

CCNA 1: Networking Basics

**Cisco Networking Academy Program
Version 3.1**

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Target Audience

The target audience is anyone who desires a practical, technical introduction to the field of networking. This includes high school students, community college students, and lifelong-learning students who are interested in careers as network technicians, network engineers, network administrators, and network help-desk staff.

Prerequisites

The successful completion of this course, requires the following:

- Reading Age Level (RAL) of 13
- Basic computer literacy and awareness of the Internet

The following skills are beneficial, but not required:

- Prior experience with computer hardware, binary math, and basic electronics
- Background in cabling

Course Description

CCNA 1: Networking Basics is the first of four courses leading to the Cisco Certified Network Associate (CCNA) designation. CCNA 1 introduces Cisco Networking Academy Program students to the networking field. The course focuses on the following:

- Network terminology
- Network protocols
- Local-area networks (LANs)
- Wide-area networks (WANs)
- Open System Interconnection (OSI) model
- Cabling
- Cabling tools
- Routers
- Router programming
- Ethernet
- Internet Protocol (IP) addressing
- Network standards

In addition, the course provides instruction and training in the proper care, maintenance, and use of networking software, tools, and equipment.

Course Objectives

The CCNA certification indicates knowledge of networking for the small office, home office (SOHO) market, and the ability to work in small businesses or organizations using networks that have fewer than 100 nodes. A CCNA certified individual can perform the following tasks:

- Install and configure Cisco switches and routers in multiprotocol internetworks using LAN and WAN interfaces
- Provide Level 1 troubleshooting service
- Improve network performance and security
- Perform entry-level tasks in the planning, design, installation, operation, and troubleshooting of Ethernet and TCP/IP networks.

CCNA 1 is an important step toward achieving CCNA certification.

Upon completion of this course, students will be able to perform tasks related to the following:

- Networking mathematics, terminology, and models
- Networking media such as copper, optical, and wireless
- Testing and cabling LANs and WANs
- Ethernet Operation and 10/100/1000/10 G versions of Ethernet
- Ethernet Switching
- IP addressing and subnetting
- IP, TCP, UDP, and application layer protocols

Lab Requirements

Please refer to the CCNA Equipment Bundle Spreadsheets on Academy Connection.

Certification Alignment

The curriculum is aligned with the Cisco Internet Learning Solution Group (ILSG) INTRO and ICND courses.

Course Overview

The course has been designed for 70 contact hours. Approximately 35 hours will be designated to lab activities and 35 hours will be spent on curriculum content. A case study on structured cabling is required, but format and timing will be determined by the Local Academy.

The following changes have taken place since CCNA version 2.x:

- More information on optical and wireless media
- More cable testing terminology and concepts

- More details on the operation of Ethernet
- More focus on Fast, Gigabit, and 10-Gigabit Ethernet
- Structured cabling resource materials have been moved to the case study
- Case study is now required with format and timing determined by the Local Academy
- More interactive flash activities
- Lab focus on cable making, building small networks, and interconnecting devices

The following changes have taken place since CCNA version 3.0:

- Technical updates
- Improved readability

Course Outline

Module 1. Introduction to Networking

Overview

1.1 Your Connection to the Internet

- 1.1.1 Requirements for Internet connection
- 1.1.2 PC basics
- 1.1.3 Network interface card
- 1.1.4 NIC and modem installation
- 1.1.5 Overview of high-speed and dialup connectivity
- 1.1.6 TCP/IP description and configuration
- 1.1.7 Testing connectivity with ping
- 1.1.8 Web browser and plug-ins
- 1.1.9 Troubleshooting Internet connection problems

1.2 Networking Math

- 1.2.1 Binary presentation of data
- 1.2.2 Bits and bytes
- 1.2.3 Base 10 number system
- 1.2.4 Base 2 number system
- 1.2.5 Converting decimal numbers to 8-bit binary numbers
- 1.2.6 Converting 8-bit binary numbers to decimal numbers
- 1.2.7 Four-octet dotted decimal representation of 32-bit binary numbers
- 1.2.8 Hexadecimal
- 1.2.9 Boolean or binary logic
- 1.2.10 IP addresses and network masks

Summary

Module 2. Networking Fundamentals

Overview

2.1 Networking Terminology

- 2.1.1 Data networks
- 2.1.2 Network history
- 2.1.3 Networking devices
- 2.1.4 Network topology

- 2.1.5 Network protocols
 - 2.1.6 Local-area networks (LANs)
 - 2.1.7 Wide-area networks (WANs)
 - 2.1.8 Metropolitan-area networks (MANs)
 - 2.1.9 Storage-area networks (SANs)
 - 2.1.10 Virtual private network (VPN)
 - 2.1.11 Benefits of VPNs
 - 2.1.12 Intranets and extranets
 - 2.2 Bandwidth
 - 2.2.1 Importance of bandwidth
 - 2.2.2 Analogies
 - 2.2.3 Measurement
 - 2.2.4 Limitations
 - 2.2.5 Throughput
 - 2.2.6 Data transfer calculation
 - 2.2.7 Digital versus analog
 - 2.3 Networking Models
 - 2.3.1 Using layers to analyze problems in a flow of materials
 - 2.3.2 Using layers to describe data communication
 - 2.3.3 OSI model
 - 2.3.4 OSI layers
 - 2.3.5 Peer-to-peer communications
 - 2.3.6 TCP/IP model
 - 2.3.7 Detailed encapsulation process
- Summary

Module 3. Networking Media

Overview

3.1 Copper Media

- 3.1.1 Atoms and electrons
- 3.1.2 Voltage
- 3.1.3 Resistance and impedance
- 3.1.4 Current
- 3.1.5 Circuits
- 3.1.6 Cable specification and termination

- 3.1.7 Coaxial cable
- 3.1.8 STP cable
- 3.1.9 UTP cable
- 3.2 Optical Media
 - 3.2.1 The electromagnetic spectrum
 - 3.2.2 Ray model of light
 - 3.2.3 Reflection
 - 3.2.4 Refraction
 - 3.2.5 Total internal reflection
 - 3.2.6 Multimode fiber
 - 3.2.7 Single-mode fiber
 - 3.2.8 Other optical components
 - 3.2.9 Signals and noise in optical fibers
 - 3.2.10 Installation, care, and testing of optical fiber
- 3.3 Wireless Media
 - 3.3.1 Wireless LAN organizations and standards
 - 3.3.2 Wireless devices and topologies
 - 3.3.3 How wireless LANs communicate
 - 3.3.4 Authentication and association
 - 3.3.5 The radio wave and microwave spectrums
 - 3.3.6 Signals and noise on a WLAN
 - 3.3.7 Wireless security
- Summary

Module 4. Cable Testing

Overview

- 4.1 Background for Studying Frequency-Based Cable Testing
 - 4.1.1 Waves
 - 4.1.2 Sine waves and square waves
 - 4.1.3 Exponents and logarithms
 - 4.1.4 Decibels
 - 4.1.5 Time and frequency signals
 - 4.1.6 Analog and digital signals in time and frequency
 - 4.1.7 Noise in time and frequency
 - 4.1.8 Bandwidth

4.2 Signals and Noise

- 4.2.1 Signaling over copper and fiber optic cabling
- 4.2.2 Attenuation and insertion loss on copper media
- 4.2.3 Sources of noise on copper media
- 4.2.4 Types of crosstalk
- 4.2.5 Cable testing standards
- 4.2.6 Other test parameters
- 4.2.7 Time-based parameters
- 4.2.8 Testing optical fiber
- 4.2.9 A new standard

Summary

Module 5. Cabling LANs and WANs

Overview

5.1 Cabling the LAN

- 5.1.1 LAN physical layer
- 5.1.2 Ethernet in the campus
- 5.1.3 Ethernet media and connector requirements
- 5.1.4 Connection media
- 5.1.5 UTP implementation
- 5.1.6 Repeaters
- 5.1.7 Hubs
- 5.1.8 Wireless
- 5.1.9 Bridges
- 5.1.10 Switches
- 5.1.11 Host connectivity
- 5.1.12 Peer-to-peer
- 5.1.13 Client-server

5.2 Cabling the WANs

- 5.2.1 WAN physical layer
- 5.2.2 WAN serial connections
- 5.2.3 Routers and serial connections
- 5.2.4 Routers and ISDN BRI connections
- 5.2.5 Routers and DSL connections
- 5.2.6 Routers and cable connections

- 5.2.7 Setting up console connections
- Summary

Module 6. Ethernet Fundamentals

Overview

6.1 Ethernet Fundamentals

- 6.1.1 Introduction to Ethernet
- 6.1.2 IEEE Ethernet naming rules
- 6.1.3 Ethernet and the OSI model
- 6.1.4 Naming
- 6.1.5 Layer 2 framing
- 6.1.6 Ethernet frame structure
- 6.1.7 Ethernet frame fields

6.2 Ethernet Operation

- 6.2.1 MAC
- 6.2.2 MAC rules and collision detection/backoff
- 6.2.3 Ethernet timing
- 6.2.4 Interframe spacing and backoff
- 6.2.5 Error handling
- 6.2.6 Types of collisions
- 6.2.7 Ethernet errors
- 6.2.8 FCS and beyond
- 6.2.9 Ethernet auto-negotiation
- 6.2.10 Link establishment and full/half duplex

Summary

Module 7. Ethernet Technologies

Overview

7.1 10 Mbps and 100 Mbps Ethernet

- 7.1.1 10 Mbps Ethernet
- 7.1.2 10BASE5
- 7.1.3 10BASE2
- 7.1.4 10BASE-T
- 7.1.5 10BASE-T wiring and architecture
- 7.1.6 100-Mbps Ethernet

- 7.1.7 100BASE-TX
- 7.1.8 100BASE-FX
- 7.1.9 Fast Ethernet architecture
- 7.2 Gigabit and 10-Gigabit Ethernet
 - 7.2.1 1000-Mbps Ethernet
 - 7.2.2 1000BASE-T
 - 7.2.3 1000BASE-SX and LX
 - 7.2.4 Gigabit Ethernet architecture
 - 7.2.5 10-Gigabit Ethernet
 - 7.2.6 10-Gigabit Ethernet architectures
 - 7.2.7 Future of Ethernet
- Summary

Module 8. Ethernet Switching

Overview

- 8.1 Ethernet Switching
 - 8.1.1 Layer 2 bridging
 - 8.1.2 Layer 2 switching
 - 8.1.3 Switch operation
 - 8.1.4 Latency
 - 8.1.5 Switch modes
 - 8.1.6 Spanning-Tree protocol
- 8.2 Collision Domains and Broadcast Domains
 - 8.2.1 Shared media environments
 - 8.2.2 Collision domains
 - 8.2.3 Segmentation
 - 8.2.4 Layer 2 broadcasts
 - 8.2.5 Broadcast domains
 - 8.2.6 Introduction to data flow
 - 8.2.7 What is a network segment?

Summary

Module 9. TCP/IP Protocol Suite and IP Addressing

Overview

- 9.1 Introduction to TCP/IP

- 9.1.1 History and future of TCP/IP
 - 9.1.2 Application layer
 - 9.1.3 Transport layer
 - 9.1.4 Internet layer
 - 9.1.5 Network access layer
 - 9.1.6 The OSI model and the TCP/IP model
 - 9.1.7 Internet architecture
 - 9.2 Internet Addresses
 - 9.2.1 IP addressing
 - 9.2.2 Decimal and binary conversion
 - 9.2.3 IPv4 addressing
 - 9.2.4 Class A, B, C, D, and E IP addresses
 - 9.2.5 Reserved IP addresses
 - 9.2.6 Public and private IP addresses
 - 9.2.7 Introduction to subnetting
 - 9.2.8 IPv4 versus IPv6
 - 9.3 Obtaining an IP Address
 - 9.3.1 Obtaining an Internet address
 - 9.3.2 Static assignment of an IP address
 - 9.3.3 RARP IP address assignment
 - 9.3.4 BOOTP IP address assignment
 - 9.3.5 DHCP IP address management
 - 9.3.6 Problems in address resolution
 - 9.3.7 Address Resolution Protocol (ARP)
- Summary

Module 10. Routing Fundamentals and Subnets

Overview

10.1 Routed Protocol

- 10.1.1 Routable and routed protocols
- 10.1.2 IP as a routed protocol
- 10.1.3 Packet propagation and switching with a router
- 10.1.4 Connectionless and connection-oriented delivery
- 10.1.5 Anatomy of an IP packet

10.2 IP Routing Protocols

- 10.2.1 Routing overview
 - 10.2.2 Routing versus switching
 - 10.2.3 Routed versus routing
 - 10.2.4 Path determination
 - 10.2.5 Routing tables
 - 10.2.6 Routing algorithms and metrics
 - 10.2.7 IGP and EGP
 - 10.2.8 Link state and distance vector
 - 10.2.9 Routing protocols
 - 10.3 The Mechanics of Subnetting
 - 10.3.1 Classes of network IP addresses
 - 10.3.2 Introduction to and reason for subnetting
 - 10.3.3 Establishing the subnet mask address
 - 10.3.4 Applying the subnet mask
 - 10.3.5 Subnetting Class A and B networks
 - 10.3.6 Calculating the resident subnetwork through ANDing
- Summary

Module 11. TCP/IP Transport and Application Layer

Overview

11.1 TCP/IP Transport Layer

- 11.1.1 Introduction to transport layer
- 11.1.2 Flow control
- 11.1.3 Session establishment, maintenance, and termination overview
- 11.1.4 Three-way handshake
- 11.1.5 Windowing
- 11.1.6 Acknowledgement
- 11.1.7 TCP
- 11.1.8 UDP
- 11.1.9 TCP and UDP port numbers

11.2 The Application Layer

- 11.2.1 Introduction to the TCP/IP application layer
- 11.2.2 DNS
- 11.2.3 FTP and TFTP
- 11.2.4 HTTP

- 11.2.5 SMTP
 - 11.2.6 SNMP
 - 11.2.7 Telnet
- Summary

Case Study: Structured Cabling