Junos Segment Routing with SRv6 Micro-SIDs

Course overview

This four-day, advanced-level course provides an in-depth introduction to segment routing (SR), otherwise known as Source Packet Routing in Networking (SPRING). The course focuses on using IS-IS and BGP to deploy Segment Routing for IPv6 (SRv6) micro-SIDs, which encode multiple instructions into a single IPv6 address in the data plane.

After exploring the features and use cases for SRv6 with micro-SIDs, students are introduced to the fundamentals of a segment-routed network, such as locator blocks, locator prefixes, and a variety of BGP service functions such as uDT4 and uDT6 segments. This also includes VPN configuration, with a focus on Layer 3 VPNs and the MPLS label transposition process.

Students are then taught how an SRv6 micro-SID network can encode multiple segments into a single address, and the segment popping process that takes place across a path. Students configure End and End.X transport segments to test this, which acts as a starting point to deploy a variety of backup paths with Topology-Independent Loop-Free Alternate (TI-LFA).

A self-study section then follows that considers topics including classic SRv6, microloop avoidance, and some advanced TI-LFA calculation concepts. Students also briefly learn the most fundamental concepts of Segment Routing for MPLS (SR-MPLS). This knowledge enables students to compare and contrast the two SR methods.

This course is based on Junos OS Release 25.2R1.8.

Course level

Junos Segment Routing with SRv6 Micro-SIDs is an advanced-level course.

Audience

The primary audiences for this course include:

- 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 and IS-IS, and who may previously have used MPLS to create transport paths across their networks.

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

ACX Series, Junos OS, MX Series, QFX Series, Juniper Paragon Pathfinder, PTX Series

Recommended next course

- *Junos Segment Routing with SR-MPLS*

Objectives

- Explain the basic philosophy of segment routing.
- Describe some of the exciting features offered by segment routing.
- Demonstrate how SRv6 micro-SIDs can enable a BGP-free core.
- Demonstrate how to deploy and verify SRv6 micro-SID locator blocks and locator prefixes in Junos OS.
- Describe the variety of function types you can deploy in an SRv6 network.
- Demonstrate how to configure internal BGP and external BGP in preparation for generating SRv6 micro-SIDs.
- Demonstrate how to deploy BGP service micro-SIDs such as uDT4, uDT6, and uDT46.
- Demonstrate how to override the default Junos OS micro-SID Local ID Block (LIB) range.
- Configure and verify Layer 3 VPNs in an SRv6 micro-SID network.
- Explain how a path with multiple precise hops can be encoded in a single SRv6 micro-SID address.
- Explain how adjacency segments can be used to define strict hops along a path.
- Explain how the Segment Routing Header (SRH) can carry multiple SRv6 addresses inside a single header.

- Explain the three flavors that can pop a Segment Routing Header or an IPv6 transport header.
- Explain how TI-LFA backup paths can radically reduce downtime during link or node failure.
- Demonstrate how to configure and verify TI-LFA link protection in a Junos OS SRv6 network.
- Demonstrate how to configure and verify TI-LFA node protection in a Junos OS SRv6 network.
- Explain the various ways that you can continue your SRv6 micro-SID studies once the course is completed.
- Describe the process by which Junos OS calculates a SID stack for TI-LFA backup paths.
- Explain how enabling microloop avoidance can solve problems that may occur during network convergence.
- Explain how to configure and verify a classic SRv6 deployment using Junos OS.
- Explain how SR-MPLS adjacency SIDs and node SIDs can build segment-routed paths using MPLS labels
- Review crucial MPLS concepts such as the label format, the inet.3 and mpls.0 tables, and BGP next-hop resolution.

Course contents

Day 1

Module 01: Introducing Segment Routing

- Explain how a segment serves as an instruction to forward or process a packet in a particular way
- Describe the high-level difference between SR-MPLS, classic SRv6, and micro-SIDs
- Demonstrate at a high level how segments are advertised inside your interior gateway protocol

Module 02: The Features Enabled by Segment Routing

- Explain how segment routing enables both shortest paths and traffic-engineered paths
- Describe some exciting features offered by segment routing, such as Flex Algo and TI-LFA

Module 03: Segments in the Data Plane—SRv6 Micro-SIDs

- Explain how micro-SIDs compress one SRv6 SID into a single IPv6 hextet
- Describe how the SRv6 locator enables shortest-path routing to a remote node
- Describe how the SRv6 function encodes an instruction for a local router to process

Module 04: SRv6 Micro-SID Locators—Configuration and Verification

- Explain the design of the test network used throughout this course
- Describe how to choose and deploy a micro-SID locator block
- Configure a micro-SID locator prefix in Junos OS
- Verify micro-SID locator blocks and locator prefixes in Junos OS

Lab 01: Enabling Locators and Shortest-Path Tunnels in an SRv6 Micro-SID Network

Module 05: SRv6 Micro-SID Functions

- Explain the purpose and meaning of End.DT4, End.DT6, and End.DT46 functions in SRv6
- Demonstrate the importance of maintaining separate blocks of micro-SID values for global and local segments

Day 2

Module 06: SRv6 Micro-SIDs—Initial EBGP and IBGP Configuration

- Configure IPv6 EBGP sessions to advertise IPv4 prefixes with IPv4 next hops
- Configure IBGP to process SRv6 SIDs and to advertise IPv4 prefixes with IPv6 next hops
- Demonstrate how to verify that your IBGP network is ready to host micro-SIDs

Lab 02: Configuring the Underlying EBGP and IBGP Settings for SRv6 Micro-SIDs

Module 07: BGP Service Micro-SIDs—Configuration and Verification

- Configure uDT4, uDT6, and uDT46 micro-SIDs in the default Junos OS routing tables
- Verify BGP micro-SID prefix resolution on the Junos OS CLI

Lab 03: Tagging BGP Updates with uDT4 and uDT6 Micro-SIDs for IP Prefix Resolution

Module 08: Customizing the Micro-SID Local ID Block

- Configure Junos OS to allocate a range of micro-SID values for manual allocation
- Configure Junos OS to allocate a larger range of micro-SID values to the LIB

Lab 04: SRv6 Micro-SID Block Customization

Module 09: SRv6 Micro-SIDs and Layer 3 VPNs

- Describe the transposition process of using MPLS labels in BGP Updates to efficiently advertise SRv6 SIDs
- Demonstrate how to deploy a Layer 3 VPN that uses the SRv6 micro-SID data plane

- Describe the function types required in a Layer 2 Ethernet VPN deployment.

Lab 05: SRv6 Micro-SIDs and L3VPN Integration

Day 3

Module 10: Micro-SID Stacks, Part 1—Micro-Node SIDs and SRv6 Traceroute

- Describe the hop-by-hop behavior of an SRv6 address that contains a stack of shortest-path micro node SIDs
- Demonstrate how to use SRv6 traceroute to test and troubleshoot a micro-SID deployment

Module 11: Micro-SID Stacks, Part 2—Micro-Adjacency SIDs

- Configure and verify End.X micro-adjacency SIDs using Junos OS
- Demonstrate how End.X micro-SIDs are processed in the data plane
- Explain the meaning of the formal RFC name of NEXT-CSID for micro-SIDs

Module 12: The Segment Routing Header and Flavors, Part 1

- Explain the format and behavior of the SRH along a path
- Describe how flavors offer additional permission for transport segments to pop the SRH and the IPv6 header
- Explain the behavior and benefit of Penultimate Hop Popping
- Demonstrate how Junos OS represents the SRH in an SRv6 traceroute

Module 13: The Segment Routing Header and Flavors, Part 2

- Explain why the name Penultimate Segment Pop is not quite accurate in a micro-SID network
- Describe the purpose of Ultimate Segment Decapsulation
- Explain a theoretical use case for the Ultimate Segment Pop
- Demonstrate how to verify flavor tags in the IS-IS database

Lab 06: Using SRv6 Traceroute to Troubleshoot Transport Micro-SIDs and the Segment Routing Header

Day 4

Module 14: Topology-Independent Loop-Free Alternate—Theory

- Explain how TI-LFA creates loop-free backup paths with full topology coverage
- Explain the concepts of the pre-convergence and post-convergence topologies
- Describe the difference between link protection and node protection in TI-LFA

Module 15: TI-LFA Link Protection—Configuration

- Configure Junos OS for TI-LFA with link protection
- Explain how Junos calculates SRv6 TI-LFA SID stacks to route around pre-convergence loops
- Explain the three main methods of writing TI-LFA SIDs to a packet in an SRv6 micro-SID network
- Verify that Junos automatically offers TI-LFA protection to prefixes learned from BGP

Module 16: TI-LFA Node Protection—Configuration

- Configure Junos OS for TI-LFA with loose node protection
- Configure Junos OS for TI-LFA with strict node protection
- Explain what types of traffic are eligible for local repair

Lab 07: Topology-Independent Loop-Free Alternate

Module 17: Where Do You Go From Here?

- Describe some crucial topics for future self-study, including traffic engineering, locator prefix aggregation, and Flex Algo
- Explain the free study materials offered by Juniper Networks, including the certification program

Self-study modules

Module 18: Topology-Independent Loop-Free Alternate—The Micro-SID Stack

- Explain how P space and extended P space are used to find loop-free backup paths
- Demonstrate how Q space can be used to tunnel backup paths across topological loops on a backup path
- Describe how TI-LFA bridges gaps between P space and Q space

Module 19: Creating Interface Maps

- Describe how microloop avoidance can prevent temporary loops between two nodes during network convergence
- Configure and verify microloop avoidance in Junos OS

Module 20: Classic SRv6—An Introduction

- Demonstrate how to configure and verify a classic SRv6 locator prefix

- Describe the format and purpose of a classic SRv6 function value
- Demonstrate the way that SID stacks in classic SRv6 operate differently from micro-SIDs

Module 21: A Brief Introduction to SR-MPLS

- Demonstrate how SR-MPLS encodes instructions in an MPLS label
- Describe how SR-MPLS creates and advertises adjacency SIDs
- Explain how the Segment Routing Global Block enables efficient advertisement of node SIDs
- Configure and verify node SIDs and an SRGB on the Junos OS CLI

Module 22: Refresher—Using MPLS Tunnels to Resolve BGP Prefixes

- Explain the required prerequisite knowledge for this course
- Describe the IS-IS LSP message format, and describe how BGP resolves its protocol next-hops
- Demonstrate how MPLS can create tunnels between devices
- Define some crucial MPLS terminology

Resources

All-Access Training Pass

On-Demand

Courses

Schedule

Learning Paths

Certification

Key contacts

Americas: networking.training.ams@hpe.com

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

Asia Pacific & Japan: networking.training.apj@hpe.com

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