Advanced Junos MPLS Transport with RSVP and LDP

Revision 26A

Course overview

This four-day, advanced-level course provides in-depth coverage of advanced MPLS label-switched path (LSP) features that are enabled using RSVP and LDP. Due to the abundance of traffic engineering (TE) features that RSVP offers, this course mostly focuses on RSVP. This course builds on the foundations that are taught in the course titled *Junos MPLS Fundamentals*.

After a deep analysis of the contents of various RSVP objects, the student explores the details of various RSVP backup options, including standby paths, one-to-one backup detour LSPs (also known as fast-reroute LSPs), and facility backup bypass LSPs (a feature also known as link-protection and node-link-protection).

Students explore how to enhance their existing RSVP network by enabling features such as LSP optimization, fate sharing, extended admin groups, auto-bandwidth, container LSPs, and pop-and-forward LSPs. Students also explore the many ways to override the default behavior of BGP prefix resolution, including advanced LSP and routing table customization, and binding prefixes to a specific LSP out of multiple choices using a routing policy. This approach sets the groundwork for a detailed explanation of the modern Classful Transport feature in Junos OS, and a variety of RSVP design options.

The student will also consider various advanced LDP configuration features, including how to combine LDP and RSVP for increased scalability.

This course is based on Junos OS Release 25.2R1.9.

Course level

Advanced Junos MPLS Transport with RSVP and LDP is an advanced-level course.

Audience

- Individuals who work with routers that run Junos OS
- Individuals involved in the service provider industry, the data center industry, or who work in large enterprise networks
- Operators who use BGP, IS-IS, and OSPF
- Operators who use MPLS to create transport paths across their networks
- Individuals who want to learn how they can enable advanced RSVP and LDP features in their network to solve complex challenges

Prerequisites

- Advanced routing knowledge. Completion of the *Advanced Junos Service Provider Routing* course or equivalent knowledge is recommended
- Intermediate Junos CLI experience
- Fundamental knowledge of MPLS transport functions, including LDP and RSVP, and the BGP prefix resolution process in such environments. Completion of the *Junos MPLS Fundamentals* course or equivalent knowledge is recommended
- Recommended basic knowledge of Layer 3 VPNs in an MPLS environment

Related products

Juniper Networks® MX Series Universal Routers, Juniper Networks® QFX Series Switches, Juniper Networks® ACX Series Routers, Juniper Networks® PTX Series Routers, and Junos OS

Related certification

JNCIP-SP

Recommended next course

Junos Segment Routing with SR-MPLS

Objectives

- Describe the high-level format of the Path and Resv messages that create RSVP LSPs.
- Describe the detailed contents of RSVP Path and Resv messages.
- Explain how RSVP LSPs can automatically find and signal better, more optimal paths.
- Describe how secondary paths offer resilience while a new primary path is calculated.
- Describe the benefits of running local repair backup paths in an RSVP network.
- Demonstrate how to configure the one-to-one method of local repair, otherwise known as fast reroute.
- Explain the behavior of facility backup, otherwise known as link protection and node-link protection.

- Explain the variety of RSVP messages that are used to tear down LSPs and report on network problems.
- Describe the benefits of using shared risk link groups and extended admin groups.
- Demonstrate how to deploy pop-and-forward RSVP LSPs.
- Describe how Hello messages transform RSVP from a soft-state protocol into a reliable and efficient protocol.
- Describe how RSVP LSPs can automatically reserve bandwidth based on real user traffic levels.
- Demonstrate the benefits and basic operation of TE++ container LSPs.
- Describe the steps required to configure and verify a TE++ container LSP.
- Describe some advanced additional features and benefits offered by container LSPs.
- Demonstrate how LSPs can offer forwarding options beyond the default BGP resolution behavior.
- Explain how the BGP color community can automatically map prefixes to a specific traffic-engineered path.
- Describe how Classful Transport offers advantages in a network with color-aware LSPs.
- Explain how the default behavior of RSVP can be customized to meet specific network design requirements.
- Describe the details of the protocol messages that enable LDP networks.
- Demonstrate how LDP can be customized to offer additional functionality and additional egress points.
- Describe and configure features that help to scale RSVP and LDP in very large topologies.
- Explain the three ways LDP can offer local repair paths in times of link or node failure.
- Describe how forwarding adjacencies and hierarchical LSPs can help RSVP to scale in large networks.

Course contents

Day 1

Module 01: RSVP Path and RSVP Resv Messages—A Closer Look, Part 1

- Explain how RSVP messages contain individual objects that carry crucial information
- Describe the general format of the RSVP common header, and Hello, Path, and Resv messages
- Demonstrate how to verify Path and Resv message information on the Junos CLI

Module 02: RSVP Path and RSVP Resv Messages—A Closer Look, Part 2

- Explain the purpose of every object in a standard RSVP Path message
- Explain the purpose of every object in a standard RSVP Resv message

Module 03: RSVP—LSP Optimization and Adaptive Behavior

- Describe, configure, and verify RSVP LSP optimization
- Explain the four optimization rules used to decide if a new RSVP path is better than the current path
- Demonstrate some important customization options, including timers and aggressive optimization
- Explain how adaptive RSVP LSPs with Shared Explicit signaling prevent double-counting of bandwidth

Lab 01: RSVP—LSP Optimization and Adaptive Behavior

Module 04: RSVP—Secondary Paths and Standby Secondary Paths

- Describe the challenges faced by link-state routing protocols during network convergence
- Explain the use case for on-demand secondary paths
- Configure and verify on-demand secondary paths
- Describe the benefits and trade-offs of always-up standby secondary paths

Lab 02: RSVP—Secondary Paths and Standby Secondary Paths

Module 05: RSVP Local Repair, Part 1—The Advantage of Backup Paths

- Identify how RSVP local repair can radically reduce packet loss after link or node failure
- Describe the difference between one-to-one backup (fast-reroute) and facility backup (node-link-protection)
- Explain the many definitions of the term “fast reroute”

Module 06: RSVP Local Repair, Part 2—One-to-One Backup, or Fast Reroute

- Explain the behavior of the one-to-one backup method of local repair
- Configure and verify the one-to-one backup method on an ingress router
- Verify the one-to-one backup method on transit routers
- Demonstrate the most important customization features within an LSP’s fast-reroute configuration hierarchy

Lab 03: RSVP Local Repair—One-to-One Backup

Day 2

Module 07: RSVP Local Repair, Part 3—Facility Backup, or Node-Link Protection

- Demonstrate how facility backup tunnels traffic across a bypass LSP
- Configure bypass LSPs on an ingress router
- Verify bypass LSPs on ingress and transit routers
- Describe the design considerations when choosing between one-to-one backup and facility backup

Lab 04: RSVP Local Repair—Facility Backup

Module 08: RSVP—PathErr, ResvErr, PathTear, and ResvTear Messages

- Explain the purpose of every object in a typical RSVP PathTear and ResvTear message
- Explain the purpose of every object in a typical RSVP PathErr and ResvErr message

Module 09: RSVP—Fate Sharing and Extended Admin Groups

- Explain the concept of shared fate, and configure fate-sharing and Shared Risk Link Groups
- Configure and verify extended admin groups

Lab 05: RSVP—Fate Sharing and Extended Admin Groups

Module 10: RSVP—Pop-and-Forward LSPs

- Explain how RSVP can use pop-and-forward to request shared segment-routed labels
- Configure and verify a basic RSVP pop-and-forward LSP
- Explain how delegation labels enable pop-and-forward LSPs to have long paths, regardless of interface label stack constraints

Lab 06: RSVP—Pop-and-Forward LSPs

Module 11: RSVP—Hello Messages and Reliability Extensions

- Explain the history of hello messages in RSVP
- Describe the purpose of the objects found in a modern RSVP Hello message
- Demonstrate the benefit of RSVP refresh overhead reduction

Day 3

Module 12: RSVP—Auto-Bandwidth

- Explain how auto-bandwidth solves the challenge of deciding an accurate RSVP bandwidth reservation
- Configure an auto-bandwidth RSVP LSP with an MPLS stats file
- Verify the behavior of RSVP auto-bandwidth in response to changes in traffic levels
- Describe some important auto-bandwidth customizations, including underflow and overflow samples

Lab 07: RSVP—Auto-Bandwidth

Module 13: RSVP—Container LSPs, Part 1—The Theory

- Explain the consequences of the All or Nothing Problem and the Bin Packing Problem for RSVP
- Describe how container LSPs can solve problems faced by traditional RSVP bandwidth reservations

Module 14: RSVP—Container LSPs, Part 2—Configuration and Verification

- Configure a basic container LSP
- Demonstrate how to verify the initial state of a container LSP
- Demonstrate how to verify whether the normalization process has signaled or torn down member LSPs

Lab 08: RSVP—Container LSPs: Initial Settings

Module 15: RSVP—Container LSPs, Part 3—Advanced Concepts

- Demonstrate how multiple member LSPs can collectively route around global bandwidth constraints
- Describe how to customize the sampling method of a container LSP
- Describe the benefits of customizing the TE++ normalization threshold
- Explain the benefits of failover normalization and of in-place LSP bandwidth updates

Lab 09: RSVP—Container LSPs: Advanced Concepts

Module 16: RSVP and LDP—Advanced Routing Features

- Describe the different ways that LSPs can be moved between routing tables, and the advantages and trade-offs of each method
- Explain how to customize the IP egress points of an RSVP LSP
- Demonstrate the various ways of binding a destination prefix to a specific LSP

Lab 10: MPLS—Advanced Routing Features

Day 4

Module 17: The BGP Color Community and Classful Transport, Part 1

- Describe the format of the BGP color community
- Configure and verify prefixes tagged with the BGP color community
- Explain the difference between using the legacy inetcolor.0 method and using Classful Transport for resolving color-tagged prefixes

Module 18: The BGP Color Community and Classful Transport, Part 2

- Enable Classful Transport in Junos OS
- Verify that Junos has created dedicated transport classes for each color in your network
- Configure and verify IP prefix resolution to color-aware RSVP LSPs, including color-aware MPLS VPN prefixes

Lab 11: Resolving Color-Aware LSPs with Classful Transport

Module 19: RSVP—Design Considerations

- Demonstrate the advantages of customizing various RSVP thresholds
- Explain how the TED credibility preference is considered during network mergers and migrations

Module 20: LDP in the Control Plane—A Closer Look

- Explain the format of the control plane messages that build and maintain LDP sessions

Module 21: LDP—Customization Options and Routing Policies

- Describe how the BGP next-hop resolution process can be altered in LDP
- Configure session protection to improve the integrity of LDP during network failure
- Configure and verify LDP egress policies to advertise any FEC of your choosing
- Configure and verify LDP import and export policies to limit the distribution of FECs

Lab 12: LDP Customization Options and Routing Policies

Module 22: LDP and RSVP—Advanced Scaling Techniques

- Explain how LDP Tunneling can be used to create edge-to-edge LDP label-switched paths over an RSVP core
- Explain how RSVP Automatic Mesh can dynamically create RSVP LSPs on-demand

Lab 13: LDP and RSVP—Advanced Scaling Techniques

Self-study modules

Module 23: LDP—Local Repair

- Describe the three ways that LDP can offer local repair
- Demonstrate how LDP can take advantage of Loop-Free Alternate backup paths from your IGP
- Configure remote LFA to enable an LDP tunnel to a remote loop-free router
- Configure LDP with dynamic RSVP tunnels for full topology coverage

Resources

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Key contacts

Americas: networking.training.ams@hpe.com

Europe, Middle East, Africa: networking.training.emea@hpe.com

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