CCIE Enterprise Infrastructure v1.1

Contents at a Glance

Contents

Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.

Introduction

Enterprise networking has undergone many small changes over the years, building from simple shared bus LANs to intricate routing and switching architectures and wireless communications. Behind all of this is a need to ensure high reliability, agility, and speed. Through the decades, many different networking technologies, from physical connections to software protocols, have been created to assist enterprise networks in reaching those goals. For seasoned networking veterans, working with the various protocols and architectures is second nature. However, those who are just starting to build their careers and trying to study more advanced areas of network engineering may be overwhelmed by the multitude of routing protocols, Layer 2 features, and new buzzwords like “software-defined.”

This book is written as a foundation guide for the most common enterprise networking concepts that are required for a network engineer looking to move forward to more advanced aspects of networking. It combines aspects of theory instruction with practical application. Topics such as LAN switching, IP routing, and overlay networking technologies such as DMVPN are explained as foundational topics, including examples. Each chapter also functions as a lab manual with a task-oriented structure. Lab scenarios are presented as either configuration objectives, troubleshooting scenarios, or design scenarios. Each lab scenario includes full solutions and explanations. For beginner to intermediate readers, the solutions can be read while solving the tasks. Advanced readers can challenge their knowledge and skills by solving tasks first and then comparing their solutions to the ones provided in this book.

This book is not meant to be an exhaustive study of all the included technologies. It is meant to provide enough information on all topics to allow you to speak intelligently about each technology and even implement some of the configurations, if necessary, in your own environment. It takes topics from Cisco’s CCIE Enterprise Infrastructure certification blueprint but includes some legacy topics, where necessary, to facilitate understanding.

Who This Book Is For

Although the title of this book is *CCIE Enterprise Infrastructure Foundation*, the target audience is not limited to just those seeking expert-level certification. Any person looking to learn a little bit more about these foundational technologies will find this book very accessible.

This book breaks down complicated topics and provides examples to maximize understanding. It does, however, assume some basic networking knowledge. The following types of readers will get the most out of this book:

- Those who have completed CCNA certification and are part of the way through their preparation for CCNP Enterprise certification
- Those who have completed CCNP Enterprise certification and are pursuing CCIE
- Those who are currently working in an environment that is implementing specific technologies covered in this book
- Those who are migrating from another vendor to a Cisco environment and need to understand Cisco configurations for common networking protocols

How This Book Is Organized?

This book is divided into the 11 chapters described here. Every chapter can stand alone and can be used as a reference for the technologies it covers.

Chapter 1: Switching

Chapter 1 introduces Layer 2 concepts such as preventing loops with Spanning Tree Protocol, segmenting with VLANs, extending VLANs between switches through trunking, and bonding multiple Ethernet links together to increase bandwidth between network nodes. It covers topics such as Spanning Tree Protocol, RSTP, MSTP, VTP and VTP pruning, 802.1Q and ISL trunking, and LACP and PAgP.

Chapter 2: IP Prefix Lists

Chapter 2 introduces a common route filtering mechanism known as a prefix list. It explains why prefix lists were invented and why they are used over access lists for route filtering. This chapter shows how to write prefix lists and apply them in various routing protocols for filtering routes.

Chapter 3: RIPv2

Chapter 3 introduces Routing Information Protocol (RIP). RIP may not be included on the exam, but it is a perfect example of a simple distance vector routing protocol that follows all the standard distance vector designs. It focuses on the simplicity of RIP configuration, advanced RIP filtering scenarios, and RIP configuration challenges.

Chapter 4: EIGRP

Chapter 4 focuses on Cisco's improvement on its own version of Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP). It introduces EIGRP as a distance vector protocol that forms neighbor relationships and keeps a topology table like some other protocols. EIGRP is considered an advanced distance vector protocol that uses more than simple hop counts to learn loop-free paths through a network. This chapter covers EIGRP configuration topics such as EIGRP classic and address family configuration, EIGRP stub routing, and EIGRP with BFD.

Chapter 5: OSPF

Chapter 5 introduces the Open Shortest Path First (OSPF) routing protocol. It begins with an analysis of how OSPF builds its link-state database (LSDB) with various linkstate advertisements (LSA) and uses that information to calculate loop-free routed paths through a network. This chapter also details multiarea OSPF design, filtering, and virtual links. It includes a detailed walkthrough on OSPF's best-path determination to help you understand OSPF's path selection process.

Chapter 6: BGP

Chapter 6 introduces Border Gateway Protocol (BGP), the protocol that routes the Internet. It explains BGP operation between autonomous systems (external BGP, or eBGP) and within a single autonomous system (internal BGP, or iBGP). Topics covered include BGP session establishment, route reflectors and confederations, aggregation, and filtering. This chapter includes a detailed walkthrough of the BGP best-path determination process.

Chapter 7: DMVPN

Chapter 7 focuses on Cisco's original SD-WAN technology, known as Dynamic Multipoint VPN (DMVPN). It explains DMVPN from the ground up, introducing concepts such as overlay and underlay networking, the link between DMVPN and NHRP, DMVPN routing using common routing protocols, and different DMVPN designs. It covers DMVPN Phase 1 through Phase 3 configurations, NHRP shortcut switching enhancements, hub-and-spoke networking designs, and (m)GRE tunnels.

Chapter 8: MPLS and L3VPNs

Chapter 8 introduces Multiprotocol Label Switching (MPLS) and the suite of services MPLS can provide. This chapter begins with an introduction to MPLS labels and Label Distribution Protocol (LDP). It also introduces the most common MPLS service, MPLS Layer 3 VPN (L3VPN). Topics covered include CE and PE routers, MPLS core configuration, LDP session establishment, BGP route targets and route distinguishers, and exchange of IGP routes between two sites connected by an MPLS L3VPN.

Chapter 9: IPv6

Chapter 9 introduces Internet Protocol Version 6 (IPv6), which is the successor to IPv4 due to its massive address space. It also details IPv6 address types, assignment, and configuration. Topics covered include IPv6 NDP, IPv6 SLAAC, DMVPN for IPv6, OSPF for IPv6 (OSPFv3), EIGRP for IPv6, and BGP for IPv6.

Chapter 10: SD-WAN

Chapter 10 introduces Cisco's new SD-WAN platform, which is based on its acquisition of Viptela. This chapter details basic SD-WAN components, such as vSmart, vManage, and vBond, as well as the setup and configuration required to join vEdge routers to an SD-WAN solution. Topics covered include onboarding WAN edge devices, unicast routing, segmentation, vManage device templates, ZTP, and application-aware policies.

Chapter 11: SD-Access

Chapter 11 introduces Cisco's SD-Access solution for creating scalable, automated, and resilient enterprise fabric. This chapter covers the configuration of the SD-Access policy engine as well as SDA design and implementation. Topics covered include Cisco ISE, pxGrid, XMPP, SDA hierarchy global IP pools, DNAC, and LAN automation.