ROUTE

Implementing Cisco IP Routing

Course Administration Guide

Version 1.0

Refer to Student Guides

Text Part Numbers: 97-2814-01, 97-2815-01, and 97-2816-01

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Course Management

Overview

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.

Outline

The Course Management section of the Course Administration Guide includes these topics:

- Overview
- Course Instruction Details
- Course Evaluations
- Lab Setup

Course Version

This is the original release of the course named *Implementing Cisco IP Routing* (ROUTE) v1.0.

Course Objectives

Upon completing this course, the student will be able to meet these overall objectives:

- 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, large-scale internetworks based on requirements.

- Identify, analyze, and match OSPF multiarea 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

Target Audience

The primary audience for this course is as follows:

- 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.

The secondary audience for this course is as follows:

- Any individual involved in implementation and verification of routing protocols in enterprise networks.

Student Skills and Knowledge

The knowledge and skills that a student must have before attending this course are as follows:

- Knowledge and skill level equal to Cisco CCNA® certification.

Note	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. This includes knowledge of and experience with the following technologies:
  - ICND1

    Upon completing the ICND1 course, you will be able to meet these objectives:

    - Describe how networks function, and identify major components, the functions of network components, and the OSI reference model
    - Using the host-to-host packet delivery process, describe issues related to increasing traffic on an Ethernet LAN and identify switched LAN technology solutions to Ethernet networking issues
    - Describe the reasons for extending the reach of a LAN, and the methods that can be used, with a focus on RF wireless access

- Describe the reasons for connecting networks with routers, and how routed networks transmit data using TCP/IP
- Describe the function of WANs and the major devices of WANs, and configure PPP encapsulation, static and dynamic routing, and Port Address Translation (PAT) and Routing Information Protocol (RIP) routing
- Use the CLI to discover neighbors on the network and manage router startup and configuration

— ICND2

Upon completing the ICND2 course, you will be able to meet these objectives:

- Review how to configure and troubleshoot a small network
- Expand a small-sized, switched LAN to a medium-sized LAN with multiple switches, supporting VLANs, trunking, and a spanning tree
- Describe routing concepts as they apply to a medium-sized network and discuss considerations when implementing routing on the network
- Configure, verify, and troubleshoot OSPF
- Configure, verify, and troubleshoot EIGRP
- Determine how to apply ACLs based on network requirements, and configure, verify, and troubleshoot ACLs on a medium-sized network
- Describe when to use NAT or PAT on a medium-sized network and configure NAT or PAT on routers, explain IPv6 addressing, and configure IPv6 in a Cisco router

Course Instruction Details

This topic provides the information that you need to prepare the course materials and set up the classroom environment.

Instructor Requirements

To teach this course, instructors must have attended the following training or completed the following requirements:

- Current Certified Cisco Systems Instructor (CCSI) in good standing
- Current BSCI 3.0 Certification
- Attendance in Route v1.0 TTT or sit the class
- Pass ROUTE exam 642-902

Note	Submit questions concerning instructor certification to icad@external.cisco.com.

If you have not taught BSCI v3.0 before and want to teach ROUTE v1.0, you must meet the following requirements:

- Be a CCSI in good standing.
- Attend the ROUTE v1.0 course.
- Become familiar with the course content and lab exercises.
- Pass the ROUTE v1.0 exam at the pass rate required of instructors. Learning Partners will be advised when the exam is scheduled for release.

Note	It is strongly recommended that an instructor practice and review all labs before teaching this class. Because there is typically not enough time during a standard class delivery to resolve all trouble tickets and because the labs are performed as a team exercise, it is recommended that the instructor practice the labs solo after attending the class, in order to get a full view of all the labs.

Classroom Reference Materials

These items should be available for the student during the course:

- Student Guide
- Lab Guide
- Office supplies, such as paper, pen, pencils, and sticky notes

Class Environment

This information describes the equipment needed for classroom setup:

- A standard classroom with chairs and tables to accommodate all the students, preferably with tables and chairs arranged so that it is easy to form teams of two students working together

- One laptop or desktop PC per student
- Whiteboard or flip chart or both
- Projector to display the course slides
- Projection screen as, necessary
- For local labs: sufficient floor space, racks, and power for all equipment
- For remote labs: Internet access for all students and the instructor

Course Flow

In the following pages you will find the suggested course schedule. Adjustments can be made based on the skills, knowledge, and preferences of the attendees. The presentation of all topics is optional for noncertification offerings, but you are encouraged to use them because they are designed to reinforce the lesson concepts, technology, configuration, and verification steps, and to ensure that students apply some of the concepts in the labs.

Day 1: Planning Routing Services to Requirements and Implementing an EIGRP-Based Solution

9:00–9:30 (0900–0930)	**Course Introduction**
9:30–9:50 (0930–0950)	Lesson 1-1: Assessing Complex Enterprise Network Requirements
9:50–10:10 (0950–1010)	Lesson 1-2: Creating an Implementation Plan and Documenting the Implementation
10:10–10:25 (1010–1025)	Break
10:25–11:15 (1025–1115)	Lab 1-1: Assess Skills for Implementing Complex Networks
11:15–11:30 (1115–1130)	Lesson 1-3: Lab 1-1 Debrief
11:30–12:00 (1130–1200)	Lesson 2-1: Planning Routing Implementations with EIGRP
12:00–1:00 (1200–1300)	**Lunch**
1:00–1:50 (1300–1350)	Lesson 2-2: Implementing and Verifying Basic EIGRP for the Enterprise LAN Architecture
1:50–2:50 (1350–1450)	Lab 2-1: Configure and Verify EIGRP Operations
2:50–3:05 (1450–1505)	Lesson 2-3: Lab 2-1 Debrief
3:05–3:20 (1505–1520)	**Break**
3:20–4:00 (1520–1600)	Lesson 2-4: Configuring and Verifying EIGRP for the Enterprise WAN Architecture
4:00–5:00 (1600–1700)	Lab 2-2: Configure and Verify EIGRP Circuit Emulation, and Frame Relay Operations
5:00–5:15 (1700–1715)	Lesson 2-5: Lab 2-2 Debrief
5:15 (1715)	**Day ends**

Day 2: Implementing an EIGRP-Based Solution and Implementing a Scalable Multiarea Network OSPF-Based Solution

9:00–9:15 (0900–0915)	**Review of Day 1**
9:15–9:35 (0915–0935)	Lesson 2-6: Implementing and Verifying EIGRP Authentication
9:35–10:15 (935–1015)	Lab 2-3: Configure and Verify EIGRP Authentication
10:15–10:30 (1015–1030)	Lesson 2-7: Lab 2-3 Debrief
10:30–10:45 (1030–1045)	**Break**
10:45–12:15 (1045–1215)	Lesson 2-8: Advanced EIGRP Features in an Enterprise Network
12:15–1:15 (1215–1315)	**Lunch**
1:15–2:20 (1315–1420)	Lab 2-4: Implement and Verify EIGRP Operations
2:20–2:35 (1420–1435)	Lesson 2-9: Lab 2-4 Debrief
2:35–3:25 (1435–1525)	Lesson 3-1: Planning Routing Implementations with OSPF as the Scalable Routing Protocol
3:25–3:40 (1525–1540)	**Break**
3:40–4:20 (1540–1620)	Lesson 3-2: How OSPF Packet Processes Work
4:20 (1620)	**Day ends**

Day 3: Implementing a Scalable Multiarea Network OSPF-Based Solution

9:00–9:15 (0900–0915)	**Review of Day 2**
9:15–10:05 (0915–1005)	Lesson 3-3: Improving Routing Performance in a Complex Enterprise Network
10:05–10:55 (1005–1055)	Lesson 3-4: Configuring and Verifying OSPF Routing
10:55–11:10 (1055–1110)	**Break**
11:10–11:50 (1110–1150)	Lesson 3-4: Configuring and Verifying OSPF Routing
11:50–12:50 (1150–1250)	**Lunch**
12:50–1:45 (1250–1345)	Lab 3-1: Configure and Verify OSPF to Improve Routing Performance
1:45–2:00 (1345–1400)	Lesson 3-5: Lab 3-1 Debrief
2:00–2:50 (1400–1450)	Lab 3-2: Implement and Verify OSPF Multiarea Routing
2:50–3:05 (1450–1505)	Lesson 3-6: Lab 3-2 Debrief

3:05–3:20 (1505–1520)	Break
3:20–3:45 (1520–1545)	Lesson 3-7: Configuring and Verifying OSPF Route Summarization
3:45–4:45 (1545–1645)	Lab 3-3: Configure and Verify OSPF Route Summarization for Interarea and External Routes
4:45–5:00 (1645–1700)	Lesson 3-8: Lab 3-3 Debrief
5:00 (1700)	**Day ends**

Day 4: Implementing a Scalable Multiarea Network OSPF-Based Solution; Implementing an IPv4-Based Redistribution Solution; and Implementing Path Control

9:00–9:15 (0900–0915)	**Review of Day 3**
9:15–10:00 (0915–1000)	Lesson 3-9: Configuring and Verifying OSPF Special Area Types
10:00–11:00 (1000–1100)	Lab 3-4: Configure and Verify OSPF Special Area Types
11:00–11:15 (1100–1115)	Lesson 3-10: Lab 3-4 Debrief
11:15–11:30 (1115–1130)	Break
11:30–12:00 (1130–1200)	Lesson 3-11: Configuring and Verifying OSPF Authentication
12:00–1:00 (1200–1300)	**Lunch**
1:00–1:40 (1300–1340)	Lab 3-5: Configure and Verify OSPF Authentication
1:40–1:55 (1340–1355)	Lesson 3-12: Lab 3-5 Debrief
1:55–2:40 (1355–1440)	Lesson 4-1: Assessing Network Routing Performance and Security Issues
2:40–3:20 (1440–1520)	Lesson 4-2: Operating a Network Using Multiple IP Routing Protocols
3:20–3:35 (1520–1535)	**Break**
3:35–4:20 (1535–1620)	Lesson 4-3: Configuring and verifying Route Redistribution
2:35–3:25 (1435–1525)	Lab 4-1: Configure Route Redistribution Between Multiple IP Routing Protocols
3:25–3:40 (1525–1540)	Lesson 4-4: Lab 4-1 Debrief
3:40–4:10 (1540–1610)	Lesson 5-1: Assessing Path Control Network Performance Issues
4:10–5:00 (1610–1700)	Lab 5-1: Configure and Verify Path Control Between Multiple IP Routing Protocols
5:00–5:15 (1700–1715)	Lesson 5-2: Lab 5-1 Debrief
5:15–5:20 (1715–1720)	Lesson 5-3: References to additional Path Control in E-Learning

5:20 (1720)	**Day ends**

Day 5: Connecting an Enterprise Network to ISP Networks

9:00–9:15 (0900–0915)	**Review of Day 4**
9:15–9:50 (0915–0950)	Lesson 6-1: Planning the Enterprise-to-ISP Connection
9:50–10:25 (0950–1025)	Lesson 6-2: Considering the Advantages of Using BGP
10:25–10:40 (1025–1040)	**Break**
10:40–11:15 (1040–1115)	Lesson 6-3: Comparing the Functions and Uses of EBGP and IBGP
11:15–12:05 (1115–1205)	Lesson 6-4: Configuring and Verifying Basic BGP Operations
12:05–1:05 (1205–1305)	**Lunch**
1:05–2:00 (1305–1400)	Lab 6-1: Configure BGP Operations
2:00–2:15 (1400–1415)	Lesson 6-5: Lab 6-1 Debrief
2:15–3:15 (1415–1515)	Lesson 6-6: Using the BGP Attributes and Path Selection Process
3:15–3:30 (1515–1530)	**Break**
3:30–4:25 (1530–1625)	Lab 6-2: Manipulate EBGP Path Selections
4:25–4:40 (1625–1640)	Lesson 6-7: Lab 6-2 Debrief
4:40–4:45 (1640–1645)	Lesson 6-8: E-Learning Training on IPv6 and Routing for Branch Offices and Remote Workers
4:45–5:00 (1645–1700)	**Wrap-up**

Instructor Notes

The ROUTE course was designed to support job tasks of network engineers and written in a manner that is designed to give the best learning experience. Additional instructor notes are as follows.

General Notes

- The content of the course is oriented to support the job tasks of network engineers working in enterprise networks. All the modules and lessons are adapted to these requirements.
- Two of the more important tasks for the network engineer are the creation of the implementation and verification plans to support the implementation of a solution. The ROUTE course teaches the basic concepts for creating typical implementation and verification plans. Additionally, all lessons teaching configuration and verification skills present a step-by-step approach to implementing the solution and reinforce the value of implementation and verification plan creation.

- Instructors should not teach the whole syntax and every keyword of the commands presented in the course. Job tasks and the structure of the configuration commands presented in the course are based on real examples. If additional information is needed, the Student Guide suggests where additional information can be found.
- Labs support the theoretical concepts and the step-by-step configuration tasks learned during the presentation. The first lab is used to teach the importance of the implementation and verification plan as well as to discover the lab environment provided by the Cisco Learning Partner. In the first lab, students must go through the process of creating the implementation and verification plan as suggested by Cisco recommended practices. In all other labs, the implementation and verification plan is part of the lab but the purpose of this step in every lab is not to spend all the lab time in creating the perfect plan. It is used to guide the students through the process for creating the implementation and verification plan, which can be as short as a few bullets or as long as the detailed list of step-by-step tasks.
- An essential element of each lab is the lab debrief lesson that follows each lab. These lessons have been included in the Student Guide, but should not be treated as traditional lectures. They are intended as a means to facilitate a discussion about the student's experiences in the lab. The instructor should use these lessons to review the solution and to trigger a discussion about the methods that different students used to complete all the lab tasks, the solutions they found, possible alternative solutions, the tools they used, and other relevant experiences from the labs. The objective of the lab debrief is for each student to evaluate their performance and to learn from the experiences of other students participating in the lab to improve their process. Also, the lab debriefs serve as a tool for the instructor to verify that that the students did not miss any of the important lessons that could be learned from the lab. The role of the instructor is to facilitate and lead these discussions and to provide feedback on the performance of each of the teams.
- Students should bring their own laptops if the classroom is not providing the PC computers for connection to the lab. Please verify the setup of PC computers in the classroom in order comply with the provider of the labs for the ROUTE course each time. Some solutions for labs require a correct version of java or other specific items.
- The ROUTE course is divided into ILT and ELT parts. Both parts are included in the ROUTE exam and the instructor should point out that the ELT portion exists and its importance.

Content Notes

- Module 1
  - Lesson 1: The purpose of this lesson is to establish that networks are built around an architecture that is influenced by hardware and application requirements. Cisco Service-Oriented Network Architecture (SONA) is presented as an example of network architecture. It is not the intention of this lesson to present a detailed, lengthy discussion of the pros and cons of SONA.
  - Lesson 2: This lesson describes the requirements of the enterprise network, implementation plan, and documentation of the implementation process and its results. The intent of this lesson is to establish the need for planning an implementation before starting the configuration tasks and documenting the results during the implementation and at its completion. Sample implementation and verification plans are provided as examples. The instructor should highlight that these plans are simply examples. As the student will see in the labs, some plans can be complicated and detailed, while others require just a few notes. In the end, the

actual plans and documentation the engineers will use on the job will be defined by their organizations.

- Lesson 3: no special comments.
- Lab 1-1: From a learning perspective, it is important that the student complete the resource and implementation plan before starting the physical lab. To this end, it is suggested that the instructor does not provide the lab login information until after the student has completed the preparatory work.

- Module 2
  - Lesson 1: no special comments.
  - Lesson 2: no special comments.
  - Lesson 3: During this debrief the instructor should reinforce the need for the implementation and verification plans by posing questions such as the following:
    1. How did you know what information you needed?
    2. How did you know that you had completed all of the required tasks?
    3. How did you know you were successful?
  - Lesson 4: no special comments.
  - Lesson 5: During this debriefing, the instructor should reinforce the need for an implementation and verification plan. However, by this point the students will most likely be setting their own expectations as to how much detail is needed. The instructor should allow the students to present differing approaches. The instructor should then highlight that any approach that successfully meets company requirements is acceptable .
  - Lesson 6: no special comments.
  - Lesson 7: no special comments.
  - Lesson 8: no special comments.
  - Lesson 9: Allow the students to explain how they isolated the issue. Encourage the student to indentify alternate methods.
  - Lab 2-1: The student should be encouraged to complete the implementation and verification plan before starting the actual configuration task; however, the actual level is left to their discretion.
  - Lab 2-2: No special comments.
  - Lab 2-3: This is a very short lab. It is expected that the student will have a very short or no implementation plan.
  - Lab 2-4: This lab involves isolating issues related to a recent implementation. The instruction should lay the groundwork before the students start the lab. Point out the following types of things:
    4. This is a verification lab, not an implementation lab.
    5. There is no implementation plan. Instead, there is a troubleshooting log that the student can use.

- Module 3
  - Lesson 1: no special comments.
  - Lesson 2: no special comments.

- Lesson 3: no special comments.
- Lesson 4: no special comments.
- Lesson 5: no special comments.
- Lesson 6: no special comments.
- Lesson 7: no special comments.
- Lesson 8: no special comments.
- Lesson 9: no special comments.
- Lesson 10: no special comments.
- Lesson 11: no special comments
- Labs: no special comments.

- Module 4:
  - Lesson 1: no special comments.
  - Lesson 2: no special comments.
  - Lesson 3: no special comments.
  - Lesson 4: no special comments.
  - Labs: no special comments.
- Module 5:
  - Lesson 1: no special comments.
  - Lesson 2: no special comments.
  - Labs: no special comments.
  - Lesson 3: Additional e-learning is provided on this concept. The instructor should ensure that students have the CD containing the content and that the students know how to access the content. The instructor should perform a short demonstration. Also ensure that students know that if they are pursuing the CCNP certification, the e-learning content may appear on the exam.
- Module 6: This module introduces students to BGP. It is not intended to be a complete and detailed coverage of all BGP capabilities. Rather, it focuses on the knowledge that the network engineer needs to support BGP in an enterprise network.
  - Lesson 1: no special comments.
  - Lesson 2: no special comments.
  - Lesson 4: no special comments.
  - Lesson 5: no special comments.
  - Lesson 6: no special comments.
  - Lesson 7: no special comments.
  - Labs: no special comments.
- "Implementing IPv6": This is an e-learning module that provides the network engineer with a working knowledge of IPv6 implementations. The instructor should ensure that students know that the content is available. Also ensure that students know that if they are pursuing the CCNP certification, the e-learning content may appear on the exam.

- "Implementing Routing Facilities for Branch Offices and Mobile Workers": This is an e-learning module that provides the network engineer with a working knowledge of implementations for branch offices and mobile workers. The instructor should ensure that students know that the content is available. Also ensure that students know that if they are pursuing the CCNP certification, the e-learning content may appear on the exam.

High-Level Course Outline

This subtopic provides an overview of how the course is organized. The course contains these components:

- Course Introduction
- Planning Routing Services to Requirements
- Lab 1-1: Assess Skills for Implementing Complex Networks
- Implementing an EIGRP-Based Solution
- Lab 2-1: Configure and Verify EIGRP Operations
- Lab 2-2: Configure and Verify EIGRP Circuit Emulation and Frame Relay Operations
- Lab 2-3: Configure and Verify EIGRP Authentication
- Lab 2-4: Implement and Verify EIGRP operations
- Implementing a Scalable Multiarea Network OSPF-Based Solution
- Lab 3-1: Configure and Verify OSPF to Improve Routing Performance
- Lab 3-2: Implement and Verify OSPF Multiarea Routing
- Lab 3-3: Configure and Verify OSPF Route Summarization for Interarea and External Routes
- Lab 3-4: Configure and Verify OSPF Special Area Types
- Lab 3-5: Configure and Verify OSPF Authentication
- Implementing an IPv4-Based Redistribution Solution
- Lab 4-1: Configure Route Redistribution Between Multiple IP Routing Protocols
- Implementing Path Control
- Lab 5-1: Configure and Verify Path Control Between Multiple IP Routing Protocols
- Connection of an Enterprise Network to an ISP Network
- Lab 6-1: Configure BGP Operations
- Lab 6-2: Manipulate EBGP Path Selections

Detailed Course Outline

This in-depth outline of the course structure lists each module, lesson, and topic.

Course Introduction

The Course Introduction provides students with the course objectives and prerequisite student skills and knowledge. The Course Introduction presents the course flow diagram and the icons that are used in the course illustrations and figures. This course component also describes the curriculum for this course, providing students with the information that they need to make decisions regarding their specific learning path.

- Overview
  - Student Skills and Knowledge
- Course Goal and Objectives
- Course Flow
- Additional References
  - Cisco Glossary of Terms
- Your Training Curriculum
- General Administration

Module 1: Planning Routing Services to Requirements

Objective: Students should be able to describe the converged network requirements of various network and networked applications within the Cisco network architectures. Then use this information to identify the typical information that should be collected when planning an implementation and contained in an implementation plan.

Lesson 1: Assessing Complex Enterprise Network Requirements

Objective: Identify the distinctive business and technical requirements of complex Enterprise networks (comparing to the simpler networks of CCNA)

Enabling Objectives:

- 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

Objective: Assess a provided network design and create an implementation plan by selecting the proper tools and resources as well as planning of work.

Enabling Objectives:

- 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.
-

Lab 1-1: Assess Skills for Implementing Complex Networks

Objective: Review student skills and knowledge from ICND2 and assess readiness for the job tasks needed to implement and operation Lay 3 functions in a complex enterprise network.

Lesson 3: Lab 1-1 Debrief

This lesson explains gathering of network requirements and required data. You will be able to create implementation plan, verify it, and document the whole process. Upon completing this lesson the student will be able to meet these objectives:

- Describe the lab topology and identify the implementation and verification tasks
- Present a sample solution and identify possible alternative solutions

Module 2: Implementing an EIGRP based Solution

Objective: Implement an EIGRP based solution according to a given network design and requirements.

Lesson 1: Planning Routing Implementations with EIGRP

Objective: Given a network design and business and technical requirements and constraints, identify the technologies, components and metrics of EIGRP to implement routing in diverse, large-scale internetworks. Select correct commands, tools and steps used to configure and verify basic EIGRP implementation.

Enabling Objectives:

- 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

Objective: Configure EIGRP according to a given implementation plan and set of requirements by applying the planned implementation processes using Cisco IOS commands and applications in the correct and verify that the configuration was correctly implemented

Enabling Objectives:

- 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

Lab 2-1: Configure and Verify EIGRP Operations

Lab Objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure basic EIGRP operations
- Organize the tasks into an implementation plan to implement EIGRP functions

- Implement the identified EIGRP solution to configure basic EIGRP functions in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct Operation
- Document implementation, operations and maintenance

Lesson 3: Lab 2-1 Debrief

This lesson explains how to configure and verify EIGRP operations. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for basic EIGRP configuration and how to influence the EIGRP path selection
- Present a sample solution and identify possible alternative solutions

Lesson 4: Configuring and Verifying EIGRP for the Enterprise WAN Architecture

Objective: Configure EIGRP over circuit emulation, and Frame Relay for given operational performance by applying the planned implementation processes using correct Cisco IOS commands and applications. Verify that the configuration was correctly implemented and is performing with the desired effects.

Enabling Objectives:

- 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

Lab 2-2: Configure and Verify EIGRP Circuit Emulation, and Frame Relay Operations

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure EIGRP circuit emulation, and Frame Relay operations
- Organize the tasks into an implementation plan to implement EIGRP functions
- Implement the identified EIGRP solution to EIGRP circuit emulation, and Frame Relay operations in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct Operation Document implementation, operations and maintenance
- Compare performance improvements to expectations

Lesson 5: Lab 2-2 Debrief

This lesson explains how to configure and verify EIGRP circuit emulation and Frame Relay operations. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for basic EIGRP configuration and how to influence EIGRP path selection
- Present a sample solution and identify possible alternative solutions

Lesson 6: Implementing and Verifying EIGRP Authentication

Objective: Implement and Verify authentication in an EIGRP network

Enabling objectives:

- Evaluate router authentication
- Describe the Message Digest 5 (MD5) authentication used in EIGRP
- Configure MD5 authentication
- Troubleshoot MD5 authentication

Lab 2-3: Configure and Verify EIGRP Authentication

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure basic EIGRP authentication
- Organize the tasks into an implementation plan to implement EIGRP authentication
- Implement the identified EIGRP solution to configure basic EIGRP authentication in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria

- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct Operation Document implementation, operations and maintenance

Lesson 7: Lab 2-3 Debrief

This lesson explains how to configure and verify EIGRP authentication. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for EIGRP authentication over LAN and WAN interfaces
- Present a sample solution and identify possible alternative solutions

Lesson 8: Advanced EIGRP Features in an Enterprise Network

Objective: Implement advanced EIGRP features in an Enterprise Network.

Enabling Objectives:

- 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

Lab 2-4: Implement and Verify EIGRP Operations

Lab objectives: Given a campus EIGRP implementation in a large enterprise network and performance specifications and expectations of the EIGRP operations:

- Develop a work plan to troubleshoot configuration and security issues.
- Isolate the issues
- Correct all of the identified issues
- Test the fixes made
- Document and report the troubleshooting procedures, findings and recommendations

Lesson 9: Lab 2-4 Debrief

This lesson explains how to implement and troubleshoot EIGRP operations to solve EIGRP adjacency and limited connectivity. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation, verification, and troubleshooting tasks for EIGRP operations to solve adjacency and connectivity issues
- Present a sample solution and identify possible alternative solutions

Module 3: Implementing a Scalable Multiarea Network OSPF Based Solution

Objective: Configure and verify a scalable multiarea network with OSPF.

Lesson 1: Planning Routing Implementations with OSPF as Scalable Routing Protocol

Objective: Identify, analyze and match OSPF multiarea routing functions and benefits for routing efficiencies in network operations in a complex enterprise network.

Enabling Objectives:

- 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

Objective: Demonstrate how OSPF improves packet processes in a multiarea enterprise network.

Enabling Objectives:

- 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

Objective: Configure OSPF to improve routing performance in a complex enterprise network.

Enabling Objectives:

- 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 subinterfaces 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

Objective: Given a network design, configure OSPF multiarea routing to improve network operations to performance expectations.

Enabling Objectives:

- 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 multiarea OSPF operations
- Verify basic multiarea 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

Lab 3-1: Configure and Verify OSPF to Improve Routing Performance

Lab objective: Given a network design and performance expectations, configure and verify OSPF routing performance improvements.

Lesson 5: Lab 3-1 Debrief

This lesson describes how to implement and verify OSPF to improve routing performance. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation, verification, and troubleshooting tasks for OSPF operations over LAN and WAN interfaces with different Frame Relay WAN segment representations
- Present a sample solution and identify possible alternative solutions

Lab 3-2: Implement and Verify OSPF Multiarea Routing

Lab objectives: Given a network design and performance expectations, configure and verify OSPF multiarea routing functions:

- Select the required tools and commands to configure OSPF multiarea routing functions
- Organize the tasks into an implementation plan to implement OSPF multiarea routing functions
- Implement the identified OSPF solution to configure basic OSPF multiarea routing functions in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance
- Compare and report performance improvements to expectations

Lesson 6: Lab 3-2 Debrief

This lesson describes how to implement and verify OSPF multiarea routing. Additionally, it describes how to manipulate cost, router ID, and routing updates in order to optimize the OSPF implementation. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation, verification and troubleshooting tasks for OSPF operations in multiarea over LAN and WAN interfaces with different Frame Relay WAN segment representations
- Present a sample solution and identify possible alternative solutions

Lesson 7: Configuring and Verifying OSPF Route Summarization

Objective: Configure OSPF route summarization for interarea and external routes.

Enabling Objectives:

- Describe the functions of interarea 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

Lab 3-3: Configure and Verify OSPF Route Summarization for Interarea and External Routes

Lab objectives: Given a network design and performance expectations, configure and verify OSPF route summarization:

- Select the required tools and commands to configure route summarization
- Organize the tasks into an implementation plan to implement route summarization
- Implement the identified OSPF solution to configure route summarization in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network

- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance
- Compare and report performance improvements to expectations

Lesson 8: Lab 3-3 Debrief

This lesson describes how to implement and verify OSPF route summarization for interarea and external routes. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation, verification, and troubleshooting tasks for OSPF route summarization for interarea and external routes
- Present a sample solution and identify possible alternative solutions

Lesson 9: Configuring and Verifying OSPF Special Area Types

Objective: Configure and verify OSPF area parameters including stub, not-so-stubby area (NSSA), and totally stubby areas.

Enabling Objectives:

- 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

Lab 3-4: Configure and Verify OSPF Special Area Types

Lab objectives: Given a network design and performance expectations, configure and verify OSPF special area functions:

- Select the required tools and commands to configure OSPF special area types
- Organize the tasks into an implementation plan to implement OSPF special area types
- Implement the identified OSFP solution to configure OSPF special area types the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance

Lesson 10: Lab 3-4 Debrief

This lesson describes how to implement and verify OSPF special area types. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for implementing the OSPF special area types including stub, totally-stubby, and totally not-so-stubby area (NSSA)
- Present a sample solution and identify possible alternative solutions

Lesson 11: Configuring and Verifying OSPF Authentication

Objective: Implement authentication in an OSPF network.

Enabling Objectives:

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

Lab 3-5: Configure and Verify OSPF Authentication

Lab objectives: Given a network design and performance expectations, configure and verify OSPF Authentication:

- Select the required tools and commands to configure OSPF Authentication
- Organize the tasks into an implementation plan to implement OSPF Authentication
- Implement the identified SOPF solution to configure route summarization in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct Operation Document implementation, operations and maintenance
- Compare and report performance improvements to expectations
- Develop a work plan to troubleshoot
- Assemble tools, applications and resources to troubleshoot
- Isolate the issues
- Correct all of the identified issues
- Test the fixes made
- Document and report the troubleshooting procedures, findings and recommendations

Lesson 12: Lab 3-5 Debrief

This lesson describes how to implement and verify OSPF authentication. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for implementing OSPF authentication
- Present a sample solution and identify possible alternative solution

Module 4: Implement an IPv4-based Redistribution Solution

Objective: Implement a Redistribution Solution in a Multi-protocol Network that uses IOS features to control path selection and loop free topology according to a given network design and requirements.

Lesson 1: Assessing Network Routing Performance and Security Issues

Objective: Evaluate common network performance issues caused by routing update inefficiencies and describe the tools used during redistribution

Enabling Objectives:

- 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

Objective: Identify what pre-defined network infrastructure resources are needed to best provide a Redistribution Solution in a Multi-protocol Network to a given set of network requirements. Create a distribution and loop map for a given network to redistribute routes between multiple protocols.

Enabling Objectives:

- 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

Objective: Configure route redistribution between multiple IP routing protocols.

Enabling Objectives:

- 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

Lab 4-1: Configure Route Redistribution Between Multiple IP Routing Protocols

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to improve routing through route redistribution in multiple protocols
- Organize the tasks into an implementation plan to improve routing through route redistribution in multiple protocols
- Implement the identified to improve routing through route redistribution in multiple protocols in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance
- Compare and report performance improvements to expectations

Lesson 4: Lab 4-1 Debrief

This lesson describes how to configure redistribution between multiple routing protocols as well as implement filtering of routes. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for implementing the redistribution between OSPF and EIGRP and OSPF and RIPv2 protocols
- Present a sample solution and identify possible alternative solutions

Module 5: Implementing Path Control

Objective: Implement a Layer 3 Path Control Solution.

Lesson 1: Assessing Path Control Network Performance Issues

Objective: Evaluate common network performance issues caused by inefficient control of path selection and identify what resources are needed to best provide a layer 3 solution that uses IOS features to control path selection to a given set of network requirements.

Enabling Objectives:

- 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

Lab 5-1: Configure and Verify Path Control between Multiple IP Routing Protocols

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure path control
- Organize the tasks into an implementation plan to implement path control functions
- Implement the identified EIGRP solution to configure path control functions in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance
- Compare and report performance improvements to expectations

Lesson 2: Lab 5-1 Debrief

This lesson explains destination-based forwarding, as well as how to configure path control using PBR tool. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks for manipulating the path for a selection of the packets traveling across the network
- Present a sample solution and identify possible alternative solutions

Lesson 3: References to additional Path Control in E-Learning

Objective: Direct to the E-Learning products that teach configuring Path Control through other methods.

ROUTE-01 of 3: Implement Path Control

Objective: Implement Route Control using alternate methods

ROUTE-01 Lesson 1: Parallel processes when implementing Path Control

Objective: Compare Path Control process for other methods to ROUTE course methods

ROUTE-01 Lesson 2: Directed Demo of Procedures to Implement Path Control by Other Methods

Objective: Demonstrate the process to implement Path Control by other methods

ROUTE-01 Lesson 3: Self-Check Assessment

Objective: Assess mastery of Implementing Path Control by Other Methods

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

Objective: Implement a layer 3 solution using BGP to connect an enterprise to a service provider using EBGP.

Lesson 1: Planning the Enterprise-to-ISP Connection

Objective: Justify the components and methods used to connect an enterprise network to an ISP.

Enabling Objectives:

- 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
  - Multihomed
  - Dual-multihomed

Lesson 2: Considering the Advantages of Using BGP

Objective: Match BGP functionality to advantages to the benefits of using BGP to connect an enterprise network to ISPs.

Enabling Objectives:

- 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 multihoming 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

Objective: Compare and contrast the requirements for establishing EBGP to IBGP neighbor relationships.

Enabling Objectives:

- 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

Objective: Given an enterprise network and ISP specifications for connection, implement BGP operations.

Enabling Objectives:

- 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

Lab 6-1: Configure BGP Operations

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure EBGP operations
- Organize the tasks into an implementation plan to implement EIGRP functions
- Implement the identified EBGP solution to configure basic EBGP functions in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network
- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance

Lesson 5: Lab 6-1 Debrief

This lesson explains lab topology, configure BGP operations, create checkpoints for configuration and verification, and find alternative solutions. Upon completing this lesson the student will be able to meet these objectives:

- Compare your solution, findings, and action log against a set of checkpoints provided by the instructor and identify common and alternative solutions.
- Consolidate the lessons learned during the review discussions into a set of best practice methods and commands to aid you in future troubleshooting procedures.

Lesson 6: Using the BGP Attributes and Path Selection Process

Objective: Configure and verify BGP operations in a multihomed environment using the BGP attributes and route maps to control inbound and outbound path selection for all EBGP routes from the router

Enabling Objectives:

- 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

Lab 6-2: Manipulate EBGP Path Selections

Lab objectives: For a provided layer 3 network design and predefined infrastructure:

- Select the required tools and commands to configure EBGP path selections
- Organize the tasks into an implementation plan to implement VS
- Implement the identified EBGP solution to configure EBGP in the provided network according to the implementation plan, using Cisco IOS commands and applications in the correct order to the selected devices and portions of the network

- Write a verification and test plan to verify correct implementation and operation according to the expected performance criteria
- Verify the implementation according to the verification plan, using the appropriate show and debug commands and applications to verify correct operation
- Document implementation, operations and maintenance

Lesson 7: Lab 6-2 Debrief

This lesson explains the lab topology, configuration of BGP path manipulation using a local preference and the MED BGP attributes, creation of check points for configuration, verification, and alternative solutions. Upon completing this lesson the student will be able to meet these objectives:

- Identify the implementation and verification tasks to establish BGP adjacency in the network and manipulate the BGP path using local preference and MED BGP attributes
- Present the sample solution and identify possible alternative solutions

Lesson 8: E-Learning Training on IPv6 and Routing for Branch Offices and Remote Workers

Objective: Refer to E-Learning products that teach implementing IPv6 and provide information how to plan and implement routing facilities for Branch Offices and Mobile Workers.

- Route-02: Implementing IPv6

  Objective: Implement IPv6 with multiple protocols and with IPv4.

  — Lesson 1: IPv6 Addressing and Unicast

    Objective: Specify IPv6 addressing and implement Unicast in IPv6.

  — Lesson 2: Implementing RIPng, OSPFv3, EIGRP and Redistribution in IPv6

    Objective: Implement RIPng, OSPFv3, EIRGP and Redistribution in IPv6

  — Lesson 3: IPv6 Transition Techniques

    Objective: Plan transition to IPv6.

  — Lesson 4: NAT and PAT with IPv6

    Objective: Configure IPv6 for NAT and PAT functionality.

- ROUTE-03: Implementing Routing Facilities for Branch Offices and Mobile Workers

  Objective: Plan and implement routing facilities for Branch Offices and Mobile Workers.

  — Lesson 1: Analyzing Branch Office Designs and Planning for Branch Office Installations

    Objective: Analyze branch office designs for special facilities and connections as well as Create implementation plans for standard and update implementations of Branch Offices.

  — 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

Objective: Debrief/Evaluate the Lab planning, procedures, verification, etc.

— Lesson 4: Analyzing Mobile Workers Designs and Planning for Mobile Workers Installations

Objective: Analyze Mobile Workers designs for special facilities and connections as well as Create implementation plans for standard and update implementations of Mobile Workers.

— 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

Objective: Debrief/Evaluate the Lab 02-2 planning, procedures, verification, etc.

— Lesson 7: Self-Check Assessment

Objective: Assess Mastery of Module

Sources for ROUTE Course Information

This section provides a summary of the information from previous Cisco CCNP courses, *Building Scalable Cisco Internetworks* (BSCI) v3.0, *Implementing Secure Converged Wide Area Networks* (ISCW) v1.0, and *Cptimizing Converged Cisco Networks* (ONT) v1.0, that contributed to the development of *Implementing Cisco lP Routing* (ROUTE) v1.0.

Executive Summary

Overview

The *Implementing Cisco lP Routing* course is designed to provide professionals working with medium to large networks 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. A summary of the changes is listed in the module content comparison table here.

Module Content Comparison

This table provides a high-level summary of sources for this course.

ROUTE v1.0 (Updated)	**BSCI v3.0, ISCW v1.0, or ONT v1.0 (Previous)**	
ROUTE	**Source**	**Source Course and Module**
Module 1: Planning Routing Services **Maintenance Processes and Procedures**	New content	New development of all network engineer job tasks and processes, soft skills, and collaboration with operations and specialists
	BSCI	**BSCI Module 1, Network Requirements**
	ONT	**ONT Module 1, Describe Network Requirements**
	ISCW	**ISCW Module 1, Network Connectivity Requirements**
Module 2: Implementing an EIGRP-Based Solution	**BSCI**	**BSCI Module 2, Configuring EIGRP**
	New content	Added new "Advanced Features" content
Module 3: Implementing a Scalable Multiarea Network OSPF-Based Solution	**BSCI**	**BSCI Module 3, Configuring OSPF**
Module 4: Implementing an IPv4-Based Redistribution Solution	Redesign and new content	Redesigned and expanded content and extended to IPv6
	BSCI	**BSCI Module 5, Manipulating Routing Updates**
Module 5: Implementing Path Control	**BSCI**	**BSCI Module 5, Manipulating Routing Updates**

ROUTE v1.0 (Updated)	BSCI v3.0, ISCW v1.0, or ONT v1.0 (Previous)	
ROUTE	**Source**	**Source Course and Module**
ROUTE e-learning, 1 of 3: Implementing Path Control	New content	New content developed to give students practice in alternate methods of path control
	BSCI	**BSCI Module 5, Manipulating Routing Updates**
Module 6: Connecting an Enterprise Network to ISP Networks Lesson 1: Planning the Enterprise–to-ISP Connection Lesson 2: Considering the Advantages of Using BGP Lesson 3: Comparing the Functions and Uses of EBGP and IBGP Lesson 4: Configuring and Verifying Basic BGP Operations Lesson 6: Using the BGP Attributes and Path Selection Process	Edited to job scope	Focus on eBGP
	BSCI	**BSCI Module 6, Implementing BGP**
ROUTE e-learning 2 of 3: Implementing IPv6	**Cisco 360 CCIE Routing and Switching**	**Cisco 360 Routing and Switching**
	BSCI	**BSCI Module 8, Implementing IPv6**
ROUTE e-learning 3 of 3: Implementing Routing Facilities for Branch Offices and Mobile Workers	New content	New content and case studies developed to give students practice in integrating routing and switching features and providing features for mobile workers and for voice and video services
	BCMSN	**BCMSN Module 6, Wireless LANs**
	ONT	**ONT Module 6, Implement Wireless Scalability**
	ONT	**ONT Module 2, Teleworker Connectivity**

Course Evaluations

Cisco uses a post-course evaluation system, Metrics That Matter (MTM), for its instructor-led courses. The instructor must ensure that each student is aware of the confidential evaluation process and that all students submit an evaluation for each course. There are two options for students to complete the evaluation.

For Classes with Internet Access

A URL will be made available, specific to each Cisco Learning Partner. Obtain the URL from your MTM system administrator before the last day of class.

1. Upon completion of the course, instruct the students to enter the URL into their browser.
2. Make sure that the students input their e-mail address (used only for a follow-up evaluation).

Note	Sixty days following a learning event, students will receive a brief follow-up evaluation, and, again, responses will be kept confidential. E-mail addresses will not be used for marketing purposes. (If students do not have e-mail addresses, they may type in a "dummy" address.)

3. Instruct the students to select the appropriate course from the drop-down list.
4. Instruct the students to complete the course evaluation and click **Submit** one time only.
5. Advise the students to wait for "Thank you" to appear on the screen before leaving.

For Classes Without Internet Access

A paper-based version of the post-course evaluation is available. Your MTM system administrator can provide you with copies.

1. Distribute paper-based evaluations at the beginning of the last day of class.
2. Instruct the students to complete the survey only after completing the course.
3. Collect the evaluations and submit them to your MTM system administrator.

To View Evaluation Results

To view your post-course evaluation results:

1. Go to www.metricsthatmatter.com/client. (Reminder: *All* data is confidential; you will see only your own data.)
2. Log in using your ID and the password sent to you from MTM or provided by your company MTM system administrator to ensure confidentiality.
3. Choose Menu Option – Student Evaluation Reports:
   - Evaluation Retrieval Tool
   - Class Evaluation Summary Report
4. Search for and select the appropriate class.

Lab Setup

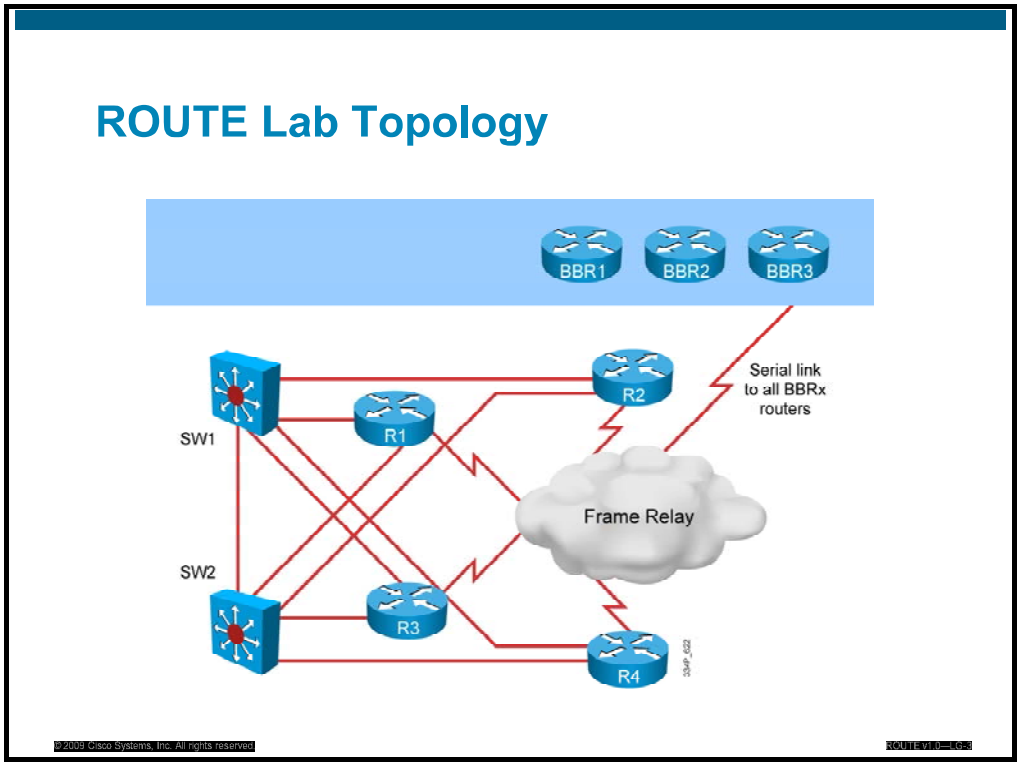
Overview

The purpose of the "Lab Setup" section is to assist in the setup and configuration of the training equipment for the *Implementing Cisco IP Routing* (ROUTE) v1.0 course. This section includes these topics:

- Lab Topology
- Hardware and Software Requirements
- Lab Equipment Configuration
- General Lab Setup
- Configuration Files Summary

Lab Topology

This topic describes the lab topology for *Implementing Cisco IP Routing* (ROUTE) v1.0.



The ROUTE v1.0 lab topology consists of a student pod that represents an enterprise network. The student pod is connected to a backbone managed by the instructor, which represents the Internet. The student pod consists of four routers and two multilayer switches. The instructor-managed backbone consists of three routers, a Layer 2 LAN switch, and a Frame Relay switch. All student pods are independent and use exactly the same IP address scheme and configurations.

Note	Although it is up to the Cisco Learning Partners to decide the ideal equipment-to-student ratio for their classes, the labs have been designed to have students share a pod and work through the lab exercises together. Ideally, a team consists of two students.

Device Name	
R1	POD router
R2	POD router
R3	POD router
R4	POD router
SW1	POD switch
SW2	POD switch
BBR1	Backbone router
BBR2	Backbone router
BBR3	Backbone router
BBSW	Backbone switch
FRSW	Frame Relay switch

Hardware and Software Requirements

Hardware List

The hardware listed in the following table is suggested for this learning product.

Description (Student Pod Equipment)	Mfr.	Part Number	Qty.
Cisco 1841, w/2xFE, 2 WAN slots, 32 FL/128 DR (Routers R1, R2, R3, R4, BBR1, BBR2, and BBR3)	Cisco Systems	CISCO1841	4 per pod
2-Port Async/Sync Serial WAN Interface Card (Used in routers R1, R2, R3, R4, BBR1, BBR2, and BBR3)	Cisco Systems	WIC-2A/S	4 per pod
Cisco 1841 IOS 12.4(23) Advanced IP Services (Used in routers R1, R2, R3, R4, BBR1, BBR2, and BBR3)	Cisco Systems	S184AISK9-12423	4 per pod
Catalyst 3560 24 10/100 + 2 SFP + IPS Image (Switches SW1, SW2, CSW1, and CSW2)	Cisco Systems	WS-C3560-24TS-E	2 per pod
Power Cord (Used for routers R1, R2, R3, R4, SW1, SW2)	Cisco Systems	CAB-AC	6 per pod
X.21 Cable, DCE Female to Smart Serial, 10 Feet	Cisco Systems	CAB-SS-X21FC	4 per pod
X.21 Cable, DTE Male to Smart Serial, 10 Feet	Cisco Systems	CAB-SS-X21MT	4 per pod
CAT5e UTP Cable, straight			7 per pod
CAT5e UTP Cable, crossover			3 per pod

Cisco Learning Partners are free to select different hardware to implement the labs for this course. However, all labs have been tested using the hardware and software described in this section and the configuration files provided with the course are based on this setup. If different equipment is selected, the Cisco Learning Partner should adapt the configurations and test the labs to verify that the selected equipment and software fully supports all features and functions required by the labs.

Description (Backbone Equipment)	Mfr.	Part Number	Qty.
Cisco 1841, w/2xFE, 2 WAN slots, 32 FL/128 DR (Routers BBR1, BBR2, and BBR3)	Cisco Systems	CISCO1841	3
2-Port Async/Sync Serial WAN Interface Card (Used in routers BBR1, BBR2, and BBR3)	Cisco Systems	WIC-2A/S	3
Cisco 1841 IOS 12.4(23) Advanced IP Services (Used in routers BBR1, BBR2, and BBR3)	Cisco Systems	S184AISK9-12423	3
Catalyst 2960 24 10/100 + 2 1000BT LAN Base Image (Switch BBSW, supports up to 8 pods)	Cisco Systems	WS-C2960-24TT-L	1
Cisco 2811 w/ AC PWR, 2FE, 4HWICs, 2PVDMs, 1NME, 2AIMS, IP BASE, 64F/256D (Frame relay switch FRSW and console server. Can be combined in a single router)	Cisco Systems	CISCO2811	2
16-Port Async/Sync Serial Network Module (Used in the frame relay switch FRSW, supports up to 3 pods)	Cisco Systems	NM-16A/S	1
16-Port Async HWIC (Used in the console server, supports the backbone and a pod. Add more for additional pods).	Cisco Systems	HWIC-16A	1
Cisco 2800 IP BASE W/O CRYPTO (Used in frame relay switch FRSW and console server)	Cisco Systems	S28NIPB-12423	2
Power Cord (Used for routers BBR1, BBR2, BBR3, FRSW, console server, and switch BBSW)	Cisco Systems	CAB-AC	6
High Density 8-port EIA-232 Async Cable (Used for the console server, supports the backbone and a pod. Add more for additional pods).	Cisco Systems	CAB-HD8-ASYNC	2
CAT5e UTP Cable, straight			5

The backbone equipment can be implemented in one of two different ways: A dedicated set of backbone equipment per pod can be allocated, or several pods can share the backbone equipment. However, because the IP addressing scheme is identical for all pods, this requires the use of virtual routing and forwarding (VRF) configuration. This allows routers BBR1, BBR2, and BBR3 to support several pods.

LAN switch BBSW and Frame Relay switch FRSW can also support multiple pods, but the physical number of ports in each chassis limits the number of pods supported.

Console access is provided through a router functioning as a console server. This is listed as a separate device, but the functionality can be combined with the Frame Relay switch if desired.

For local labs, no extra equipment is necessary. For remote labs, the use of remote power control is recommended.

Lab Equipment Configuration

This equipment configuration information is necessary for initial setup of the lab configuration.

- Cable the equipment according to the following table.

From device	Interface	To Device	Interface	Comments
SW1	Fa 0/1	R1	Fa 0/0	
SW1	Fa 0/2	R2	Fa 0/0	
SW1	Fa 0/3	R3	Fa 0/0	
SW1	Fa 0/4	R4	Fa 0/0	
SW1	Fa 0/5	SW2	Fa 0/5	
SW1	Fa 0/6	BBSW	Fa 0/6	
SW2	Fa 0/1	R1	Fa 0/1	
SW2	Fa 0/2	R2	Fa 0/1	
SW2	Fa 0/3	R3	Fa 0/1	
SW2	Fa 0/4	R4	Fa 0/1	
SW2	Fa 0/6	BBSW	Fa 0/7	
BBSW	Fa 0/1	BBR1	Fa 0/1	
BBSW	Fa 0/2	BBR2	Fa 0/1	
BBSW	Fa 0/3	BBR3	Fa 0/1	
BBSW	Fa 0/4	CRO1	Fa 0/0	
BBSW	Fa 0/5	CRO2	Fa 0/0	
FRSW	Se 0/0/0	R1	Se 0/0/0	
FRSW	Se 0/0/1	R2	Se 0/0/0	
FRSW	Se 0/0/2	R3	Se 0/0/0	
FRSW	Se 0/0/3	R4	Se 0/0/0	
FRSW	Se 0/0/4	BBR1	Se 0/0/0	
FRSW	Se 0/0/5	BBR2	Se 0/0/0	
FRSW	Se 0/0/6	BBR3	Se 0/0/0	

Note This table describes the cabling for a single pod. To add more pods, cable additional interfaces on backbone switch BBSW and Frame Relay switch FRSW.

- Connect the consoles of the devices to the console server. The specific mapping of devices to lines on the terminal server is decided by the Cisco Learning Partner and is dependent on the number of pods in use.
- Data-link connection identifier (DLCI) mapping providing Frame Relay connectivity is decided by the Learning Partner as well, although initial configurations of the Frame Relay switch (FRSW) and all pod routers have the DLCI mapping defined.

General Lab Setup

This information details the procedure to set up and configure the lab equipment.

Step 1 Ensure that all pod routers (R1, R2, R3, and R4) have the correct software installed (Cisco IOS Release 12.4(23) Advanced IP Services or better).

Step 2 Ensure that all pod switches (SW1, and SW2) have the correct software installed (Cisco IOS Release 12.2(46) SE Advanced IP Services or better).

Step 3 Ensure that all backbone routers (BBR1, BBR2, and BBR3) have the correct software installed (Cisco IOS Release 12.4(23) Advanced IP Services or better).

Step 4 Ensure that the backbone switch (BBSW) has the correct software installed (Cisco IOS Release 12.2(35) SE5 LAN Base or better).

Step 5 Ensure that the frame relay switch (FRSW) has the correct software installed (Cisco IOS Release 12.4(23) IP Base or better).

Step 6 Ensure that for all pod routers and switches (R1, R2, R3, R4, BBR1, BBR2, BBR3, SW1, SW2, and BBSW) the initial configuration for each lab is prepared and available before the lab starts. At the beginning of each lab, the students must be able to change the configuration of the pod devices to the initial configuration for each specific lab or the instructor must prepare the configurations.

Note Each Cisco Learning Partner can use its own way to provide initial configurations for students for each lab exercise. All the labs are organized in a way to be Cisco Learning Partner independent.

Configuration Files Summary

This topic details the course configuration files, which provide information about the starting condition of each lab. Files will be located on the instructor CD, which is part of the instructor kit.

Configuration Filename	Comments
R1-lab11.txt	Baseline configuration for router R1 in Lab 1.1
R1-lab21.txt	Lab 2-1 configuration for router R1
R1-lab22.txt	Lab 2-2 configuration for router R1
R1-lab23.txt	Lab 2-3 configuration for router R1
R1-lab24.txt	Lab 2-4 configuration for router R1
R1-lab31.txt	Lab 3-1 configuration for router R1
R1-lab32.txt	Lab 3-2 configuration for router R1
R1-lab33.txt	Lab 3-3 configuration for router R1
R1-lab34.txt	Lab 3-4 configuration for router R1
R1-lab35.txt	Lab 3-5 configuration for router R1
R1-lab41.txt	Lab 4-1 configuration for router R1
R1-lab51.txt	Lab 5-1 configuration for router R1
R1-lab61.txt	Lab 6-1 configuration for router R1
R1-lab62.txt	Lab 6-2 configuration for router R1
R2-lab11.txt	Baseline configuration for router R2 in Lab 1.1
R2-lab21.txt	Lab 2-1 configuration for router R2
R2-lab22.txt	Lab 2-2 configuration for router R2
R2-lab23.txt	Lab 2-3 configuration for router R2
R2-lab24.txt	Lab 2-4 configuration for router R2
R2-lab31.txt	Lab 3-1 configuration for router R2
R2-lab32.txt	Lab 3-2 configuration for router R2
R2-lab33.txt	Lab 3-3 configuration for router R2
R2-lab34.txt	Lab 3-4 configuration for router R2
R2-lab35.txt	Lab 3-5 configuration for router R2
R2-lab41.txt	Lab 4-1 configuration for router R2
R2-lab51.txt	Lab 5-1 configuration for router R2
R2-lab61.txt	Lab 6-1 configuration for router R2
R2-lab62.txt	Lab 6-2 configuration for router R2
R3-lab11.txt	Baseline configuration for router R3 in Lab 1.1
R3-lab21.txt	Lab 2-1 configuration for router R3
R3-lab22.txt	Lab 2-2 configuration for router R3

Configuration Filename	Comments
R3-lab23.txt	Lab 2-3 configuration for router R3
R3-lab24.txt	Lab 2-4 configuration for router R3
R3-lab31.txt	Lab 3-1 configuration for router R3
R3-lab32.txt	Lab 3-2 configuration for router R3
R3-lab33.txt	Lab 3-3 configuration for router R3
R3-lab34.txt	Lab 3-4 configuration for router R3
R3-lab35.txt	Lab 3-5 configuration for router R3
R3-lab41.txt	Lab 4-1 configuration for router R3
R3-lab51.txt	Lab 5-1 configuration for router R3
R3-lab61.txt	Lab 6-1 configuration for router R3
R3-lab62.txt	Lab 6-2 configuration for router R3
R4-lab11.txt	Baseline configuration for router R4 in Lab 1.1
R4-lab21.txt	Lab 2-1 configuration for router R4
R4-lab22.txt	Lab 2-2 configuration for router R4
R4-lab23.txt	Lab 2-3 configuration for router R4
R4-lab24.txt	Lab 2-4 configuration for router R4
R4-lab31.txt	Lab 3-1 configuration for router R4
R4-lab32.txt	Lab 3-2 configuration for router R4
R4-lab33.txt	Lab 3-3 configuration for router R4
R4-lab34.txt	Lab 3-4 configuration for router R4
R4-lab35.txt	Lab 3-5 configuration for router R4
R4-lab41.txt	Lab 4-1 configuration for router R4
R4-lab51.txt	Lab 5-1 configuration for router R4
R4-lab61.txt	Lab 6-1 configuration for router R4
R4-lab62.txt	Lab 6-2 configuration for router R4
SW1-lab11.txt	Baseline configuration for switch SW1 in Lab 1.1
SW1-lab21.txt	Lab 2-1 configuration for switch SW1
SW1-lab22.txt	Lab 2-2 configuration for switch SW1
SW1-lab23.txt	Lab 2-3 configuration for switch SW1
SW1-lab24.txt	Lab 2-4 configuration for switch SW1
SW1-lab31.txt	Lab 3-1 configuration for switch SW1
SW1-lab32.txt	Lab 3-2 configuration for switch SW1
SW1-lab33.txt	Lab 3-3 configuration for switch SW1
SW1-lab34.txt	Lab 3-4 configuration for switch SW1
SW1-lab35.txt	Lab 3-5 configuration for switch SW1
SW1-lab41.txt	Lab 4-1 configuration for switch SW1

Configuration Filename	Comments
SW1-lab51.txt	Lab 5-1 configuration for switch SW1
SW1-lab61.txt	Lab 6-1 configuration for switch SW1
SW1-lab62.txt	Lab 6-2 configuration for switch SW1
SW2-lab11.txt	Baseline configuration for switch SW1 in Lab 1.1
SW2-lab21.txt	Lab 2-1 configuration for switch SW2
SW2-lab22.txt	Lab 2-2 configuration for switch SW2
SW2-lab23.txt	Lab 2-3 configuration for switch SW2
SW2-lab24.txt	Lab 2-4 configuration for switch SW2
SW2-lab31.txt	Lab 3-1 configuration for switch SW2
SW2-lab32.txt	Lab 3-2 configuration for switch SW2
SW2-lab33.txt	Lab 3-3 configuration for switch SW2
SW2-lab34.txt	Lab 3-4 configuration for switch SW2
SW2-lab35.txt	Lab 3-5 configuration for switch SW2
SW2-lab41.txt	Lab 4-1 configuration for switch SW2
SW2-lab51.txt	Lab 5-1 configuration for switch SW2
SW2-lab61.txt	Lab 6-1 configuration for switch SW2
SW2-lab62.txt	Lab 6-2 configuration for switch SW2
BBR1-lab11.txt	Baseline configuration for router BBR1 in Lab 1.1
BBR1-lab21.txt	Lab 2-1 configuration for router BBR1
BBR1-lab22.txt	Lab 2-2 configuration for router BBR1
BBR1-lab23.txt	Lab 2-3 configuration for router BBR1
BBR1-lab24.txt	Lab 2-4 configuration for router BBR1
BBR1-lab31.txt	Lab 3-1 configuration for router BBR1
BBR1-lab32.txt	Lab 3-2 configuration for router BBR1
BBR1-lab33.txt	Lab 3-3 configuration for router BBR1
BBR1-lab34.txt	Lab 3-4 configuration for router BBR1
BBR1-lab35.txt	Lab 3-5 configuration for router BBR1
BBR1-lab41.txt	Lab 4-1 configuration for router BBR1
BBR1-lab51.txt	Lab 5-1 configuration for router BBR1
BBR1-lab61.txt	Lab 6-1 configuration for router BBR1
BBR1-lab62.txt	Lab 6-2 configuration for router BBR1
BBR2-lab11.txt	Baseline configuration for router BBR2 in Lab 1.1
BBR2-lab21.txt	Lab 2-1 configuration for router BBR2
BBR2-lab22.txt	Lab 2-2 configuration for router BBR2
BBR2-lab23.txt	Lab 2-3 configuration for router BBR2
BBR2-lab24.txt	Lab 2-4 configuration for router BBR2

Configuration Filename	Comments
BBR2-lab31.txt	Lab 3-1 configuration for router BBR2
BBR2-lab32.txt	Lab 3-2 configuration for router BBR2
BBR2-lab33.txt	Lab 3-3 configuration for router BBR2
BBR2-lab34.txt	Lab 3-4 configuration for router BBR2
BBR2-lab35.txt	Lab 3-5 configuration for router BBR2
BBR2-lab41.txt	Lab 4-1 configuration for router BBR2
BBR2-lab51.txt	Lab 5-1 configuration for router BBR2
BBR2-lab61.txt	Lab 6-1 configuration for router BBR2
BBR2-lab62.txt	Lab 6-2 configuration for router BBR2
BBR3-lab11.txt	Baseline configuration for router BBR3 in Lab 1.1
BBR3-lab21.txt	Lab 2-1 configuration for router BBR3
BBR3-lab22.txt	Lab 2-2 configuration for router BBR3
BBR3-lab23.txt	Lab 2-3 configuration for router BBR3
BBR3-lab24.txt	Lab 2-4 configuration for router BBR3
BBR3-lab31.txt	Lab 3-1 configuration for router BBR3
BBR3-lab32.txt	Lab 3-2 configuration for router BBR3
BBR3-lab33.txt	Lab 3-3 configuration for router BBR3
BBR3-lab34.txt	Lab 3-4 configuration for router BBR3
BBR3-lab35.txt	Lab 3-5 configuration for router BBR3
BBR3-lab41.txt	Lab 4-1 configuration for router BBR3
BBR3-lab51.txt	Lab 5-1 configuration for router BBR3
BBR3-lab61.txt	Lab 6-1 configuration for router BBR3
BBR3-lab62.txt	Lab 6-2 configuration for router BBR3
FRSW-baseline.txt	Baseline configuration for Frame Relay switch FRSW
BBSW-baseline.txt	Baseline configuration for switch BBSW

