

## IPv6 Fundamentals, Design and Deployment

**Duration: 5 Days**    **Course Code: IP6FD**    **Version: 4.1**

### Overview:

This five-day course provides network engineers and technicians who are working in the enterprise sector with the knowledge and skills that are needed to study and configure the IP version 6 (IPv6) features of Cisco IOS Software. This course provides an overview of IPv6 technologies, covers IPv6 design and implementation, describes IPv6 operations, addressing, routing, services, and transition, and describes the deployment of IPv6 in enterprise and service provider networks. Hands-on labs and case studies are used to provide possible deployment scenarios.

**This course is worth 40 Credits in the Continuing Education Program**

### Target Audience:

The primary audience for this course is network engineers and technicians who are working in the enterprise sector.

### Objectives:

- **After completing this course you should be able to:**
- Describe the history of IP version 4 (IPv4) and the rationale for implementing IPv6 to resolve IPv4 addressing and security issues
- Explain the benefits of addressing with IPv6 and describe how larger IPv6 address sizes facilitate auto configuration and aggregation
- Describe the market drivers that help promote IPv6 as the key technology of the future
- Describe the IPv6 addressing architecture, including types of addresses and address representation
- Describe changes in the IPv6 header and the purpose of extension headers
- Describe and use Cisco IOS software commands to enable IPv6 on Cisco routers
- Describe internet control message protocol (ICMP) types and codes and IPv6 neighbor discovery, which is the process in which neighbors discover each other and autoconfigure addresses
- Describe the IPv6 configuration process on Cisco IOS software and provide some basic methods for troubleshooting issues that relate to IPv6 configurations
- Explain IP mobility in general and describe the IPv6 network mobility model with possible usages
- Describe how domain name system (DNS) works in an IPv6 environment
- Describe dynamic host configuration protocol (DHCP) version 6 (DHCPv6) for IPv6 operations, including how DHCP operation in IPv6 differs from its operation in IPv4 and how you can
- Describe redistribution of IPv6 routing information, differences among various routing protocols, and changes in the behavior of redistribution compared to IPv4
- Describe the IPv6 multicast addresses format, including a real-life multicast example
- Describe IPv6 multicast addressing options, media access control (MAC) address mappings, and multicast address scoping
- Describe the dual-stacking approach to integrating IPv6 functionality into an existing IPv4-only environment
- Describe tunneling mechanisms for IPv4-to-IPv6 transition, or for supporting IPv4 and IPv6 coexistence
- Explain the benefits of adopting IPv6 single stack instead of using both IPv4 and IPv6 and the process for converting networks from IPv4 to IPv6
- Describe the features of access control lists (ACLs) in an IPv6 environment
- Describe how security is implemented in IPv6
- Describe security issues in an IPv6 transition environment
- Describe security practices for IPv6 deployment
- Describe how Cisco IOS Firewall works and how to configure it in IPv6 traffic
- Describe the IPv6 networking environments in use today, the process of becoming an IPv6 internet service provider (ISPs), address allocation policies and organizations, and strategies for connecting to the IPv6 internet
- Identify an IPv6 multihoming issue and prescribe a potential solution
- Describe several IPv6 enterprise deployment strategies

implement DHCPv6 prefix delegation to improve the IPv6 numbering process

- Describe the fields in the IPv6 header that are used to support quality of service (QoS) and explain how these fields differ from the IPv4 QoS model
- Describe Cisco IOS tools, such as Telnet, Trivial File Transfer Protocol (TFTP), Secure Shell Protocol (SSH), and others
- Describe open shortest path first (OSPF)v3, the IPv6-capable version of the OSPF routing protocol, including its operations, configuration, and commands
- Describe Cisco enhanced interior gateway routing protocol (EIGRP), including its operation, configuration, and commands
- Explore multiprotocol border gateway protocol (MP-BGP), including operation, IPv6-related configuration, and commands
- Explain the issues when using policy-based routing (PBR) and when disabling the processing of extension headers
- Describe the characteristics of first hop redundancy protocol (FHRP) for IPv6, which are used to offer redundant connections on the network layer for upstream connectivity
- Explain how to deploy IPv6 over a multi-protocol label switching (MPLS) network
- Describe IPv6 broadband access services and digital subscriber line (DSL)-based access in particular
- Describe how to plan and implement IPv6 in enterprise networks
- Describe how plan and implement IPv6 cloud and software-defined deployments
- Describe and identify the most common planning and implementation approaches as they pertain to moving to IPv6 in branch networks

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## Prerequisites:

**Attendees should meet the following pre-requisites:**

- Cisco CCNA® certification:
- Understanding of networks and routing ( Cisco CCNP® level recommended but not required).
- Working knowledge of the Microsoft Windows operating system.
- CCNA - Implementing and Administering Cisco Solutions
- ENCOR - Implementing and Operating Cisco Enterprise Network Core Technologies

## Testing and Certification

**Recommended preparation for exam(s):**

- No exam currently aligns to this course

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## Follow-on-Courses:

**The following courses are recommended for further study:**

- None recommended at this time

## Content:

### Explaining the rationale for IPv6

- IP Address Allocation
- History of IPv4
- Next Generation of IP
- IPv4 Workarounds

### IPv6 Features and Benefits

- Features and Benefits of IPv6
- IPv6 Addresses
- IPv6 Autoconfiguration and Aggregation
- Advanced IPv6 Features
- Transition Strategies to IPv6

### Market Drivers

- IPv6 Market Growth and Technologies
- Core IPv4 Address Space Exhaustion Timeline
- Mergers and Acquisitions Driving Change
- Growth of the Internet
- IoT and the Increasing Number of Devices
- Multinational Compliance Efforts and References

### IPv6 Addressing Architecture

- IPv6 Addressing Architecture
- IPv6 Address Formats and Types
- IPv6 Address Uses
- Required IPv6 Addresses

### IPv6 Header Format

- IPv6 Header Changes and Benefits
- IPv6 Header Fields
- IPv6 Extension Headers

### Enabling IPv6 on Cisco Routers

- Enabling IPv6 on Cisco Routers
- IPv6 Address Configuration

### Using ICMPv6 and Neighbor Discovery

- ICMPv6
- ICMP Errors
- Echo
- IPv6 over Data Link Layers
- Neighbor Discovery
- Stateless Autoconfiguration
- Value of Autoconfiguration
- Renumbering
- Cisco IOS Neighbor Discovery Command Syntax
- Cisco IOS Network Prefix Renumbering Scenario
- ICMP MLD
- IPv6 Mobility

### Troubleshooting IPv6

### Examining OSPFv3

- OSPFv3 Key Characteristics
- OSPFv3 Enhancements
- OSPFv3 Address Families
- OSPFv3 Configuration
- OSPFv3 IPsec ESP Authentication and Encryption
- OSPFv3 Advanced Functionalities

### Examining EIGRP for IPv6

- EIGRP for IPv6
- Cisco IOS EIGRP for IPv6 Commands

### Understanding MP-BGP

- MP-BGP Support for IPv6
- IPv6 as Payload and Transport Mechanism in MP-BG
- BGP Peering Over Link-Local Addresses
- BGP Prefix Filtering
- MP-BGP Configuration and Troubleshooting

### Configuring IPv6 Policy-Based Routing

- Policy-Based Routing
- Configure PBR

### Configuring FHRP for IPv6

- First Hop Redundancy Protocols and Concepts
- HSRPv2 for IPv6
- VRRPv3 for IPv6
- GLBP for IPv6

### Configuring Route Redistribution

- Route Redistribution
- PE-CE Redistribution for Service Providers

### Implementing Multicast in an IPv6 Network

- IPv6 Multicast Addressing
- PIM for IPv6
- Rendezvous Points
- MP-BGP for the IPv6 Multicast Address Family
- IPv6 Multicast Application Example

### Using IPv6 MLD

- Multicast Listener Discovery
- MLD Snooping and MLD Group Limits
- Multicast User Authentication and Group Range Support

### Implementing Dual Stack

- Dual-Stack Applications

### Security Issues in an IPv6 Transition Environment

- Dual-Stack Transition Mechanism
- Single-Stack Security Issues
- Security at the Network Edge
- ICMP Traffic Requirements
- Private IPv6 Addressing Versus Public IPv6 Addressing
- IP Overloading Issues

### IPv6 Security Practices

- Threats in IPv6 Networks
- Zero trust Overview
- Build Distributed Security Capability
- Hide Topology when Possible
- Secure the Local Link
- ICMPv6 at Edge—Manage ICMPv6 Traffic
- Develop Mobility Support Plan
- Use Transition Mechanisms as Transport
- Secure the Routing Plane
- Deploy an Early-Warning System

### Configuring Cisco IOS Firewall for IPv6

- Cisco IOS Firewall for IPv6
- IPv6 Inspection on ISRs
- Implement IPv6 Inspection on ISR
- Zone-Based Policy Firewall for IPv6 on ISRs
- Configuring Zones and Zone Pairs
- Configuring a Basic OSI Layer 3 to 4 Interzone Access Policy
- Troubleshooting the Zone-Based Policy Firewall

### IPv6 Address Allocation

- IPv6 Internet
- IPv6 Address Allocation
- Connecting to the IPv6 Internet

### IPv6 Multihoming Issue

- IPv6 Multihoming Aspects and Issues
- IPv6 Multihoming Status
- Protocol-Based Solutions

### IPv6 Enterprise Deployment Strategies

- Enterprise Networks
- Impacts of Network Services
- WAN Networks
- Dual Stack: Advantages and Disadvantages
- Tunneling: Advantages and Disadvantages
- Translation: Advantages and Disadvantages

### Support for IPv6 in MPLS

- MPLS Operations

- Cisco IOS IPv6 Configuration Example
- Cisco IOS show Commands
- Cisco IOS debug Commands
- Cisco IOS debug Command Example

#### IPv6 Mobility

- Introduction to IP Mobility
- Mobile IPv6
- Network Mobility Examples

#### DNS in an IPv6 Environment

- DNS Objects and Records
- DNS Tree Structure
- Dynamic DNS

#### DHCPv6 Operations

- DHCPv6
- DHCPv6 Operation
- DHCPv6 Multicast Addresses
- DHCPv6 Prefix Delegation Process
- DHCPv6 Troubleshooting

#### QoS Support in an IPv6 Environment

- IPv6 Header Fields Used for QoS
- IPv6 and the Flow Label Field
- IPv6 QoS Configuration

#### Cisco IOS Software Features

- Cisco IOS XE Software Features
- Cisco IOS XE Software IPv6 Tools
- IPv6 Support for Cisco Discovery Protocol
- Cisco Express Forwarding IPv6
- IP Service Level Agreements

- Dual-Stack Node
- The Dual-Stack Approach

#### Describing IPv6 Tunnelling Mechanisms

- Overlay Tunnels
- Manually Configured Tunnels
- Automatic Tunnels

#### Transition to Single-Stack Deployments

- IPv6 Single Stack
- DNS for IPv6 Migrating from A to AAAA
- Translation Options

#### Configuring IPv6 ACLs

- IPv6 ACLs
- IPv6 ACL Configuration
- Reflexive and Time-Based ACLs
- Cisco IOS IPv6 Header Filtering
- Cisco IOS New ICMPv6 Types
- Editing of ACLs
- How to Configure ACLs in an IPv6 Environment

#### Using IPsec, IKE and VPNs

- IPsec, IKE, and VPNs Basics
- IPsec and IKE
- VPN Connections Using IPv6

- IPv6 over MPLS Deployment Scenarios
- IPv6 Tunnels Configured on CE Routers
- IPv6 over Layer 2 MPLS VPN
- Cisco 6PE
- Deploy Cisco 6PE on MPLS Networks

#### IPv6 Broadband Access Services

- IPv6 Rapid Deployment
- Customer Link Encapsulations
- FTTH Access Architecture
- Cable Access Architecture
- Wireless Access Architecture
- DSL Access Architecture

#### Planning and Implementing IPv6 Cloud and Software-Defined Deployments

- Cisco SD-WAN
- Cisco SD-Access
- Cloud-Native Deployment
- IaaS - AWS and Azure

#### Planning and Implementing IPv6 in Enterprise Networks

- Enterprise Network Definition
- Implementing IPv6 in an Enterprise Campus Network
- IPv6 in an Enterprise WAN Network

#### Planning and Implementing IPv6 in Branch Networks

- Branch Deployment General Considerations
- Branch Deployment Profiles: Single-Tier Profile Implementation

#### Labs

- Discovery Lab 1: Using Neighbor Discovery
- Discovery Lab 2: Using Prefix Delegation
- Discovery Lab 3: Routing with OSPFv3
- Discovery Lab 4: Routing with EIGRP
- Discovery Lab 5: Routing with BGP and MP-BGP
- Discovery Lab 6: Multicasting
- Discovery Lab 7: Implementing Tunnels for IPv6
- Discovery Lab 8: Configuring Advanced ACLs
- Discovery Lab 9: Implementing IPsec and IKE
- Discovery Lab 10: Configuring Cisco IOS Firewall

## Further Information:

For More information, or to book your course, please call us on Head Office Tel.: +974 40316639

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