

# TCP/IP Networking

Learn via: **Classroom**

Duration: **5 Days**

## **Overview**

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 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, as well as for product-specific training such as Cisco, Avaya, and Microsoft.

## **Prerequisites**

There are no prerequisites for this course.

## **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.

## **What You Will Learn**

- The essential elements of the TCP/IP protocol suite
- Install and configure TCP/IP in a live classroom network
- The roles of various devices in a TCP/IP network
- IP addressing and subnetting including Variable Length Subnet Masking (VLSM)
- Subnet an IP network and implement the resulting addresses
- Details of ARP, IP, ICMP, TCP, and UDP - their functions and relationships
- Automate address assignment and name resolution using DHCP and DDNS
- IP routing and the protocols that support it, such as RIP and OSPF
- How applications like FTP, HTTP, Telnet, and others work in a TCP/IP network
- Functions of IPv6 and its related protocols
- Functions and capabilities of multicasting, Voice over IP, and e-mail
- Use of a protocol analyzer to isolate and troubleshoot network problems
- Troubleshoot problems at each layer of a TCP/IP network

## **Outline**

### **1. History and Standards**

- Origin of TCP/IP
- ARPANET Requirement Documents
- Collaborative Network Requirements
- One Protocol?
- Peer-to-Peer Protocols: Actual Flow
- Peer-to-Peer Protocols: Effective Flow
- Documentation and RFCs
- RFC Categories

### **2. TCP/IP Numbering Systems**

- Data Representation

- Numbering Systems
- Number Grouping
- Converting Binary or Hexadecimal to Decimal
- Practice Converting Binary to Decimal
- Converting Decimal to Binary or Hexadecimal
- Example 1: Converting 1500 to Binary
- Example 2: Converting 1500 to Hexadecimal
- Decimal Conversions
- Converting Hexadecimal to Binary and Binary to Hexadecimal
- Counting
- Guidelines for Determining Base

### 3. Local Signaling

- Local Signaling
- Ethernet Addressing
- Unicast
- Multicast
- Broadcast
- The Ethernet Header
- Protocol Type
- Size Limits
- CSMA/CD

### 4. IP Addressing

- A Logical Address
- IP Address Structure
- Dotted Decimal Notation
- Classful Addressing (Class A, B, C, D, E)
- Reserved Addresses
- Masking
- Comparing Addresses
- Prefix Notation
- Private Addressing
- Network Address Translation
- Address Assignment
- One Flat Network
- IP Address Blocks

### 5. IP Subnets

- A Logical Address
- Subnetting
- Required Information
- Multiple Subnets
- Determining the Mask
- The First Subnet
- Laying out the Subnets and their Addresses
- The Second Subnet
- The Third Subnet
- Planning for Growth
- The Current Picture
- Sequential Allocation Error
- A Future Fourth Subnet
- With The Fourth Subnet
- Subnetting Subnets

### 6. Address Resolution Protocol

- Address Mapping
- ARP Cache
- ARP Restrictions
- ARP Message Fields
- Hardware and Protocol Types
- Hardware and Protocol Address Lengths
- Operation
- Addresses
- Exception
- LAN Fill
- How Else Can ARP Help?
- ARP Commands

## 7. Multicasting

- What is Multicasting?
- Uses of Multicasting
- Multicasting Overview
- Some Reserved IP Multicast Addresses
- " Multicast Groups and Internet Group Management Protocol (IGMP)
- Multicast Groups
- IGMP
- IGMP Restrictions
- Multicast Routing
- Mapping a Class D IP Address to an Ethernet Multicast Address
- How Does It All Work Together?

## 8. Internet Protocol

- TCP/IP Protocols
- Self-Healing Networking
- IP Header
- IP Header Layout
- Type of Service Byte
- Differentiated Services
- Total IP Length
- Datagram ID Number
- Fragmentation
- TTL
- Protocol Field
- IP Header Checksum
- IP Address
- IP Option Fields
- IP Sample Data Exchanges

## 9. IP Routing

- TCP/IP Protocol
- Routing Function
- The IP Routing Algorithm
- The Routing Table
- Routing Table Basics
- Automatic Table Maintenance
- Exterior or Interior Protocol
- Interior Gateway
- Exterior Gateway
- Routing Information Protocol
- RIP Routing Information Basics
- RIP Route Loops
- OSPF vs. RIP 1 vs. RIP 2
- Layer 3 Switching

## 10. Simple Sessions with User Datagram Protocol

- TCP/IP Protocols
- Host-to-Host Layer Categories
- Connectionless Protocol
- Connection-Oriented Protocol
- Low Overhead vs. Reliability
- UDP Header
- UDP Header Layout
- Port Basics
- UDP Ports and Sockets
- Applications
- UDP Sample Data Exchanges

## 11. Robust Sessions with TCP

- TCP/IP Protocols
- Reliable Transport Services
- Introduction to TCP
- TCP Headers
- TCP Source and Target Ports
- Source Sequence Number
- Acknowledgment Sequence Number
- TCP Header Length

- Session Bit Flags
- Flagging a Session
- Sender Window Size
- TCP Checksum
- Urgent Data Size
- Option Fields
- Maximum Segment and Window Size
- TCP Three-Step Handshake
- As the Session Flows
- Congestion and TCP
- Primary Cause
- Secondary Cause
- Four Step Session Shutdown
- Normal End
- Reset Session
- TCP Sample Session

## 12. Autoconfiguration

- BootP and DHCP
- Manual vs. Automatic Address Assignment
- Earlier Solutions
- DHCP New Lease Acquisition Process
- DHCP Discover
- DHCP Offer
- DHCP Request
- DHCP Acknowledgment
- DHCP Scopes and Options
- IP Lease Renewal
- DHCP in a Routed Network
- Troubleshooting
- The ipconfig /release Command
- The ipconfig /renew Command
- Multiple DHCP Servers

## 13. DNS: Names Instead of Numbers

- DNS Overview
- A Distributed Service
- The DNS Tree
- Generic Top-Level Domains
- Sponsored Top-Level Domains
- Country Domains
- Name Server
- Primary and Secondary Servers
- DNS Database
- DNS Cache Feature
- Resource Records
- The Name Resolution Process
- Name Query Packet
- Name Query Response Packet
- Reversing the Process
- Name and Number Organizations
- Dynamic DNS
- Troubleshooting

## 14. Diagnostics and Error Reports via ICMP

- ICMP Overview
- ICMP Basics
- ICMP Message Destinations
- Silent Discard vs. Informed Discard
- ICMP Messages
- ICMP Echo Request (Type 8) and Response (Type 0)
- Destination Unreachable (Type 3)
- Redirecting Traffic with an ICMP Message (Type 5)
- ICMP Time Exceeded Message (Type 11)
- ICMP Sample Data Exchanges

## 15. Common TCP Applications

- TCP/IP Protocols
- Uses of Telnet

- Telnet Option Negotiations
- Telnet Protocol Options
- File Transfer Protocol (FTP)
- Multiple Sessions
- FTP Commands
- FTP Response Codes
- E-mail
- SMTP Commands
- SMTP Response Codes
- POP3
- POP3 Transaction State
- IMAP4
- World Wide Web
- Uniform Resource Locator (URL)
- HTTP Requests and Responses

## 16. Common UDP Applications

- TCP/IP Protocols
- Trivial File Transfer Protocol (TFTP)
- TFTP Transfer Process
- TFTP Operation Codes
- TFTP Sample Sessions
- Read Session
- Write Session
- Error Session
- Simple Network Management Protocol (SNMP)
- SNMP Manager Model
- SNMP Agent Model
- SNMP Commands
- The Structure of Management Information
- Management Information Base
- Private MIBs
- Remote Network Monitoring

## 17. VoIP

- What is VoIP?
- Why VoIP Instead of TDM Voice?
- Uses for VoIP
- Talk to Operator
- Communication Characteristics
- Protocol Standards
- H.323
- SIP
- MGCP RFCs
- H.248 MEGACO
- Real-Time Transport Protocol
- G.7xx Standards
- How VoIP Works
- Gatekeeper Call Server
- Hard Phone vs. Soft Phone
- Dial Tone
- Security
- LANs and WANs
- VoIP and LANs
- VoIP and WANs
- Bandwidth and QoS

## 18. Security

- Protocol Limitations
- C-I-A Triad
- Threats
- Disaster Threats
- Attack Threats
- Attacks
- Malicious Code
- Types of Attackers
- Solutions
- Securing Systems
- User Authentication

- Security-Related Protocols and IPsec
- IPsec Components
- IPsec Session
- Virtual Private Networks (VPNs)
- Establishing a VPN Connection
- PPTP Encapsulation
- PPTP Encryption
- L2TP Encapsulation
- L2TP Encryption

## 19. IPv6

- Overview
- Addressing
- IPv6 Address Categories
- IPv6 Address Formats
- Interface Identification
- Interface Identifier
- Address Type Identification
- Header
- Extension Headers
- ICMPv6
- Destination Unreachable
- Packet Too Big
- Time Exceeded
- Parameter Problem
- Echo Request and Echo Reply
- Neighbor Solicitation
- Neighbor Advertisement
- Redirect Message
- IPv6 DNS operation
- DNS Sample Records
- Routing Services and Protocols
- Static Routing
- RIPng
- OSPFv3
- MP-BGP (Multiprotocol extensions for BGP)
- EIGRP for IPv6
- Internet2