Junos MPLS and VPNs (JMV)

Course No: EDU-JUN-JMV
Length: Five days
Onsite Price: $32500 for up to 12 students
Public Enrollment Price: $3500/student

Course Level

JMV is an advanced-level course.

Prerequisites

Students should have intermediate-level networking knowledge and an understanding of the Open Systems Interconnection (OSI) model and the TCP/IP protocol suite. Students should also have familiarity with the Protocol Independent Multicast-Sparse Mode (PIM-SM) protocol. Students should also attend the "Introduction to the Junos Operating System (IJOS)", "Junos Routing Essentials (JRE)", "Junos Service Provider Switching (JSPX)", and "Junos Intermediate Routing (JIR)" courses prior to attending this class.

About this Course

This five-day course is designed to provide students with MPLS-based virtual private network (VPN) knowledge and configuration examples. The course includes an overview of MPLS concepts such as control and forwarding plane, RSVP Traffic Engineering, LDP, Layer 3 VPNs, next-generation multicast virtual private networks (MVPNs), BGP Layer 2 VPNs, LDP Layer 2 Circuits, and virtual private LAN service (VPLS). This course also covers Junos operating system-specific implementations of Layer 2 control instances and active interface for VPLS. This course is based on the Junos OS Release 10.3R1.9.

Through demonstrations and hands-on labs, students will gain experience in configuring and monitoring the Junos OS and in device operations.

Objectives

After successfully completing this course, you should be able to:

- Explain common terms relating to MPLS.
- Explain routers and the way they forward MPLS packets.
- Explain packet flow and handling through a label-switched path (LSP).
- Describe the configuration and verification of MPLS forwarding.
- Understand the information in the Label Information Base.
- Explain the two label distribution protocols used by the Junos OS.
- Configure and troubleshoot RSVP-signaled and LDP-signaled LSPs.
- Explain the constraints of both RSVP and LDP.
- Explain the path selection process of RSVP without the use of the Constrained Shortest Path First (CSPF) algorithm.
- Explain the Interior Gateway Protocol (IGP) extensions used to build the Traffic Engineering Database (TED).
- Describe the CSPF algorithm and its path selection process.
- Describe administrative groups and how they can be used to influence path selection.
- Describe the default traffic protection behavior of RSVP-Signaled LSPs.
- Explain the use of primary and secondary LSPs.
- Explain LSP priority and preemption.
- Describe the operation and configuration of fast reroute.
- Describe the operation and configuration of link and node protection.
- Describe the LSP optimization options.
• Explain the purpose of several miscellaneous MPLS features.
• Explain the definition of the term "Virtual Private Network".
• Describe the differences between provider-provisioned and customer-provisioned VPNs.
• Describe the differences between Layer 2 VPNs and Layer 3 VPNs.
• Explain the features of provider-provisioned VPNs supported by the Junos OS.
• Explain the roles of Provider (P) routers, Provider Edge (PE) routers, and Customer Edge (CE) routers.
• Describe the VPN-IPv4 address formats.
• Describe the route distinguisher use and formats.
• Explain the RFC 4364 control flow.
• Create a routing instance, assign interfaces, create routes, and import and export routes within the routing instance using route distinguishers and route targets.
• Explain the purpose of BGP extended communities and how to configure and use these communities.
• Describe the steps necessary for proper operation of a PE to CE dynamic routing protocol.
• Configure a simple Layer 3 VPN using a dynamic CE-PE routing protocol.
• Describe the routing-instance switch.
• Explain the issues with the support of traffic originating on multiaccess VPN routing and forwarding table (VRF table) interfaces.
• Use operational commands to view Layer 3 VPN control exchanges.
• Use operational commands to display Layer 3 VPN VRF tables.
• Monitor and troubleshoot PE-CE routing protocols.
• Describe the four ways to improve Layer 3 VPN scaling.
• Describe the three methods for providing Layer 3 VPN customers with Internet access.
• Describe how the auto-export command and routing table groups can be used to support communications between sites attached to a common PE router.
• Describe the flow of control and data traffic in a hub-and-spoke topology.
• Describe the various Layer 3 VPN class-of-service (CoS) mechanisms supported by the Junos OS.
• Explain the Junos OS support for generic routing encapsulation (GRE) and IP Security (IPsec) tunnels in Layer 3 VPNs.
• Describe the flow of control traffic and data traffic in a next-generation MVPN.
• Describe the configuration steps for establishing a next-generation MVPN.
• Monitor and verify the operation of next-generation MVPNs.
• Describe the purpose and features of a BGP Layer 2 VPN.
• Describe the roles of a CE device, PE router, and P router in a BGP Layer 2 VPN.
• Explain the flow of control traffic and data traffic for a BGP Layer 2 VPN.
• Configure a BGP Layer 2 VPN and describe the benefits and requirements of over-provisioning.
• Monitor and troubleshoot a BGP Layer 2 VPN.
• Explain the BGP Layer 2 VPN scaling mechanisms and route reflection.
• Describe the Junos OS BGP Layer 2 VPN CoS support.
• Describe the flow of control and data traffic for an LDP Layer 2 circuit.
• Configure an LDP Layer 2 circuit.
• Monitor and troubleshoot an LDP Layer 2 circuit.
• Describe and configure circuit cross-connect (CCC) MPLS interface tunneling.
• Describe the difference between Layer 2 MPLS VPNs and VPLS.
• Explain the purpose of the PE device, the CE device, and the P device.
• Explain the provisioning of CE and PE routers.
• Describe the signaling process of VPLS.
• Describe the learning and forwarding process of VPLS.
• Describe the potential loops in a VPLS environment.
• Configure BGP and LDP VPLS.
• Troubleshoot VPLS.
• Describe the Junos OS support for carrier of carriers.
• Describe the Junos OS support for interprovider VPNs.

**Intended Audience**

This course benefits individuals responsible for configuring and monitoring devices running the Junos OS.
Course Contents

Day 1

Chapter 1: Course Introduction

Chapter 2: MPLS Fundamentals

- MPLS Foundation
- Terminology
- MPLS Configuration
- MPLS Packet Forwarding
- Lab 1: MPLS Fundamentals

Chapter 3: Label Distribution Protocols

- Label Distribution Protocols
- RSVP
- LDP
- Lab 2: Label Distribution Protocols

Chapter 4: Constrained Shortest Path First

- RSVP Behavior Without CSPF
- CSPF Algorithm
- CSPF Tie Breaking
- Administrative Groups
- Lab 3: CSPF

Day 2

Chapter 5: Traffic Protection and Optimization

- Default Traffic Protection Behavior
- Primary and Secondary LSPs
- Fast Reroute
- Bypass LSPs
- LSP Optimization
- Lab 4: Traffic Protection

Chapter 6: Miscellaneous MPLS Features

- Routing Table Integration
- Forwarding Adjacencies
- Policy Control over LSP Selection
- LSP Metrics
- Automatic Bandwidth
- TTL Handling
- Explicit Null Configuration
- MPLS Pings
- Lab 5: Miscellaneous MPLS Features

Chapter 7: VPN Review

- Overview of VPNs
- CPE-Based VPNs
- Provider-Provisioned
Chapter 8: Layer 3 VPNs

- Layer 3 VPN Terminology
- VPN-IPv4 Address Structure
- Operational Characteristics
- Lab 6: VPN Baseline Configuration

Day 3

Chapter 9: Basic Layer 3VPN Configuration

- Preliminary Steps
- PE Router Configuration
- Lab 7: Layer 3 VPN with Static and BGP Routing

Chapter 10: Troubleshooting Layer 3 VPNs

- A Layered Approach
- The routing-instance Switch
- PE-Based and CE-Based Traceroutes
- Viewing VRF Tables and PE-PE Signaling Flow
- Monitoring PE-CE Routing Protocols

Chapter 11: Layer 3 VPN Scaling and Internet Access

- Scaling Layer 3 VPNs
- Public Internet Access Options
- Lab 8: Route Reflection and Internet Access

Chapter 12: Layer 3 VPNs—Advanced Topics

- Exchanging Routes Between VRF Tables
- Hub-and-Spoke Topologies
- Layer 3 VPN CoS Options
- Layer 3 VPN and GRE Tunneling Integration
- Layer 3 VPN and IPsec Integration
- Lab 9: GRE Tunnel Integration

Day 4

Chapter 13: Multicast VPNs

- Multicast VPN Overview
- Next-Generation MVPN Operation
- Configuration
- Monitoring

Chapter 14: BGP Layer 2 VPNs

- Overview of Layer 2 Provider-Provisioned VPNs
- BGP Layer 2 VPN Operational Model: Control Plane
- BGP Layer 2 VPN Operational Model: Data Plane
- Preliminary BGP Layer 2 VPN Configuration
- BGP Layer 2 Configuration
- Monitoring and Troubleshooting BGP Layer 2 VPNs
- Lab 10: BGP Layer 2 VPNs
Chapter 15: Layer 2 VPN Scaling and CoS

- Review of VPN Scaling Mechanisms
- Layer 2 VPNs and CoS

Chapter 16: LDP Layer 2 Circuits

- LDP Layer 2 Circuit Operation
- LDP Layer 2 Circuit Configuration
- LDP Layer 2 Circuit Monitoring and Troubleshooting
- Circuit Cross-Connect
- Lab 11: Circuit Cross-Connect and LDP Layer 2 Circuits

Chapter 17: Virtual Private LAN Services

- Layer 2 MPLS VPNs Versus VPLS
- BGP VPLS Control Plane
- BGP VPLS Data Plane
- Learning and Forwarding Process
- Loops

Day 5

Chapter 13: VPLS Configuration

- VPLS Configuration
- VPLS Troubleshooting
- Lab 12: VPLS

Chapter 14: Interprovider VPNs

- Hierarchical VPN Models
- Junos Support of Carrier-of-Carriers Model
- Junos Support of Carrier-of-Carrier VPN Applications
- Lab 13: Carrier-of-Carrier VPNs