseudowire method combines BGP for autodiscovery and LDP for signaling.
- Describe the purpose and mechanics of a VPLS.
- Create a VPLS instance that is signaled using BGP and demonstrate the commands that verify its status.
- Create VPLS instances that are signaled using LDP and FEC 129 and demonstrate the commands available to verify their status.
- Describe how mismatched VLAN tags are handled in a default VPLS configuration.
- Configure a VPLS to swap mismatched VLAN tags automatically and to create multiple bridge domains inside a single VPLS instance.
- Configure the most important VPLS traffic management features, including flood protection, MAC limiting, integrated routing and bridging (IRB) interfaces, and automated Site IDs.
- Configure hub-and-spoke VPLS topologies.
- Configure multihomed sites in a VPLS.
- Describe the features of Ethernet VPN and the enhancements that EVPN brings over VPLS.
- Explain how EVPNs advertise MAC addresses and how they request to receive flooded traffic within a bridge domain.
- Configure and verify a single-homed VLAN-based EVPN instance (EVI).
- Configure and verify a single-homed VLAN-aware bundle EVI.
- Configure a multihomed EVPN and explain the purpose of the EVPN Type 4 route.
- Describe the features provided by EVPN Type 1 routes.
- Describe how to use MAC Mobility and IRB interfaces in an EVPN.
- Explain how EVPNs can tightly integrate themselves into MPLS Layer 3 VPNs to provide highly efficient forwarding.
- Describe and configure various solutions that create MPLS VPNs between service providers.
- Describe the circuit cross-connect pseudowire method and explain how this old method can still have value in modern networks.
- Describe how multisegment pseudowires can create Layer 2 VPNs across autonomous system boundaries.

COURSE CONTENTS

DAY 1

Module 01: Refresher—VPNs and MPLS

- Explain the basic function and purpose of a VPN
- Describe how MPLS uses labels to forward traffi
- Explain the differences between MPLS layer 3 VPNs and MPLS layer 2 VPNs

Module 02: The Different Flavors of Layer 2 VPN

- Describe the purpose and creation of pseudowires
- Define the different technical terms related to pseudowires
- Describe the purpose and creation of VPLS
- Describe the purpose, creation, and advantages of EVPN

Module 03: L2VPN, aka BGP-Signaled Pseudowires

- Define the concepts of attachment circuit and pseudowire encapsulation
- Explain the importance of route targets, route distinguishers, and Site IDs
- Explain the control plane and data plane of an L2VPN
- Describe the contents of an L2VPN BGP packet capture

Module 04: L2VPN—Configuration

- Configure an L2VPN that accepts all Ethernet traffic
- Configure an L2VPN that accepts specific VLAN tags

Module 05: L2VPN—Troubleshooting

- Diagnose and fix L2VPN problems caused by missing LSPs, mismatched site information, and incorrect configuration

Module 06: L2VPN—Site IDs, the Label Base, and Overprovisioning

- Explain the purpose of the Site ID and the VPN label base

- Configure an overprovisioned L2VPN with explicit remote Site IDs
- Configure an overprovisioned L2VPN with implicit remote Site IDs

Lab 01: BGP-Signaled Layer 2 VPNs

Module 07: L2VPN—Advanced Concepts

- Configure and verify L2VPN multihoming
- Explain the purpose of Martini encapsulation
- Configure VLAN normalization in an L2VPN
- Configure out-of-band route reflection and route target constraint

Lab 02: L2VPNs—Advanced Concepts

Module 08: L2Circuit—LDP-Signaled Pseudowires

- Explain the concept of targeted LDP sessions, and the elements that L2Circuits have in common with L2VPNs
- Configure and verify an L2Circuit
- Describe the contents of an LDP advertisement packet capture

Module 09: L2Circuit—Troubleshooting

- Configure the Pseudowire Status TLV
- Explain the meaning of the most frequent L2Circuit error codes

DAY 2

Module 10: L2Circuit—Advanced Concepts

- Describe the purpose and benefits of virtual circuit connectivity verification
- Configure multihoming, local switching, and interworking

Lab 03: LDP-Signaled L2Circuits

Module 11: FEC 129 Pseudowires

- Explain the way that FEC 129 autodiscovers remote PEs and signals pseudowires
- Configure and verify a FEC 129 pseudowire

Lab 04: FEC 129 Pseudowires (Optional)

Module 12: Virtual Private LAN Service—Introduction

- Describe how a VPLS is built, and how it compares to a regular pseudowire
- Explain how VPLS forwards traffic between multiple sites
- Describe the BGP and LDP methods of signaling a VPLS

Module 13: VPLS—BGP Configuration and Verification

- Configure a BGP-signaled VPLS
- Verify a BGP-signaled VPLS

Module 14: VPLS—LDP and FEC 129 Configuration and Verification

- Configure and verify an LDP-signaled VPLS
- Configure and verify a FEC 129 VPLS

Module 15: VPLS—The Default VLAN Mode

- Define the four VLAN modes for VPLS
- Define the concept of a bridge domain, and verify the default VPLS VLAN mode

Module 16: VPLS—VLAN Normalization, VLAN-Aware Instances, and Dual-Stacked VLANs

- Configure and verify VLAN-Aware mode
- Configure and verify VLAN-Normalizing mode and No-VLAN mode

- Configure and verify dual-stacked VLAN tags in VPLS

Module 17: VPLS—Advanced Features and Troubleshooting

- Deploy automated BGP VPLS Site IDs
- Configure flood protection, MAC flap protection, and MAC limiting
- Explain how to add IRB interfaces to a VPLS, and configure efficient traffic flooding using multicast LSPs
- Describe the most important VPLS-specific troubleshooting techniques

Module 18: VPLS—Multihoming

- Configure multihomed sites in a BGP-signaled VPLS
- Configure multihomed sites and single sites on the same PE in a BGP-signaled VPLS
- Configure best-site multihoming in a BGP-signaled VPLS
- Configure multihomed sites in an LDP-signaled VPLS

Lab 05: VPLS

DAY 3

Module 19: EVPN—Introduction

- Explain the main disadvantages of a VPLS solution
- Explain how EVPN overcomes these disadvantages, and enables extra features

Module 20: EVPN—Using BGP to Advertise MACs and to Flood Traffic

- Explain the meaning of an EVPN Instance
- Describe how EVPN Type 2 routes advertise MAC addresses and MAC/IP bindings
- Describe how EVPN Type 3 routes request to receive flooded traffic within a bridge domain

Module 21: EVPN—Configuring a Single-Homed VLAN-Based EVI

- Configure a service provider network to host EVPN services
- Configure a single-homed VLAN-based EVI
- Verify a VLAN-based EVI

Module 22: EVPN—Configuring a Single-Homed VLAN-Aware Bundle EVI

- Configure a VLAN-aware bundle EVI
- Verify a VLAN-aware bundle EVI

Module 23: EVPN—Multihoming Configuration and Type 4 Routes

- Configure a CE and two PEs to take part in a multihomed EVPN
- Describe the contents of the Type 4 Ethernet Segment route
- Explain how the Type 4 route prevents layer 2 loops, using the designated forwarder election

Module 24: EVPN—Multihoming Features Using Type 1 Routes

- Describe Type 1 Ethernet Auto-Discovery Per-Ethernet Segment routes
- Explain how Type 1 Per-Ethernet Segment routes prevent layer 2 loops
- Describe how Type 1 Per-EVI routes are different from Per-ES routes

Module 25: EVPN—MAC Mobility and IRB Interfaces

- Configure and verify the EVPN Mac Mobility feature
- Configure and verify Automatic Gateway MAC-IP Synchronization
- Configure and verify Manual Gateway MAC-IP Synchronization
- Configure and verify EVPN Virtual Gateway Addresses

Lab 06: EVPN

SELF-STUDY MODULES

Self-Study Module 26:EVPN—Integration with L3VPNs

- Describe the basic functionality of an L3VPN
- Explain how EVPNs and L3VPNs integrate for optimal routing
- Describe how chained composite next hop brings efficiency to EVPN in the Packet Forwarding Engine

Self-Study Module 27:Inter-AS MPLS VPNs

- Describe the functionality of Interprovider Options A, B, and C
- Configure and verify the Interprovider Option C method
- Describe and configure carrier-of-carrier VPNs

Self-Study Module 28: Circuit Cross-Connect

- Use circuit cross-connect to stitch pseudowires together, and to signal pseudowires that have their own pair of dedicated RSVP LSPs

Self-Study Module 29: Multisegment Pseudowires

- Explain how a multisegment pseudowire is signaled
- Configure and verify a multisegment pseudowire

Lab: Inter-AS L2VPNs

Self-Study Module 30: VPLS—Hub-and-Spoke Topologies

- Configure a hub-and-spoke BGP VPLS using route targets
- Configure a hub-and-spoke BGP VPLS using site ranges
- Configure a hub-and-spoke LDP VPLS using hierarchical VPLS

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