Introduction

Implementing Cisco IP Routing (ROUTE) v1.0 is an instructor-led training course presented by Cisco training partners to their end customers. This five-day course is designed to help students prepare for Cisco CCNP certification. The ROUTE course is a component of the CCNP curriculum. The ROUTE course is designed to provide professionals of medium to large network sites with information on the use of advanced routing in implementing scalability for Cisco routers that are connected to LANs and WANs. The goal is to train professionals to dramatically increase the number of routers and sites using these techniques instead of redesigning the network when additional sites or wiring configurations are added. The ROUTE training reinforces the instruction by providing students with hands-on labs to ensure they thoroughly understand how to implement advanced routing within their networks.

Audience

This course is intended for those engineers who are candidates for Cisco CCNP certifications as well as those who are candidates for Cisco CCIE Routing and Switching and CCIE certifications.

Others who will benefit from this course are:

- Network professionals who want to correctly implement routing-based solutions given a network design using Cisco IOS services and features, where implementation of routing includes planning, configuration, and verification.
- The typical job roles for this type of network professional are network engineers; network operations center (NOC) technical support personnel, and help desk technicians.
- Any individual involved in implementation and verification of routing protocols in enterprise networks.

At Course Completion

At the end of this course, you'll be able to:

- Plan and document the configuration and verification of routing protocols and their optimization in enterprise networks.
- Identify the technologies, components, and metrics of EIGRP used to implement and verify EIGRP routing in diverse,
- Identify, analyze, and match OSPF multi-area routing functions and benefits for routing efficiencies in network operations in order to implement and verify OSPF routing in a complex enterprise network
- Implement and verify a redistribution solution in a multi-protocol network that uses Cisco IOS features to control path selection and provides a loop-free topology according to a given network design and requirements
- Evaluate common network performance issues and identify the tools needed to provide Layer 3 path control that uses Cisco IOS features to control the path
- Implement and verify a Layer 3 solution using BGP to connect an enterprise network to a service provider
Prerequisites

To fully benefit from this course, students should have the following prerequisite skills and knowledge:

- Knowledge and skill level equal to Cisco CCNA certification.
- In addition to knowledge and skill level equal to Cisco CCNA certification, it is recommended that the student have practical experience in installing, operating, and maintaining Cisco routers and switches in an enterprise environment.
- Knowledge of and experience with the implementation and verification of enterprise routing and switching technologies as offered by the Interconnecting Cisco Networking Devices Part 1 (ICND1) and Interconnecting Cisco Networking Devices Part 2 (ICND2) courses or equivalent skills and knowledge.

Related Courses:

- SWITCH 1.0
- TSHOOT 1.0

Course Outline

Module 1: Planning Routing Services to Requirements

Lesson 1: Assessing Complex Enterprise Network Requirements

- Describe the Cisco conceptual network models, such as Cisco Enterprise Architectures and the Cisco hierarchical network model
- Describe the Cisco Enterprise Architecture
- Describe the traffic conditions in a converged network
- Describe the Cisco SONA framework
- Describe routing and routing protocols

Lesson 2: Common Maintenance Processes and Procedures

- Describe the step required to create a typical implementation plan
- Describe the types of information contained in a typical implementation plan.
- Describe the types of task detailed in a typical implementation plan
- Describe the types of information that should be documented related to an implementation.
- Describe the way that the information related to an implementation can be documented.

Module 2: Implementing an EIGRP based Solution

Lesson 1: Planning Routing Implementations with EIGRP

- Identify the four key technologies employed by EIGRP
- Describe how EIGRP operates
- Describe the five components of the metric used by EIGRP
- Calculate the EIGRP metric for a range of pathways between routers
- Create a typical implementation plan for an EIGRP based solution.
- Document EIGRP implementation, operations and maintenance processes

Lesson 2: Implementing and Verifying Basic EIGRP for the Enterprise LAN Architecture

- Describe the commands used in a basic EIGRP configuration task
- Select the interfaces and networks that will participate in EIGRP routing use the network command and wildcard masks
- Verify basic EIGRP operations and that the router recognizes EIGRP neighbors and their routes
- Create neighbor relationships using the neighbor command and verify that the router recognizes EIGRP neighbors and routes
- Control routing update advertisements using the passive-interface command
- Configure and verify the last-resort gateway or default route
- Determine why administrators may need to use manual route summarization over default automatic route summarization
- Configure and verify route summarization

Lesson 3: Configuring and Verifying EIGRP for the Enterprise WAN Architecture

- Describe the effect on EIGRP operations when operating over a circuit emulation link like Metro Ethernet or EoMPLS
Describe the effect on EIGRP operations when operating over MPLS VPNs
- Describe the effect on EIGRP operations when operating over Frame Relay
- Physical interface - dynamic DLCI mapping, static DLCI mapping - broadcast vs. non-broadcast
- Logical multipoint interface - dynamic DLCI mapping, static DLCI mapping - broadcast vs. non-broadcast
- Logical point-to-point interface
- Configure and verify EIGRP operating over Frame Relay
- Physical interface - dynamic DLCI mapping, static DLCI mapping - broadcast vs. non-broadcast
- Logical multipoint interface - dynamic DLCI mapping, static DLCI mapping - broadcast vs. non-broadcast
- Logical point-to-point interface
- Describe the features of load balancing across equal paths
- Configure and verify EIGRP load balancing across unequal-cost paths
- Evaluate why EIGRP defaults may need to be changed to ensure efficient use of bandwidth across WAN links
- Configure EIGRP bandwidth use across WAN links

Lesson 4: Implementing and Verifying EIGRP Authentication
- Evaluate router authentication
- Describe the Message Digest 5 (MD5) authentication used in EIGRP
- Configure MD5 authentication
- Troubleshoot MD5 authentication

Lesson 5: Advanced EIGRP Features in an Enterprise Network
- Describe factors affecting scalability in large internetworks
- Describe how EIGRP uses queries to update its routing tables in the event that a route is lost and there is no feasible successor
- Mark the spokes of a large network as stubs to reduce EIGRP queries and thus improve network scaling
- Describe why stuck-in-active (SIA) connections occur
- Minimize active routes
- Illustrate how graceful shutdown prevents loss of packets when routers go down

Module 3: Implementing a Scalable Multi-area Network OSPF Based Solution
Lesson 1: Planning Routing Implementations with OSPF as Scalable Routing Protocol
- Describe link-state routing protocols
- Describe the two-tier hierarchy structure of OSPF
- Describe how routers running a link-state routing protocol establish neighbor adjacencies with their neighboring routers
- Describe how OSPF calculates the best path to each destination network
- Describe how routers use link-state updates (LSUs) to verify that links are still active
- Describe the different OSPF area types.
- Create a typical implementation plan for an OSPF based solution.
- Create a typical implementation documentation package for an OSPF based solution

Lesson 2: How OSPF Packet Processes Work
- Describe the five OSPF packet types
- Describe how OSPF neighbor adjacencies are established
- Describe the process of exchanging and synchronizing the link-state databases (LSDBs, or topology tables) between routers
- Describe how OSPF maintains synchronization of the LSDBs (topology tables) of all routers in the network
- Describe the process of maintaining a database of only the most recent link-state sequence numbers
- Describe how to verify that OSPF packets are flowing properly between two routers

Lesson 3: Improving Routing Performance in a Complex Enterprise Network
- Introduce OSPF network types
- Determine adjacency behavior in point-to-point links
- Determine adjacency behavior in a broadcast network
- Determine adjacency behavior in a Metro Ethernet and EoMPLS network
- Determine adjacency behavior in MPLS networks
- Select a DR and BDR
Implement OSPF over different Frame Relay implementations

- Implement OSPF over Frame Relay NBMA
- Use sub-interfaces in OSPF over Frame Relay
- Implement OSPF over a point-to-point Frame Relay network
- Implement OSPF over a point-to-multipoint Frame Relay network

Lesson 4: Configuring and Verifying OSPF Routing

- Describe the procedure to configure basic single-area and multiarea OSPF
- Enable the route process
- Configure a router ID
- Enable OSPF on networks and interfaces using the network and ip ospf commands
- Configure basic multi-area OSPF operations
- Verify basic multi-area OSPF operations
- Neighbor relationship
- OSPF router types
- LSAs defined by OSPF
- Interpret the OSPF LSDB and routing table
- Describe how routing advertisements can be controlled using the passive-interface command
- Describe the effects of a non-contiguous backbone or area that does not connect to area 0 and how (Design note: Network mergers are a good context.)
- OSPF virtual links are used to address these issues
- Configure and verify an OSPF virtual link
- Change the cost metric from default values

Lesson 5: Configuring and Verifying OSPF Route Summarization

- Describe the functions of inter-area route summarization and external route summarization
- Configure route summarization in OSPF
- Describe the benefits of a default route in OSPF
- Configure a default route injection into OSPF

Lesson 6: Configuring and Verifying OSPF Special Area Types

- Describe the OSPF area types
- Configure OSPF stub areas
- Configure OSPF totally stubby areas
- Interpret information shown on routing tables for stub areas and totally stubby areas
- Configure OSPF NSSAs
- Verify all types of OSPF stub areas

Lesson 7: Configuring and Verifying OSPF Authentication

- Distinguish between the two types of authentication used in OSPF
- Configure simple password authentication
- Configure MD5 authentication
- Troubleshoot simple password authentication
- Troubleshoot MD5 authentication

Module 4: Implement an IPv4-based Redistribution Solution

Lesson 1: Assessing Network Routing Performance and Security Issues

- Determine common network performance issues
- Identify How distribution lists work
- Use distribution lists to control routing updates
- Identify how prefix lists work
- Use a prefix list to control routing updates
- Identify how route maps work
- Use route maps to control routing updates
- Use route maps to filter routes
- Suppress routing updates using passive interfaces
Lesson 2: Operating a Network Using Multiple IP Routing Protocols

- Describe the need to use multiple IP routing protocols
- Define route redistribution
- Illustrate how to configure dynamic routing protocol updates for passive interfaces and distribute lists.
- Illustrate the use of Policy routing and route maps
- Identify the seed metrics that are used by various routing protocols
- Describe the process for points of distribution in a network and identifying possible routing loops.
- Create a distribution and loop map for a given network.

Lesson 3: Configuring and Verifying Route Redistribution

- Describe the procedures necessary to configure route redistribution
- Describe how to redistribute routes into RIP
- Describe how to redistribute routes into EIGRP
- Describe how to redistribute routes into OSPF
- Assess the advantages of administrative distance in terms of routing protocols
- Modify administrative distance on the router globally for a particular routing protocol or specifically for certain routes to control path selection
- Assess the impact of administrative distance changes on routing tables
- Implement route maps with route redistribution to prevent routing loops
- Verify route redistribution operations

Module 5: Implementing Path Control

Lesson 1: Assessing Path Control Network Performance Issues

- Assess path control network performance
- Use filters to determine path selection
- Use PBR to determine path selection
- Configure and verify PBR
- Configure and verify PBR operations on a Cisco router

Lesson 2: References to additional Path Control in E-Learning

- ROUTE-01 of 3: Implement Path Control
- ROUTE-01 Lesson 1: Parallel processes when implementing Path Control
- ROUTE-01 Lesson 2: Directed Demo of Procedures to Implement Path Control by Other Methods
- ROUTE-01 Lesson 3: Self-Check Assessment

Module 6: Connection of an Enterprise Network to an ISP Network

Lesson 1: Planning the Enterprise-to-ISP Connection

- Describe connectivity requirement between an enterprise network and an ISP.
- Describe the methods for exchanging routing information across an ISP.
  - Static routes
  - Common IGPs
  - MPLS VPNs
  - Circuit Emulation
  - BGP
- Describe the types of enterprise-to-ISP connections and their effect on the selection of an exchange method.
  - Single-homed
  - Dual-homed
  - Multi-homed
  - Dual multi-homed

Lesson 2: Considering the Advantages of Using BGP

- Describe connectivity between an enterprise network and an ISP that requires the use of BGP, including a description of the issues that arise when an enterprise decides to connect to the Internet through multiple ISPs
- Describe BGP multi-homing options
Describe how BGP routes between autonomous systems
- Describe how BGP uses path-vector functionality
- Describe the features of BGP in terms of deployment, enhancements over other distance vector routing protocol and database types

Lesson 3: Comparing the Functions and Uses of EBGP and IBGP
- Define terms used to describe BGP routers and their relationships
- Describe the requirements for establishing an external BGP (EBGP) neighbor relationship
- Describe the requirements for establishing an internal BGP (IBGP) neighbor relationship
- Use of metrics

Lesson 4: Configuring and Verifying Basic BGP Operations
- Initiate basic BGP configuration
- Activate a BGP session for external and internal neighboring routers
- Administratively shut down and re-enable a BGP neighbor
- Select the factors and options to correctly configure BGP
- Describe BGP neighbor states
- Configure MD5 authentication on the BGP TCP connection between two routers
- Configure and verify BGP operations in a single-homed environment.
- Troubleshoot BGP configuration

Lesson 5: Using the BGP Attributes and Path Selection Process
- Characterize BGP attributes that effect outbound EBGP path selection
- Select the criteria for selecting a BGP path
- Configure the AS path attribute to effect outbound EBGP path selection
- Describe how the local preference attribute can be configured to effect outbound path selection
- Configure the weight attribute to effect outbound EBGP path selection
- Use route maps to set selected attributes for selected routes to control outbound EBGP path selection
- AS Path prepending
- Local preference
- Weight
- Describe how the MED attribute can be configured to effect inbound EBGP path selection
- Describe how the AS path attribute (AS prepending) can be configured to affect inbound EBGP path selection
- Describe how to use route maps to set selected attributes for selected routes to control outbound EBGP path selection
- AS Path prepending
- MED

Lesson 6: E-Learning Training on IPv6 and Routing for Branch Offices and Remote Workers

ROUTE-02: Implementing IPv6
- Lesson 1: IPv6 Addressing and Unicast
- Lesson 2: Implementing RIPng, OSPFv3, EIGRP and Redistribution in IPv6
- Lesson 3: IPv6 Transition Techniques
- Lesson 4: NAT and PAT with IPv6

ROUTE-03: Implementing Routing Facilities for Branch Offices and Mobile Workers
- Lesson 1: Analyzing Branch Office Designs and Planning for Branch Office Installations
- Lesson 2: Directed Demo - Implement Special Facilities for Branch Offices.

Lab Objectives:
- Create an implementation plan to implement Branch Office facilities.
- Configure changes to the core network to connect to Branch Offices.
- Verify correct operation and required performance of the installed services.
- Document implementation, operations, and maintenance for the installed services.
- Lesson 3: Lab Debrief
- Lesson 4: Analyzing Mobile Workers Designs and Planning for Mobile Workers Installations
- Lesson 5: Directed Demo - Implement Special Facilities for Mobile Workers.
Lab Objectives:

- Create an implementation plan to implement Mobile Workers facilities.
- Configure changes to the core network to connect to Mobile Workers.
- Verify correct operation and required performance of the installed services.
- Document implementation, operations, and maintenance for the installed services.
- Lesson 6: Lab 03-2 Debrief
- Lesson 7: Self-Check Assessment

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