

# Implementing Cisco Service Provider Advanced Routing Solutions (SPRI)

**Course Duration: 40 Hours**

**Course code: SPRI**

## 1. Course Overview

The Implementing Cisco Service Provider Advanced Routing Solutions (SPRI) course expands a student's knowledge and skills in service provider core networking. You will cover the theories and practical knowledge of advanced routing technologies including routing protocols, policy language, Multiprotocol Label Switching (MPLS), and segment routing.

## 2. What you'll learn?

**After completing this course you should be able to:**

- Implement advanced features of multiarea Open Shortest Path First (OSPFv2) running in Service Provider networks
- Implement advanced features of multilevel Intermediate System to Intermediate System (ISIS) running in Service Provider networks
- Describe the main characteristics of routing protocols that are used in service provider environments
- Configure route redistribution
- Configure Border Gateway Protocol (BGP) in order to successfully connect the Service Provider network to the customer or upstream Service Provider
- Configure BGP scalability in Service Provider networks
- Implement BGP security options
- Implement advanced features in order to improve convergence in BGP networks
- Troubleshoot OSPF, ISIS, and BGP
- Implement and verify MPLS

- Implement and troubleshoot MPLS Traffic engineering
- Implement and verify segment routing technology within an interior gateway protocol
- Describe how traffic engineering is used in segment routing networks
- Implement IPv6 tunneling mechanisms
- Describe and compare core multicast concepts
- Implement and verify the PIM-SM protocol
- Implement enhanced Protocol-Independent Multicast - Sparse Mode (PIM-SM) features
- Implement Multicast Source Discovery Protocol (MSDP) in the interdomain environment
- Implement mechanisms for dynamic Rendezvous Point (RP) distribution

### 3. Target Audience

Engineers who maintain and operate advanced Service Provider core networks.

### 4. Pre-Requisites

**Attendees should meet the following prerequisites:**

- Intermediate to advanced knowledge of Cisco Internetwork Operating System (Cisco IOS®) or IOS XE and Cisco IOS XR Software configuration
- Knowledge of IPv4 and IPv6 TCP/IP networking
- Intermediate knowledge of BGP, OSPF, and ISIS routing protocols
- Understanding of MPLS technologies
- Understanding of multicast technologies
- Familiarity with segment routing

**Recommended prerequisites:**

- SPCOR - Implementing and Operating Cisco Service Provider Network Core Technologies

- SPFNDU - Understanding Cisco Service Provider Network Foundations

## 5. Course content

### 1. Implementing and Verifying Open Shortest Path First (OSPF) Multiarea Networks

- OSPF Area Types: Standard, Stub, Totally Stubby, and NSSA
- Inter-Area Route Summarization
- Virtual Links and Their Use Cases
- OSPF LSA Types and Database Verification
- Implementing OSPF in Multi-area Designs
- OSPF Packet Captures and Troubleshooting Techniques

### 2. Implementing and Verifying Intermediate System to Intermediate System (IS-IS) Multilevel Networks

- IS-IS Level 1, Level 2, and Level 1-2 Concepts
- Configuring IS-IS in Multilevel Hierarchical Networks
- Area Design and Route Propagation
- Metric Manipulation and Redistribution
- Verifying and Troubleshooting IS-IS Operations

### 3. Introducing Routing Protocol Tools, Route Maps, and Routing Policy Language (RPL)

- Route Maps: Match and Set Conditions
- Policy-Based Routing (PBR)
- Prefix Lists and Distribute Lists
- Introduction to Routing Policy Language (RPL) in IOS XR
- Applying RPL to Control Routing Protocol Behavior

### 4. Implementing Route Redistribution

- Concepts and Risks of Route Redistribution

- One-way and Mutual Redistribution
- Tagging and Filtering Routes
- Administrative Distance and Loop Prevention
- Route Redistribution Verification and Troubleshooting

## **5. Influencing Border Gateway Protocol (BGP) Route Selection**

- BGP Best Path Selection Algorithm
- Using Local Preference, MED, and AS Path
- Weight Attribute and Route Maps for Policy Control
- BGP Communities and Extended Communities
- Lab: Influencing Route Selection via Policy

## **6. Scaling BGP in Service Provider Networks**

- BGP Route Reflectors and Confederations
- Large-Scale BGP Deployments and Route Aggregation
- BGP Session Scalability and Peering Strategies
- Prefix Limiting and Soft Reconfiguration
- Peer Groups and Template Reuse

## **7. Securing BGP in Service Provider Networks**

- Prefix Filtering and AS-Path Filtering
- BGP Session Protection (TTL Security Check, MD5 Authentication)
- Route Validation using Resource Public Key Infrastructure (RPKI)
- Prefix Origin Validation
- Infrastructure Security Best Practices

## **8. Improving BGP Convergence and Implementing Advanced Operations**

- BGP Graceful Restart and NSF
- BGP Fast External Failover
- BGP Prefix Independent Convergence (PIC)

- BGP Route Dampening
- BGP Monitoring Tools and Convergence Optimization

## **9. Troubleshooting Routing Protocols**

- Troubleshooting OSPF and IS-IS Routing Issues
- Debugging BGP Sessions and Route Flaps
- Using Packet Captures and Show Commands
- Common Misconfigurations and Resolution Methods
- Analyzing Routing Loops and Route Redistribution Failures

## **10. Implementing and Verifying MPLS**

- MPLS Label Stack and Forwarding
- Label Distribution Protocol (LDP)
- MPLS Control and Data Plane Verification
- Troubleshooting Label Switched Path (LSP)
- Loop Prevention and Label Bindings

## **11. Implementing Cisco MPLS Traffic Engineering**

- MPLS TE Architecture and RSVP-TE Signaling
- Tunnel Creation and Explicit Path Configuration
- Auto-route Announce and Forwarding Adjacency
- Bandwidth Reservation and Affinity Rules
- Verifying and Troubleshooting MPLS TE

## **12. Implementing Segment Routing (SR)**

- Segment Routing Architecture (SR-MPLS, SRv6 overview)
- Prefix-SID, Adjacency-SID, and SRGB
- Control Plane Integration with OSPF/IS-IS
- SR-TE Path Computation and Flex-Algo Introduction
- Segment Routing Topology Verification

### **13. Describing Segment Routing Traffic Engineering (SR TE)**

- SR-TE Policy Architecture
- On-demand vs. Static Policy Configuration
- Integration with PCEP and Centralized Controllers
- TE Constraints and Flex-Algo
- Path Verification and Performance Monitoring

### **14. Deploying IPv6 Tunneling Mechanisms**

- 6to4 and ISATAP Tunneling
- Manual IPv6 Tunnels
- GRE over IPv6
- Dual Stack and Tunneling Best Practices
- Verifying IPv6 Tunnel Operations

### **15. Implementing IP Multicast Concepts and Technologies**

- Multicast Addressing and Group Management
- IGMP Versions and Snooping
- PIM Overview and Deployment Scenarios
- Reverse Path Forwarding (RPF) Check
- Multicast Distribution Trees

### **16. Implementing Protocol Independent Multicast Sparse Mode (PIM-SM)**

- PIM-SM Rendezvous Point (RP) Configuration
- RP Discovery: Static, Auto-RP, BSR
- Register and Join Message Flows
- PIM-SM Operation in Multi-VRF Environment
- Troubleshooting PIM Join/Prune Behavior

### **17. Implementing PIM-SM Enhancements**

- Anycast RP Deployment
- Multicast Source Discovery Protocol (MSDP)
- Bidirectional PIM Overview
- Auto-RP Redundancy Techniques
- Enhancing PIM Scalability and Resilience

## **18. Implementing Interdomain IP Multicast**

- Inter-AS Multicast Routing Options
- MSDP Configuration and Filtering
- Source Discovery Across ASes
- PIM-SM Interdomain Policy Control
- Monitoring and Troubleshooting Interdomain Flows

## **19. Implementing Distributed Rendezvous Point (RP) Solution in Multicast Networks**

- Design Concepts for Distributed RPs
- Static vs. Dynamic RP Selection
- MSDP Peering and RP Redundancy
- Source Registration and RP Failover Handling
- Advanced Troubleshooting: RP Selection and Tree Building