# TCP/IP Networking Training

Duration: **5 Day**

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## Overview

**Exclusive - Exclusive - Learn the essential skills needed to set up, configure, support, and troubleshoot your TCP/IP-based network.**

TCP/IP is the globally accepted group of protocols at the core of the Internet and organizational intranets. A solid understanding of each of these protocols and how they work will give you the ability to deploy the most effective network for your organization in three key areas:

- Efficiency: You will be able to run a more efficient network through proper implementation of subnetting and understanding how different protocols and applications impact network performance.
- Dependability: You will reduce downtime in the event of a network failure as you will be better equipped to quickly identify and resolve problems as they occur. You will also be able to solve problems in-house rather than incurring the extra costs and time required to hire a consultant.
- Future growth: Proper planning will ensure that your network can accommodate growth, including the implementation of more robust network technologies, such as IPv6.

In this course, you will gain the essential knowledge and skills required to set up, configure, support, and troubleshoot your TCP/IP-based network. Our expert instructors and extensive hands-on labs will prepare you to face and overcome the challenges of today's complex networks. This course—the longest running of its kind in the industry—also prepares you for more specialized courses in network security, wireless integration, and Voice over IP (VoIP) as well as for product-specific training such as Cisco, Avaya, and Microsoft.

**Who Should Attend?**

Anyone who is responsible for designing, installing, configuring, and maintaining TCP/IP networks or who needs to understand TCP/IP protocol structures and functions will benefit from this course. This course also provides excellent preparation for more advanced networking training.

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## What You Will Learn

- Describe the essential elements of the TCP/IP protocol suite
- Explain the functions of various devices in a TCP/IP network
- Subnet an IP network using variable-length subnet masking (VLSM), calculating appropriate subnet values to improve network efficiency
- Describe different TCP/IP protocols—ARP, IP, ICMP, TCP, UDP, and so forth—including their functions and relationships
- Examine IP routing and the protocols that support it, such as RIP, EIGRP, OSPF, and BGP
- Explain how applications like FTP, HTTP, Telnet, and others work in a TCP/IP network
- Analyze UDP and TCP application traffic to identify normal versus abnormal sessions
- Automate address assignment and name resolution using DHCP and DNS
- Analyze multicasting and Voice over IP (VoIP) traffic to determine how these protocols affect network performance
- Troubleshoot problems at each layer of a TCP/IP network using a variety of tools, including a protocol analyzer, traceroute, ping, and DNS and ARP cache manipulation
- Analyze ICMP variation reports to determine the cause of a network failure
- Explore network security protocols, including PPTP, L2TP, IPSec, SSL, TLS, and SSH
- Analyze network traffic to determine security risks
- Explore the functions of IPv6 and its related protocols

## Outline

1. TCP/IP Overview

- Origins of TCP and IP
- ARPANET Requirements Documents
- Collaborative Network Requirements
  - One Protocol?
  - The TCP/IP Networking Model
- Documentation and RFCs
  - Types of RFCs

2. TCP/IP Numbering Systems

- Introduction to Numbering Systems
- Positional Numbering System Basics
- Numbering Systems Used in Data Systems
  - Decimal Numbering
  - Binary Numbering
  - Hexadecimal Numbering
- Converting between Numbering Systems
  - Converting Binary or Hexadecimal to Decimal
  - Converting Decimal to Binary or Hexadecimal
  - Converting between Hexadecimal and Binary
- Counting
- Guidelines for Determining the Base of a Number

3. Network Access Review

- Introduction

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- MAC Addressing
- The Ethernet Header
  - Ethernet Protocol Types
- The Ethernet Frame
  - Ethernet Frame Format Modifications
- Protocol Analysis Tools

4. IPv4 Addressing

- Logical Addressing
- IP Address Features
- Dotted Decimal Notation
- Classful Addressing
  - Classful Addressing: Class A
  - Classful Addressing: Class B
  - Classful Addressing: Class C
  - Classful Addressing: Class D
  - Classful Addressing: Class E
- Reserved Addressing
- Network Mask: Boolean Logic
  - Network Mask: Comparing Addresses
- A Flat Network
- Classful Address Limitations
  - Subnetting Classful Address Blocks
  - Private Addressing
- Network Address Translation
  - Variable-Length Subnet Masking
- Classless Inter-Domain Routing
  - CIDR Prefix Notation
  - CIDR Address Blocks

Module Review and Discussion Questions

5. IPv4 Subnets

- Subnetting Overview
- FLSM vs. VLSM
- Calculating Subnet Values
- VLSM Example: Determine Needs
  - The Default Mask
  - The First Subnet
  - The Second Subnet
  - The Third Subnet
  - The Current Picture
  - Sequential Allocation Error
  - A Future Fourth Subnet
- CIDR and VLSM

6. Address Resolution Protocol

- Address Mapping
- ARP Restrictions
- ARP Cache
- ARP Commands

- ARP Message Fields
- Additional ARP Capabilities

7. Multicasting

- What Is Multicasting?
- Uses for Multicasting
- Multicasting Overview
- Reserved Multicast Addresses
- Internet Group Management Protocol
  - Joining Multicast Groups
- Multicast Routing
  - Mapping Class D IP Address to an Etherent Multicast Address
- Putting It All Together

8. Internet Protocol Version 4

- Internet Protocol Overview
- Self-Healing Networks
- IPv4 Header
  - IPv4 Header Layout
  - DS Field
  - Explicit Congestion Notification
  - Total IP Length
  - Identification Field
  - Fragmentation
  - Time To Live
  - Protocol Field
  - IPv4 Header Checksum
  - IPv4 Address Fields
  - IPv4 Options
- IPv4 Sample Data Exchanges

9. IP Routing

- IP Routing Overview
- Routing Function
- IP Routing Algorithm
- Types of Routing Protocols
- Choosing the Best Path
  - Routing Metrics
  - Administrative Distance
- Routing Tables
  - Workstation Routing Tables
  - Router Routing Table
- Routing Information Protocol
  - RIP Basics
  - RIP Route Loops
- Open Shortest Path First
- Enhanced Interior Gateway Routing Protocol
- RIP vs. OSPF vs. EIGRP
- Border Gateway Protocol
- Layer 3 Switching

10. UDP Sessions

- TCP/IP Protocols
- Connectionless Protocols
- Connection-Oriented Protocols
- Low Overhead vs. Reliability
- UDP Header Layout
- UDP/TCP Ports
- UDP Ports and Sockets
- UDP Application Port Examples
- Sample UDP Data Exchanges

11. TCP Sessions

- TCP/IP Protocols
- Reliable Transport Services
- TCP Characteristics
- TCP Header Overview
  - Source and Destination Ports
  - Sequence Number
  - Acknowledgment Number
  - Header Length
  - Session Flags
  - Window Size
  - TCP Checksum
  - Urgent Pointer
  - TCP Options
  - Maximum Segment Size and Window Size
- TCP Connection Establishment
- TCP Data Flow
- TCP Connection Termination
  - TCP Reset
- TCP Congestion Management
  - Default Congestion Management
  - Advanced Congestion Management
  - Explicit Congestion Notification and TCP
- TCP Sample Data Exchanges

12. Autoconfiguration

- TCP/IP Protocols
- Manual vs. Automatic Assignments
- Historical Solutions
  - Reverse Address Resolution Protocol
  - Bootstrap Protocol
- DHCP Overview
- DHCP New Lease Acquisition Process
  - DHCP Discovery Example
  - DHCP Offer Example
  - DHCP Request Example
  - DHCP Acknowledgment Example
- DHCP Message Format
- DHCP Scopes and Options

- IP Lease Renewal
- DHCP in a Routed Network
- Multiple DHCP Servers
- Troubleshooting DHCP

13. Domain Name System

- TCP/IP Protocols
- Name and Number Organizations
- The DNS Name Space
  - Generic Top-Level Domains
  - Sponsored Top-Level Domains
  - Country Domains
- DNS Name Servers
  - Root Servers
  - Primary and Secondary Name Servers
- A Distributed Service
  - DNS Name Resolution Process
  - DNS Message Format
  - DNS Resource Records
  - DNS Query Example
  - DNS Answer Example
- Reverse Lookup
- Dynamic DNS
- Troubleshooting DNS

14. ICMP Diagnostic and Error Reports

- ICMP Overview
- ICMP Basics
- ICMP Message Destinations
- Silent Discard vs. Informed Discard
- ICMP Message Layout
- ICMP Message Types
  - Echo Request and Echo Reply Example
  - Destination Unreachable Example
  - ICMP Redirect
  - Time Exceeded Example
- ICMP Sample Data Exchanges

15. Common TCP Applications

- TCP/IP Protocols
- Telnet
  - Telnet Negotiations
  - Telnet Protocol Options
  - Example Telnet Negotiations
- File Transfer Protocol
  - FTP Commands
  - FTP Response Codes
- E-Mail
  - Simple Mail Transfer Protocol
  - Post Office Protocol Version 3

    - Internet Message Access Protocol Version 4
- World Wide Web
    - Uniform Resource Locator
    - HTTP Requests and Responses

16. Common UDP Applications

- TCP/IP Protocols
- Trivial File Transfer Protocol
    - TFTP Transfer Process
    - TFTP Operation Codes
    - TFTP Example Sessions
- Simple Network Management Protocol
    - SNMP Manager Model
    - SNMP Agent Model
    - SNMP Commands
    - Management Information Base
    - Remote Network Monitoring

17. VOIP Implementation

- Introduction
- Benefits of VoIP
- TCP/IP Protocols Used by VoIP
- VoIP System Components
- VoIP Protocols
- Session Initiation Protocol
    - Example SIP Message
    - SIP Proxy Function
- Session Description Protocol
- VoIP Codecs
- Real-Time Transport Protocol
    - RTP Header Layout

18. TCP/IP Security

- TCP/IP Security Concerns
- The CIA Triad
- TCP/IP Vulnerabilities
    - TCP/IP Vulnerabilities: Network Access Layer
    - TCP/IP Vulnerabilities: Internet Layer
    - TCP/IP Vulnerabilities: Transport Layer
    - TCP/IP Vulnerabilities: Application Layer
- TCP/IP Security Protocols
    - Network Access Security Tools
    - IP Security
    - Virtual Private Networks
    - TLS and SSL
    - DNSSEC
    - Secure Shell Protocol

19. Internet Protocol Version 6

- Overview

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- IPv6 Addresses
  - IPv6 Address Categories
  - Breaking Down IPv6 Addresses
  - Global Unicast Address Format
  - Interface ID Structure
  - IPv6 Address Types
- IPv6 Headers
  - IPv6 Header Layout
  - Extension Headers
- ICMPv6
  - Destination Unreachable
  - Packet Too Big
  - Time Exceeded
  - Parameter Problem
  - Echo Request and Echo Reply
  - Router Solicitation
  - Router Advertisement
  - Neighbor Solicitation
  - Neighbor Advertisement
  - Redirect Message
- IPv6 DNS Records
- IPv6 Routing Services and Protocols
- Internet2