

# ROUTE: Implementing Cisco IP Routing

## Course Overview

This course provides students with the knowledge and skills to implement Cisco IP routing, including configuring EIGRP and the OSPF protocol.

### Course Introduction

3m

Course Introduction

### Chapter 01 - Routing Services

1h 1m

Lesson 1: Complex Enterprise Network Frameworks, Architectures, and Models

Traffic Conditions in a Converged Network

IIN: Cisco Intelligent Information Network

Three Phases of the Intelligent Information Network

Three Phases of the Intelligent Information Network Graph

Cisco SONA Framework

Cisco SONA Framework Layers

SONA: Networked Infrastructure Layer

SONA: Interactive Services Layer

SONA: Application Layer

Updated SONA Framework

Cisco Enterprise Architecture

Campus Architecture

Branch Architecture

Data Center Architecture

Teleworker Architecture

Cisco Hierarchical Network Model

Hierarchical Campus Model

The Hierarchical Model in a Wide Area Network

The Enterprise Composite Network Model

Lesson 2: Creating, Documenting, and Executing an Implementation Plan

Creating an Implementation Plan

Structured Approach

Ad-hoc Approach

Methodologies and Models

Cisco Lifecycle Services (PPDIOO) Model

Implementation Plan Documentation

Sample Implementation Plan

Example of Project Contact List

Example of Implementation Task List

Example of Tools Required

Example of Equipment Floor Plan

Lesson 3: Overview of IP Routing

IP Routing

Dynamic Routing

Static Routing

Third Option: OnDemand Routing

Link-State Versus Distance Vector Protocols

Classless Versus Classful Routing

Discontiguous Subnets - Classful Routing

Discontiguous Subnets - Classless Routing

IP classless Command  
Automatic Route Summarization  
Criteria of Routing Table  
Administrative Distance  
Administrative Distances  
Floating Static Route  
Demo - RIPNG  
Chapter 01 Summary

## **Chapter 02 - Configuring the Enhanced Interior Gateway Routing Protocol**

1h 24m

Lesson 1: Understanding EIGRP Terminology and Operation

EIGRP Attributes and Capabilities  
Terminology of the EIGRP Protocol  
Tables used with the EIGRP Protocol  
FD versus AD  
Successor and Feasible Successor  
Active Routes versus Passive  
Major EIGRP Technologies  
Reliable Transport Protocols  
Neighbor Discovery  
PDMs or Protocol Dependent Modules  
DUAL Finite-State Machine  
Packet Types used by EIGRP  
Hello Packet use by EIGRP  
Acknowledgement Packets  
Update Packets  
Query and Reply Packets  
EIGRP (AD) Administrative Distance  
EIGRP Metric Calculation  
EIGRP Bandwidth

Lesson 2: Planning EIGRP Routing Implementations

EIGRP Deployment Prerequisites  
EIGRP Implementation  
EIGRP Verification  
EIGRP Documentation

Lesson 3: Configuring and Verifying EIGRP

Enable EIGRP Routing  
Advertising EIGRP  
Demo - Enable EIGRP Routing  
Demo - Define EIGRP Networks  
Automatic Summarization  
Demo - Define Bandwidth on Interfaces  
EIGRP Commands  
Demo - Enable and Disable EIGRP Automatic Summarization  
EIGRP Passive-Interface  
Default Route Propagation  
Demo - Passive Interface  
IP Default Network Command  
EIGRP Route Summarization  
Demo - IP Default Network  
Demo - Configure a Router to Advertise a Default Route as the Gateway of Last Resort  
Interface Summarization  
Demo - Example of the IP Route Next Hop Command  
Demo - Example of the IP Route Quad Zero Command  
Creating Summary Route at an Arbitrary Bit Boundary  
Demo - Summarization in Discontiguous Networks

## Lesson 4: Configuring and Verifying EIGRP in an Enterprise WAN

Demo - Disabling Automatic Summarization

WAN and EIGRP Considerations

EIGRP over MPLS

Demo - Frame Relay Using Dynamic Mapping

Load Balancing with EIGRP

Demo - EIGRP over Layer 3 MPLS VPNs

Demo - EIGRP over Layer 2 MPLS VPNs

Unequal EIGRP Cost Load Balancing

EIGRP Bandwidth Use on WAN Links

Setting EIGRP Bandwidth in a WAN Environment

## Lesson 5: Configuring and Verifying EIGRP Authentication

Authentication in Routers

Comparing MD5 Authentication to Simple Password

Preparing for the Configuration of EIGRP Authentication

Demo - Configure Authentication Mode for EIGRP

The Configuration of EIGRP Authentication

Demo - Configure the Key Chain

## Lesson 6: Optimizing EIGRP Implementations

Demo - Enable Authentication to use the Key Chain

EIGRP Scalability

Query Process

Stuck-in-Active

Summarization: SIA Solution

Stub Networks

Stub Routing

Configure a Router as a Stub Router

Demo - EIGRP

Chapter 02 Summary

## **Chapter 03 - Configuring the Open Shortest Path First Protocol**

1h 22m

### Lesson 1: Understanding OSPF Terminology and Operation

OSPF: Open Shortest Path First

Features of OSPF

Characteristics of Link-State Protocol

Advantages

Terminology

Router Types

Internal Router

Backbone Router

ABR or Area Border Router

ASBR: Autonomous System Boundary Router

BDR and DR Routers

### Lesson 2: OSPF Packets

What are OSPF Packets used for?

OSPF Hello Packet: Type 1

OSPF DBD Packet: Type 2

OSPF LSR Packet: Type 3

OSPF LSU Packet: Type 4

OSPF LSAck Packet: Type 5

Adjacent Neighbors

Link-State Data Structures

### Lesson 3: Planning OSPF Routing Implementations

Planning OSPF Deployment

OSPF Implementation

OSPF Verification

OSPF Documentation  
Lesson 4: Basic OSPF Verification and Configuration  
Enable OSPF Routing  
OSPF Network Identification  
Wildcard Mask  
OSPF Network Identification (Cont.)  
Interface Bandwidth Definition  
OSPF Router ID  
Demo - Configuring Single Area OSPF  
Router ID Definition  
Demo - Configuring Multi Area OSPF  
OSPF Verification: First Method  
Demo - Verifying OSPF  
OSPF Verification: Second Method  
OSPF Verification: Third Method  
OSPF Verification: Fourth Method  
OSPF Verification: Fifth Method  
Clearing the OSPF Routing Table  
Lesson 5: OSPF Network Types  
Broadcast  
DR: Designated Router  
BDR: Backup Designated Router  
DR and BDR Election Manipulation  
Router Priority Assignment  
Demo - Assigning Router Priority  
DR Election  
Demo - Override the Default Interface Cost  
Influencing the Election Process  
Demo - Configure a Key for Simple Authentication  
Point-to-Point  
Demo - Configure the MD5 Key-ID and Key  
OSPF over MPLS  
Demo - Verifying Simple Password Authentication  
NBMA: Non-broadcast Multi-access  
DR Election in an NBMA Topology  
OSPF over NBMA  
Demo - OSPF  
Chapter 03 Summary

#### **Chapter 04 - Manipulating Routing Updates**

1h 42m

Lesson 1: Assessing Network Routing Performance Issues  
Usual Routing Performance Problems  
Running Different Protocols (At the Same Time)  
Performance Solutions for Routing Protocols  
Route Filtering  
Lesson 2: Using Multiple Routing Protocols on a Network  
Simple Protocols and Complex Networks  
Having Multiple Routing Protocols Running On One Network  
Complex Networks  
Redistribution  
Demo - Redistribution Supports All Routing Protocols  
Redistributed Routes  
How to Select the Best Route  
Edge and Core Routing Protocols  
Routing Loops Prevention  
Redistribution Guidelines

Lesson 3: Implementing Route Redistribution  
Redistribution Command  
Demo - Redistribute Routes into RIP  
Important Route Redistribution Information  
Demo - Redistribute Routes into OSPF  
Default Metric for BGP, OSPF, and RIP  
Demo - Default Metric for Routing Protocols  
Redistributing into EIGRP  
Demo - Redistributing Routes into EIGRP  
Default Metric for EIGRP  
Demo - Applying Metric Values for EIGRP  
Modifying the Administrative Distance  
Demo - Modifying the Administrative Distance for all Routing Protocols  
Changing the Default Administrative Distance  
Changing the Default OSPF Administrative Distance  
Changing the Default EIGRP Administrative Distance  
Demo - Changing OSPF AD  
Lesson 4: Controlling Routing Update Traffic  
Controlling Routing Updates  
Passive Interfaces  
passive-interface default Command  
Static Routes  
Default Routes  
Route Maps  
Demo - Route Map  
To Define a Route Map  
To Specify Criteria to be Matched  
To Modify Matching Conditions  
Define and Name the Route Map  
Various Route-map Commands for PBR (Slide 1 of 2)  
Various Route-map Commands for PBR (Slide 2 of 2)  
Configure Route Maps for Redistribution  
Redistribution Commands for Route-map (Slide 1 of 2)  
Redistribution Commands for Route-map (Slide 2 of 2)  
Using Distribute Lists  
Demo - Using Distribute Lists and Filter Incoming Routing Updates  
Define a Filter for Incoming Routing Updates  
Demo - Defining a Filter for Outgoing Routing Commands  
Define a Filter for Outgoing Routing Updates  
Demo - Distribute List In or Out and Examples  
Prefix Lists  
Demo - Distribute Lists to Avoid Route Feedback  
Demo - Fallbacks of Distribute Lists  
Prefix List Configuration  
Demo - Using Prefix Lists  
Chapter 04 Summary

## **Chapter 05 - Implementing Path Control**

1h 35m

Lesson 1: Understanding Path Control  
Path Control Network Performance Assessment  
Considerations for Network Redundancy  
Path Control Integrated Strategy  
Demo - Similarities of ACLs and Prefix Lists  
Lesson 2: Implementing Path Control using Offset-Lists  
Demo - Configuring a Prefix List  
Path Control Using Offset Lists

Demo - Implementing Path Control Using Offset-Lists  
Offset-List Definition  
Offset Lists Verification  
Demo - Verify Offset-Lists  
Lesson 3: Implementing Path Control using IOS IP SLAs  
Path Control Using Cisco IOS IP SLAs  
Cisco IOS IP SLAs  
Demo - Cisco IOS IP SLAs  
IP SLAs Applications  
Demo - IP SLAs Applications  
Operations, Responders and Sources  
Demo - Operations - Responders and Sources  
IP SLAs Operations  
Demo - IP SLAs Operations  
IP SLA Operation Definition  
Demo - Steps to Deploying IP SLAs  
IP SLAs ICMP Echo Operation Definition  
Demo - IP SLA - ICMP ECHO and ICMP ECHO Sub Commands  
icmp-echo Sub-Commands  
Scheduling an IP SLA Operation  
Demo - IP SLA Schedules  
IP SLA Object Tracking Configuration  
Demo - Define Tracking Objects to Track the State of IP SLAs Operations  
Tracking Delay Configuration  
Demo - Configuring Track Delay  
IP SLAs and Static Routing  
Demo - Configure a Static Route for IP SLAs Tracking  
Demo - Verify IP SLAs using Method 1  
Demo - Verify IP SLAs using Method 2  
Lesson 4: Implement Path Control using Policy-Based Routing  
Path Control Using PBR  
Demo - Implement Path Control using Policy-Based Routing  
PBR Configuration  
Demo - Configure PBR  
PBR route-map Commands  
Demo - Logical PBR Operation  
Demo - Route-Map Commands for PBR  
Match Statements  
Demo - Match Statements and Conditions  
match ip-address Command  
Demo - Match Commands Used in PBR  
match length Command  
Demo - Specify Criteria to be Matched using Prefix Lists of ACLs  
set Statements  
Demo - Specify Criteria to be Matched by Packet Length  
set ip next-hop Command  
Demo - Modify Matching Conditions using Set Statements  
set interface Command  
Demo - Set Conditions  
set ip default next-hop Command  
Demo - Set Commands used in PBR  
set default interface Command  
Demo - Specify the Next Hop IP Address for Matching Packets  
set ip tos Command  
Demo - Specify Interfaces Through which Packets Can be Routed  
set ip precedence Command

Demo - Specify a List of Default Next-Hop IP Addresses  
Configuring PBR on an Interface  
Demo - Specify a List of Default Interfaces  
Demo - Mark Packets Using the IP ToS Field  
Demo - Set the 3 IP Precedence Bits in the IP Packet Header  
Demo - Set IP Precedence Parameters  
Demo - Identify a Route Map to Use for Policy Routing on an Interface  
Demo - Various Methods to Verify PBR  
Lesson 5: Advanced Path Control Tools  
Cisco IOS Optimized Edge Routing  
Virtualization  
Cisco Wide Area Application Services (WAAS)  
Chapter 05 Summary

## **Chapter 06 - Implementing a Border Gateway Protocol Solution for ISP Connectivity**

1h 21m

Lesson 1: BGP Terminology, Concepts, and Operation  
EGP versus IGP  
Demo - EGP and IGP  
Autonomous Systems (AS)  
Demo - AS  
IANA  
Demo - IANA  
Demo - RIRs  
AS Numbers  
Demo - AS Numbers  
BGP  
Demo - Facts about BGP  
IGP versus BGP  
Connecting Enterprise Networks to an ISP  
Public IP Address Space  
Connection Redundancy  
BGP and Enterprise Networks  
Demo - BGP Neighbors  
BGP Path Vector Characteristics  
Demo - BGP Operational Overview  
When to Use BGP  
Demo - BGP Use between ASs  
When Not to Use BGP  
Demo - BGP and IGP  
BGP Synchronization  
Demo - Connecting Enterprise Networks to Internet Service Providers  
BGP Table  
BGP Tables  
Path Attributes  
Well-Known Mandatory: NEXT\_HOP  
Well-Known Mandatory: ORIGIN  
Well-Known Discretionary: LOCAL\_PREF  
Default Local Preference Configuration  
Well-Known Discretionary: ATOMIC\_AGGREGATE  
Optional Transitive: Community  
Optional Nontransitive: MED  
Cisco Weight Attribute  
Lesson 2: Configuring BGP  
Planning BGP Deployment  
Demo - Questions for Deploying Routing and Connection  
BGP Implementation

Demo - Public IP Address Space  
BGP Verification  
Demo - Configure Static Routes  
Documentation  
Demo - Configure the Default Local Preference  
Enabling BGP Routing  
Demo - Define BGP as the IP Routing Protocol  
Demo - Router BGP Command Parameters  
To Define BGP Neighbors  
Demo - Identify Peer Router to Establish a BGP Session  
To Define a BGP Peer Group  
Demo - Create a Peer Group  
Demo - Assign Neighbors as Part of the Peer Group  
To Shutdown a BGP Neighbor  
Demo - Disable an Existing BGP Neighbor or Peer Group Relationship  
IBGP Source IP Address Problem  
Demo - Establish the IBGP Session Using a Loopback Interface  
IBGP Source IP Address Solution  
Demo - IBGP Source IP  
Demo - Increase the TTL for EBGp Connections  
neighbor next-hop-self Command  
Demo - Configure the Router as the Next Hop for a BGP Speaking Peer  
BGP Synchronization  
To Identify BGP Networks  
BGP Authentication  
To Enable MD5 Authentication  
To Hard Reset BGP Sessions  
To Soft Reset Outbound  
Lesson 3: Verifying and Troubleshooting BGP  
For Verifying BGP  
Lesson 4: Basic BGP Path Manipulation Using Route Maps  
Configuring Route Maps in BGP  
To Match a BGP Autonomous System Path Access List  
To Specify the BGP Weight for the Routing Table  
To Specify a Preference Value for the AS Path  
BGP Path Manipulation  
To Change the Default Weight  
To Configure an Autonomous System ACL  
To Change the Default Local Preference for Outbound Routes  
Lesson 5: Filtering BGP Routing Updates  
BGP Routing Updates Filtering  
To Apply BGP Filters to Routes  
Planning BGP Filtering Using Prefix Lists  
Chapter 06 Summary

## **Chapter 07 - Implementing Routing Facilities for Branch Offices and Mobile Workers**

29m

Lesson 1: Planning the Branch Office Implementation  
Branch Office Challenges  
Branch Office Design Considerations  
The Thin Branch  
Broadband Technology Deployment  
Broadband Technologies  
Wireless Broadband  
Municipal WiFi  
WiMAX  
Satellite Internet



Broadband Cable  
Digital Subscriber Line (DSL)  
Verifying PPPoA  
Configure a NAT Pool  
Bind the ACL and NAT Pool  
Configure Static NAT  
Identify NAT Interfaces  
Create a Tunnel Interface  
Identify the GRE Tunnel Source  
Identify the GRE Tunnel Destination  
Identify the Tunnel Mode  
Demo - NAT  
Lesson 2: Planning for Mobile Worker Implementations  
Mobile Worker Connectivity  
Considerations for Enterprise Mobile Workers  
Business-Ready Mobile User Solution  
Business-Ready VPN Components  
Lesson 3: Routing Traffic to the Mobile Worker  
Easy VPN Server  
Routing Services for VPN Subnets  
Proxy ARP  
Remote Users Connections  
Chapter 07 Summary

## **Chapter 08 - Implementing IPv6 in the Enterprise Network**

1h 12m

Lesson 1: Introducing IPv6  
IPv6 Introduction  
IPv6 Features  
MTU Discovery  
New IPv6 Features  
IPv6 Address Specifics  
Abbreviating IPv6 Addresses  
Subnet Prefix  
Interface Identifiers  
Multiple IP Addresses per Interface  
Lesson 2: Configuring and Verifying IPv6 Unicast Addresses  
Enable IPv6 Routing  
Enable CEF for IPv6  
Enable IPv6 on an Interface  
Ethernet EUI-64 Address  
Enable IP Unnumbered  
Enable Stateless Auto-Configuration  
Alter the Neighbor Detection Parameter  
Add a Neighbor Router to the Neighbor Discovery Cache  
IPv6 Connectivity on FR Multipoint Links  
Lesson 3: Routing IPv6 Traffic  
IPv6 Routing  
Lesson 4: Configuring Static Routing  
Static Routing  
To Configure an IPv6 Static Route  
Static Routes Types  
RIPng  
To Enable an IPv6 RIP Process on an Interface  
To Configure the IPv6 RIP Routing Process  
To Disable Split Horizon Route Loop Prevention Feature  
Lesson 5: Configuring OSPFv3

The Protocol Implementation for IPv6 Includes these Characteristics

OSPFv3

Link-Local Addresses Are Used

Multiple OSPFv3 Instance Support

Security

LSA Types for IPv6

To Configure the OSPFv3 Routing Process Parameters

To Define the Router ID for OSPFv3

To Enable an OSPFv3 Instance on an Interface

To Specify the Cost of Sending a Packet on an Interface

To Change the OSPF Priority used in DR Elections

To Define an Area as a Stub or Totally-stub Area

To Summarize Routes at an Area Boundary

To Trigger a New SPF Recalculation and Repopulation of the RIB

Demo - OSPFv3

Lesson 6: Configuring EIGRP for IPv6

EIGRP for IPv6

To Configure the EIGRP for IPv6 Routing Process Parameters

To Define the Router ID of EIGRP for IPv6

To Enable the EIGRP for IPv6 Process

To Enable EIGRP for IPv6 on an Interface

To Identify the Router as a Stub Router

To Configure a Summary Aggregate Address for an Interface

Demo - EIGRP for IPv6

Lesson 7: Multiprotocol BGP (MP-BGP)

Multiprotocol BGP (MP-BGP)

To Configure the MBGP Routing Process Parameters

To Define the BGP Router ID

To Identify Peer BGP Routers

To Configure Routing Sessions that use Standard IPv6 Address Prefixes

To Identify Peer BGP Routers

To Configure Routing Sessions that use Standard IPv6 Address Prefixes

To Identify Peer BGP Routers (cont'd)

To Apply a Route Map to Filter Incoming or Outgoing MBGP Routes

Chapter 08 Summary

Course Closure

**Total Duration: 10h 8m**