Charting the Course ... ... to Your Success!

Juniper Networks Certified Professional Advanced Service Provider Routing and Switching MPLS BC, JMF, JL2V, and JL3V (JNCIP-SP MPLS BC)

Course Summary

Description
This advanced bootcamp combines JMF, JL2V, and JL3V into five consecutive days of training. Students can choose to attend the individual classes (JMF, JL2V, or JL3V) or attend the five-day course.

JUNOS MPLS FUNDAMENTALS (JMF)
This course is designed to provide students with a solid foundation on Multiprotocol Label Switching (MPLS). After introducing concepts such as MPLS forwarding and the structure of the MPLS header, the course will delve into the configuration and operation of the two main label distribution protocols, RSVP and LDP. Special emphasis is given to the central topics of traffic engineering and MPLS traffic protection, including fast reroute, link/node protection, and LDP loop-free alternate. The concepts are put into practice with a series of in-depth hands-on labs, which will allow participants to gain experience in configuring and monitoring MPLS on Junos OS devices. These hands-on labs utilize Juniper Networks vMX Series devices using the Junos OS Release 16.1R3.10, but are also applicable to other MX Series devices.

JUNOS LAYER 2 VPNS (JL2V)
This course is designed to provide students with MPLS-based Layer 2 virtual private network (VPN) knowledge and configuration examples. The course includes an overview of MPLS Layer 2 VPN concepts, such as BGP Layer 2 VPNs, LDP Layer 2 circuits, FEC 129 BGP autodiscovery, virtual private LAN service (VPLS), Ethernet VPN (EVPN), and Inter-AS Layer 2 VPNs. This course also covers Junos operating system-specific implementations of Layer 2 VPN instances, VPLS, and EVPNs. This course is based on the Junos OS Release 15.1R2.9. Through demonstrations and hands-on labs, students will gain experience in configuring and monitoring the Junos OS and in device operations.

JUNOS LAYER 3 VPNS (JL3V)
This course is designed to provide students with MPLS-based Layer 3 virtual private network (VPN) knowledge and configuration examples. The course includes an overview of MPLS Layer 3 VPN concepts, scaling Layer 3 VPNs, Internet access, Interprovider L3VPNs, and Multicast for Layer 3 VPNs. This course also covers Junos operating system-specific implementations of Layer 3 VPNs. This course is based on the Junos OS Release 15.1R2.9. Through demonstrations and hands-on labs, students will gain experience in configuring and monitoring the Junos OS and in device operations.

Objectives

JUNOS MPLS FUNDAMENTALS (JMF):
After successfully completing this course, you should be able to:
- Describe the history and rationale for MPLS, as well as its basic terminology.
- Explain the MPLS label operations (push, pop, swap) and the concept of label-switched path (LSP).
- Describe the configuration and verification of MPLS forwarding.
- Describe the functionalities and operation of RSVP and LDP.
- Configure and verify RSVP-signaled and LDP-signaled LSPs.
- Select and configure the appropriate label distribution protocol for a given set of requirements.
- Describe the default Junos OS MPLS traffic engineering behavior.
- Explain the Interior Gateway Protocol (IGP) extensions used to build the Traffic Engineering Database (TED).
- Describe the Constrained Shortest Path First (CSPF) algorithm, its uses, 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.
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Course Summary (cont’d)

- Describe the operation and configuration of fast reroute.
- Describe the operation and configuration of link and node protection.
- Describe the operation and configuration of LDP loop-free alternate.
- Describe the LSP optimization options.
- Explain LSP priority and preemption.
- Describe the behavior of fate sharing.
- Describe how SRLG changes the CSPF algorithm when computing the path of a secondary LSP.
- Explain how extended admin groups can be used to influence path selection.
- Explain the purpose of several miscellaneous MPLS features.

JUNOS LAYER 2 VPNS (JL2V):

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

- Define the term virtual private network.
- Describe the business drivers for MPLS VPNS.
- Describe the differences between Layer 2 VPNS and Layer 3 VPNS.
- List advantages for the use of MPLS Layer 3 VPNS and Layer 2 VPNS.
- 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 the operation of FEC 129 BGP autodiscovery for Layer 2 VPNS.
- Configure a FEC 129 BGP autodiscovery Layer 2 VPN.
- Monitor and troubleshoot a FEC 129 BGP autodiscovery for Layer 2 VPNS.
- 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, LDP, and FEC 129 BGP autodiscovery VPLS.
- Troubleshoot VPLS.
- Describe the purpose and features of Ethernet VPN.
- Configure Ethernet VPN.
- Monitor and troubleshoot Ethernet VPN.
- Describe the Junos OS support for hierarchical VPN models.
- Describe the Junos OS support for Carrier-of-Carriers VPN Option C.
- Configure the interprovider VPN Option C.
- Describe the Junos OS support for multisegment pseudowire for FEC 129.
- Describe and configure circuit cross-connect (CCC).
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Course Summary (cont’d)

JUNOS LAYER 3 VPNS (JL3V):
After successfully completing this course, you should be able to:

- Describe the value of MPLS VPNs.
- Describe the differences between provider-provisioned VPNs and customer-provisioned VPNs.
- Describe the differences between Layer 2 VPNs and Layer 3 VPNs.
- List the provider-provisioned MPLS VPN features supported by the Junos OS software.
- Describe the roles of a CE device, PE router, and P router in a BGP Layer 3 VPN.
- Describe the format of the BGP routing information, including VPN-IPv4 addresses and route distinguishers.
- Describe the propagation of VPN routing information within an AS.
- List the BGP design constraints to enable Layer 3 VPNs within a provider network.
- Explain the operation of the Layer 3 VPN data plane within a provider network.
- Create a routing instance, assign interfaces to a routing instance, create routes in a routing instance, and import/export routes from a routing instance using route distinguishers/route targets.
- Describe the purpose of BGP extended communities, configure extended BGP extended communities, and use BGP extended communities.
- List the steps necessary for proper operation of a PE-CE dynamic routing protocol.
- List the troubleshooting and monitoring techniques for routing instances.
- Explain the difference between the bgp.13vpn table and the inet.0 table of a routing instance.
- Monitor the operation of a PE multi-access interface in a Layer 3 VPN and list commands to modify that behavior.
- Describe ways to support communication between sites attached to a common PE router.
- Provision and troubleshoot hub-and-spoke Layer 3 VPNs.
- Describe the flow of control traffic and data traffic in a hub-and-spoke Layer 3 VPN.
- Describe QoS mechanisms available in L3VPNs.
- Configure L3VPN over GRE tunnels.
- Describe the RFC 4364 VPN options.
- Describe the carrier-of-carriers model.
- Configure the carrier-of-carriers and "Option C" configuration.
- Describe the flow of control and data traffic in a draft-rosen multicast VPN.
- Describe the configuration steps for establishing a draft-rosen multicast VPN.
- Monitor and verify the operation of draft-rosen multicast VPNs.
- Describe the configuration steps for establishing a next-generation multicast VPN.
- Describe the flow of control traffic and data traffic in a next-generation multicast VPN.
- Describe the configuration steps for establishing a next-generation multicast VPN.
- Monitor and verify the operation of next-generation multicast VPNs.
- Describe the flow of control traffic and data traffic when using MVPNs for Internet multicast.
- Describe the configuration steps for enabling Internet multicast using MVPNs.
- Monitor and verify the operation of MVPN internet multicast.
Topics

JUNOS MPLS FUNDAMENTALS (JMF):
- MPLS Foundation
- Terminology
- MPLS Configuration
- MPLS Packet Forwarding
- Label Distribution Protocols
- RSVP
- LDP
- Mapping Next-Hops to LSPs
- Route Resolution Example
- Route Resolution Summary
- IGP Passive versus Next-Hop Self for BGP Destinations
- Constrained Shortest Path First
- RSVP Behavior without CSPF
- CSPF Algorithm
- CSPF Tie Breaking
- Administrative Groups
- Inter-area Traffic Engineered LSPs
- Traffic Protection and LSP Optimization
- Default Traffic Protection Behavior
- Primary and Secondary LSPs
- Fast Reroute
- RSVP Link Protection
- LDP LFA and Link Protection
- LSP Optimization
- Junos OS Fate Sharing
- SRLG
- Extended Admin Groups
- Forwarding Adjacencies
- Policy Control over LSP Selection
- LSP Metrics
- Automatic Bandwidth
- Container LSPs
- TTL Handling
- Explicit Null Configuration
- MPLS Pings

JUNOS LAYER 2 VPNS (JL2V):
- MPLS VPNs
- Provider-Provisioned VPNs
- Overview of Layer 2 Provider-Provisioned VPNs
- BGP Layer 2 VPN Operational Model: Control Plane

JUNOS LAYER 3 VPNS (JL3V):
- 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
- Review of VPN Scaling Mechanisms
- Layer 2 VPNs and CoS
- LDP Layer 2 Circuit Operation
- LDP Layer 2 Circuit Configuration
- LDP Layer 2 Circuit Monitoring and Troubleshooting
- FEC 129 BGP Autodiscovery Layer 2 Circuit Operation
- FEC 129 BGP Autodiscovery Layer 2 Circuit Configuration
- FEC 129 BGP Autodiscovery Monitoring and Troubleshooting
- Layer 2 MPLS VPNs versus VPLS
- BGP VPLS Control Plane
- BGP VPLS Data Plane
- Learning and Forwarding Process
- Loops
- VPLS Configuration
- VPLS Troubleshooting
- EVPN Overview
- EVPN Control Plane
- EVPN Operation
- EVPN Configuration
- EVPN Troubleshooting
- Layer 3 VPN Terminology
- VPN-IPv4 Address Structure
- Operational Characteristics
- Preliminary Steps
- PE Router Configuration
- Scaling Layer 3 VPNs
- Public Internet Access Options
- Exchanging Routes between Routing Instances
- Hub-and-Spoke Topologies
- Layer 3 VPN CoS Options
- Layer 3 VPN and GRE Tunneling Integration
- Layer 3 VPN and IPsec Integration
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Course Summary (cont’d)

- Layer 3 VPN Egress Protection
- BGP prefix-independent convergence (PIC)
- VRF Localization
- Provider Edge Link Protection
- Support for configuring more than 3 million L3VPN Labels
- Hierarchical VPN Models
- Carrier-of-Carriers Model
- Option C Configuration
- Working with Multiple Layers
- Troubleshooting Commands on a PE Device
- Multi-Access Interfaces in Layer 3 VPNs
- PE and CE-based Traceroutes
- Layer 3 VPN Monitoring Commands
- Multicast Overview
- Draft Rosen MVPN Overview
- Draft Rosen MVPN Operation
- Configuration
- Monitoring
- Multicast VPN Overview
- Next-Generation MVPN Operation
- Configuration
- Monitoring
- Internet Multicast
- Ingress Replication
- Internet Multicast Signaling and Data Plane
- Configuring MVPN Internet Multicast
- Monitoring MVPN Internet Multicast

Audience

JNCIP-SP MPLS BC benefits individuals responsible for configuring and monitoring devices running the Junos OS.

Prerequisites

JMF: Students should have intermediate-level networking knowledge and should be familiar with the Junos OS command-line interface (CLI). Students should also attend the Introduction to the Junos Operating System (IJOS), Junos Routing Essentials (JRE), and Junos Intermediate Routing (JIR) courses prior to attending this class.

JL2V: Students should have intermediate-level networking knowledge and an understanding of OSPF, IS-IS, BGP, and Junos policy. Students should have experience configuring MPLS label-switched paths using Junos. Students should also attend Introduction to the Junos Operating System (IJOS), Junos Routing Essentials (JRE), Junos Service Provider Switching (JSPX), Junos Intermediate Routing (JIR) and Junos MPLS Fundamentals (JMF) courses prior to attending this class.

JL3V: Students should have intermediate-level networking knowledge and an understanding of OSPF, ISIS, BGP, and Junos policy. Students should have experience configuring MPLS label-switched paths using Junos. Students should also attend the Introduction to the Junos Operating System (IJOS), Junos Routing Essentials (JRE), Junos Intermediate Routing (JIR) and the Junos MPLS Fundamentals (JMF) courses prior to attending this class.

Duration

Five days
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Course Outline

JUNOS MPLS FUNDAMENTALS (JMF)

I. Course Introduction

II. MPLS Fundamentals
   A. MPLS Foundation
   B. Terminology
   C. MPLS Configuration
   D. MPLS Packet Forwarding
   Lab: MPLS Fundamental

III. Label Distribution Protocols
   A. Label Distribution Protocols
   B. RSVP
   C. LDP
   Lab: Label Distribution Protocols

IV. Routing Table Integration
   A. Mapping Next Hops to LSPs
   B. Route Resolution Example
   C. Route Resolution Summary
   D. IGP Passive Versus Next-Hop Self for BGP Destinations
   Lab: Routing Table Integration

V. Constrained Shortest Path First
   A. RSVP Behavior Without CSPF
   B. CSPF Algorithm
   C. CSPF Tie Breaking
   D. Administrative Groups
   E. Interarea Traffic Engineered LSPs
   Lab: CSPF

VI. Traffic Protection and LSP Optimization
   A. Default Traffic Protection Behavior
   B. Primary and Secondary LSPs
   C. Fast Reroute
   D. RSVP Link Protection
   E. LDP LFA and Link Protection
   F. LSP Optimization
   Lab: Traffic Protection

VII. Fate Sharing
   A. Junos OS Fate Sharing
   B. SRLG
   C. Extended Admin Groups
   Lab: Fate Sharing

VIII. Miscellaneous MPLS Features
   A. Forwarding Adjacencies
   B. Policy Control over LSP Selection
   C. LSP Metrics
   D. Automatic Bandwidth
   E. Container LSPs
   F. TTL Handling
   G. Explicit Null Configuration
   H. MPLS Pings
   Lab: Miscellaneous MPLS Features

JUNOS LAYER 2 VPNS (JL2V)

IX. Course Introduction

X. MPLS Fundamentals
   A. MPLS Foundation
   B. Terminology
   C. MPLS Configuration
   D. MPLS Packet Forwarding
   Lab: MPLS Fundamental

XI. Label Distribution Protocols
   A. Label Distribution Protocols
   B. RSVP
   C. LDP
   Lab: Label Distribution Protocols

XII. Routing Table Integration
   A. Mapping Next Hops to LSPs
   B. Route Resolution Example
   C. Route Resolution Summary
   D. IGP Passive Versus Next-Hop Self for BGP Destinations
   Lab: Routing Table Integration

XIII. Constrained Shortest Path First
   A. RSVP Behavior Without CSPF
   B. CSPF Algorithm
   C. CSPF Tie Breaking
   D. Administrative Groups
   E. Interarea Traffic Engineered LSPs
   Lab: CSPF

XIV. Traffic Protection and LSP Optimization
   A. Default Traffic Protection Behavior
   B. Primary and Secondary LSPs
   C. Fast Reroute

Due to the nature of this material, this document refers to numerous hardware and software products by their trade names. References to other companies and their products are for informational purposes only, and all trademarks are the properties of their respective companies. It is not the intent of ProTech Professional Technical Services, Inc. to use any of these names generically.
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Course Outline (cont’d)

D. RSVP Link Protection  
E. LDP LFA and Link Protection  
F. LSP Optimization  
Lab: Traffic Protection

XV. Fate Sharing  
A. Junos OS Fate Sharing  
B. SRLG  
C. Extended Admin Groups  
Lab: Fate Sharing

XVI. Miscellaneous MPLS Features  
A. Forwarding Adjacencies  
B. Policy Control over LSP Selection  
C. LSP Metrics  
D. Automatic Bandwidth  
E. Container LSPs  
F. TTL Handling  
G. Explicit Null Configuration  
H. MPLS Pings  
Lab: Miscellaneous MPLS Features

JUNOS LAYER 3 VPNS (JL3V)

XVII. Course Introduction

XVIII. MPLS VPNS  
A. MPLS VPNS  
B. Provider-Provisioned VPNS

XIX. Layer 3 VPNS  
A. Layer 3 VPN Terminology  
B. VPN-IPv4 Address Structure  
C. Operational Characteristics

XX. Basic Layer 3 VPN Configuration  
A. Preliminary Steps  
B. PE Router Configuration  
Lab: Layer 3 VPN with Static and BGP Routing

XXI. Layer 3 VPN Scaling and Internet Access  
A. Scaling Layer 3 VPNS  
B. Public Internet Access Options  
Lab: LDP over RSVP Tunnels and Public Internet Access

XXII. Layer 3 VPNS - Advanced Topics  
A. Exchanging Routes between Routing Instances  
B. Hub-and-Spoke Topologies  
C. Layer 3 VPN CoS Options  
D. Layer 3 VPN and GRE Tunneling Integration  
E. Layer 3 VPN and IPsec Integration  
F. Layer 3 VPN Egress Protection  
G. BGP prefix-independent convergence (PIC) edge for MPLS VPNS  
H. VRF Localization  
I. Provider Edge Link Protection  
J. Support for configuring more than 3 million L3VPN Labels  
Lab: GRE Tunneling

XXIII. Interprovider Backbones for Layer 3 VPNS  
A. Hierarchical VPN Models  
B. Carrier-of-Carriers Model  
C. Option C Configuration  
Lab: Carrier of Carrier Layer 3 VPNS

XXIV. Troubleshooting Layer 3 VPNS  
A. Working with Multiple Layers  
B. Troubleshooting Commands on a PE Device  
C. Multi-Access Interfaces in Layer 3 VPNS  
D. PE and CE-based Traceroutes  
E. Layer 3 VPN Monitoring Commands  
Lab: Troubleshooting Layer 3 VPNS

XXV. Draft Rosen Multicast VPNS  
A. Multicast Overview  
B. Draft Rosen MVPN Overview  
C. Draft Rosen MVPN Operation  
D. Configuration  
E. Monitoring  

XXVI. Next Generation Multicast VPNS  
A. Multicast Overview  
B. Next-Generation MVPN Operation  
C. Configuration  
D. Monitoring  
E. Internet Multicast  
F. Ingress Replication  
G. Internet Multicast Signaling and Data Plane  
H. Configuring MVPN Internet Multicast  
I. Monitoring MVPN Internet Multicast

Lab: MVPN Internet Multicast