31 Days Before Your CCNA Exam

Second Edition

Allan Johnson

A Day-By-Day Review Guide for the CCNA 640-802 Exam

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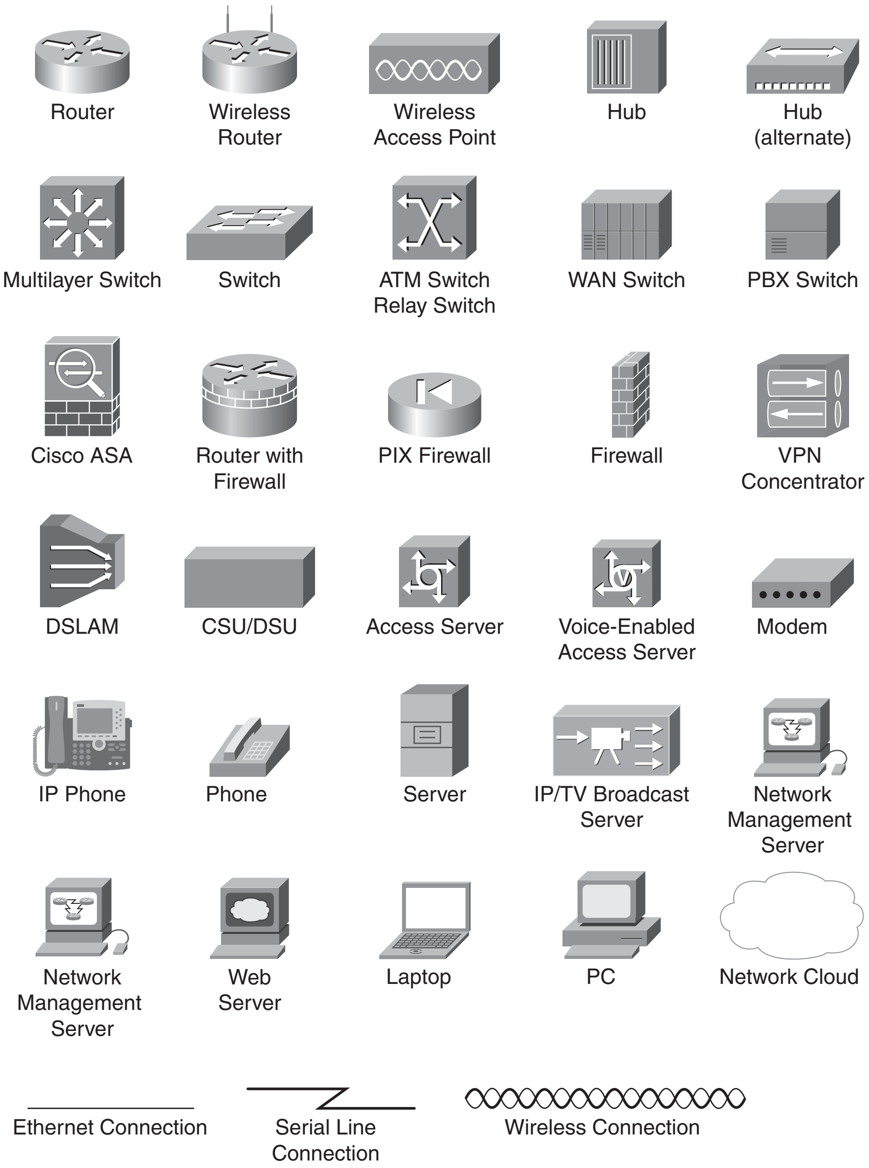


Command Syntax Conventions

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

You are almost there! If you're reading this Introduction, you've probably already spent a considerable amount of time and energy pursuing your CCNA certification. Regardless of how you got to this point in your travels through your CCNA studies, *31 Days Before Your CCNA Exam* most likely represents the last leg of your journey on your way to the destination: to become a Cisco Certified Network Associate. However if you are like me, you might be reading this book at the *beginning* of your studies. If such is the case, this book provides you with an excellent overview of the material you must now spend a great deal of time studying and practicing. I must warn you, though; unless you are extremely well versed in networking technologies and have considerable experience configuring and troubleshooting Cisco routers and switches, this book will *not* serve you well as the sole resource for CCNA exam preparation. Therefore, let me spend some time discussing my recommendations for study resources.

Study Resources

Cisco Press offers an abundance of CCNA-related books to serve as your primary source for learning how to install, configure, operate, and troubleshoot medium-size routed and switched networks. See the inside cover of this book for a quick list of my recommendations.

Foundational Resources

First on the list must be Wendell Odom's *CCNA Official Exam Certification Library*, Third Edition (ISBN: 1587201836). If you do not buy any other books, buy this set of two. Wendell's method of teaching, combined with his technical expertise and down-to-earth style, is unsurpassed in our industry. As you read through his books, you sense that he is sitting right there next to you walking you through the material. The practice exams and study materials on the CD in the back of the book are worth the price of the book. There is no better resource on the market for a CCNA candidate.

Next on the list must be Steve McQuerry's *Authorized Self-Study Guide CCNA Preparation Library*, Seventh Edition (ISBN: 1587054647). These two books are indispensable to those students who take the two Cisco recommended training classes for CCNA preparation: Interconnecting Cisco Network Devices 1 (ICND1) and Interconnecting Cisco Network Devices 2 (ICND2). These courses, available through Cisco Training Partners in a variety of formats, are usually of a very short duration (1 to 6 weeks) and are geared toward the industry professional already working in the field of networking. Steve's books serve the reader well as a concise, but thorough, treatment of the CCNA exam topics. His method and approach often differ from and complement Wendell's approach. I recommend that you also refer to these books.

If you are a Cisco Networking Academy student, you are blessed with access to the online version of the CCNA curriculum and the wildly popular Packet Tracer network simulator. Although there are two versions of the CCNA curriculum—Discovery and Exploration—I chose to use the four CCNA Exploration courses in my daily review of the exam topics. The Exploration curriculum provides a comprehensive overview of networking, from fundamentals to advanced applications and services. The Exploration courses emphasize theoretical concepts and practical application, while providing opportunities for students to gain the skills and hands-on experience needed to design, install, operate, and maintain networks in small-to-medium businesses, as well as enterprise and service provider environments. In an Academy class, not only do you have access to Packet Tracer, but you have access to extensive, guided labs and real equipment on which to practice your CCNA skills. To learn more about CCNA Exploration and to find an Academy near you, visit http://www.cisco.com/web/learning/netacad/course_catalog/CCNAexploration.html.

However, if you are not an Academy student but would like to benefit from the extensive authoring done for these courses, you can buy any or all of the CCNA Exploration Companion Guides (CG) and Lab Study Guides (LSG) of the Academy's popular online curriculum. Although you will not have access to the Packet Tracer network simulator software, you will have access to the tireless work of an outstanding team of Cisco Academy Instructors dedicated to providing students with comprehensive and engaging CCNA preparation course material. The titles and ISBNs for the CCNA Exploration CGs and LSGs are as follows:

- Network Fundamentals (CG ISBN: 1587132087; LSG ISBN: 1587132036)
- Routing Protocols and Concepts (CG ISBN: 1587132060; LSG ISBN: 1587132044)
- LAN Switching and Wireless (CG ISBN: 1587132079; LSG ISBN: 1587132028)
- Accessing the WAN (CG ISBN: 1587132052; LSG ISBN: 158713201X)

You can find these books at www.ciscopress.com by clicking the **CISCO NETWORKING ACADEMY** link.

Supplemental Resources

In addition to the book you hold in your hands, I recommend two more supplemental resources to augment your final 31 days of review and preparation.

First, Eric Rivard and Jim Doherty are coauthors of *CCNA Flash Cards and Exam Practice Pack,* Third Edition (ISBN: 1587201909). The text portion of the book includes more than 700 flash cards that quickly review exam topics in bite-sized pieces. Also included are nearly 200 pages of quick-reference sheets designed for late-stage exam preparation. And the included CD features a test engine with more than 500 CCNA practice exam questions.

Second, Wendell Odom has put together an excellent collection of more than four hours of personal, visual instruction in one package, titled *CCNA Video Mentor,* Second Edition (ISBN: 1587201917). It contains a DVD with 20 videos and a lab manual. Wendell walks you through common Cisco router and switch configuration topics designed to develop and enhance your hands-on skills.

The Cisco Learning Network

Finally, if you have not done so already, you should now register with the Cisco Learning Network at http://cisco.hosted.jivesoftware.com/. Sponsored by Cisco, the Cisco Learning Network is a free social-learning network where IT professionals can engage in the common pursuit of enhancing and advancing their IT careers. Here you will find many resources to help you prepare for your CCNA exam, as well as a community of like-minded people ready to answer your questions, help you with your struggles, and share in your triumphs.

So which resources should you buy? That question is largely up to how deep your pockets are or how much you like books. If you're like me, you must have it all! I admit it. My bookcase is a testament to my Cisco "geekness." But if you are on a budget, choose one of the foundational study resources and one of the supplemental resources, such as Wendell Odom's certification library and Rivard/Doherty's flash cards. Whatever you choose, you will be in good hands. Any or all of these authors will serve you well.

Goals and Methods

The main goal of this book is to provide you with a clear and succinct review of the CCNA objectives. Each day's exam topics are grouped into a common conceptual framework that uses the following format:

- A title for the day that concisely states the overall topic
- A list of one or more CCNA 640-802 exam topics to be reviewed
- A Key Topics section to introduce the review material and quickly orient you to the day's focus
- An extensive review section consisting of short paragraphs, lists, tables, examples, and graphics
- A Study Resources section to provide a quick reference for locating more in-depth treatment of the day's topics

The book counts down starting with Day 31 and continues through exam day to provide post-test information. You will also find a calendar and checklist that you can tear out and use during your exam preparation inside the book.

Use the calendar to enter each actual date beside the countdown day and the exact day, time, and location of your CCNA exam. The calendar provides a visual for the time that you can dedicate to each CCNA exam topic.

The checklist highlights important tasks and deadlines leading up to your exam. Use it to help you map out your studies.

Who Should Read This Book?

The audience for this book is anyone finishing preparation for taking the CCNA 640-802 exam. A secondary audience is anyone needing a refresher review of CCNA exam topics—possibly before attempting to recertify or sit for another certification to which the CCNA is a prerequisite.

Getting to Know the CCNA 640-802 Exam

For the current certifications, announced in June 2007, Cisco created the ICND1 (640-822) and ICND2 (640-816) exams, along with the CCNA (640-802) exam. To become CCNA certified, you can pass both the ICND1 and ICND2 exams, or just the CCNA exam. The CCNA exam covers all the topics on the ICND1 and ICND2 exams, giving you two options for gaining your CCNA certification. The two-exam path gives people with less experience a chance to study for a smaller set of topics at one time. The one-exam option provides a more cost-effective certification path for those who want to prepare for all the topics at once. This book focuses exclusively on the one-exam path using the entire list of exam topics for the CCNA 640-802 exam.

Currently for the CCNA exam, you are allowed 90 minutes to answer 50–60 questions. Use the following steps to access a tutorial at home that demonstrates the exam environment before you go to take the exam:

Step 1 Visit http://www.vue.com/cisco.

Step 2 Look for a link to the certification tutorial. Currently, it can be found on the right side of the web page under the heading Related Links.

Step 3 Click the Certification tutorial link.

When you get to the testing center and check in, the proctor verifies your identity, gives you some general instructions, and then takes you into a quiet room containing a PC. When you're at the PC, you have a few things to do before the timer starts on your exam. For instance, you can take the tutorial to get accustomed to the PC and the testing engine. Every time I sit for an exam, I go through the tutorial, even though I know how the test engine works. It helps me settle my nerves and get focused. Anyone who has user-level skills in getting around a PC should have no problems with the testing environment.

When you start the exam, you are asked a series of questions. Each question is presented one at a time and must be answered before moving on to the next question. The exam engine does not let you go back and change your answer. The exam questions can be in one of the following formats:

- Multiple choice
- Fill-in-the-blank
- Drag-and-drop
- Testlet
- Simlet
- Simulation

The multiple-choice format requires that you point and click a circle or check box next to the correct answer or answers. Cisco traditionally tells you how many answers you need to choose, and the testing software prevents you from choosing too many or too few.

Fill-in-the-blank questions typically require you only to type numbers. However if words are requested, the case does not matter unless the answer is a command that is case sensitive (such as passwords and device names when configuring authentication).

Drag-and-drop questions require you to click and hold, move a button or icon to another area, and release the mouse button to place the object somewhere else—typically in a list. For some questions, to get the question correct, you might need to put a list of five things in the proper order.

Testlets contain one general scenario and several multiple-choice questions about the scenario. These are ideal if you are confident in your knowledge of the scenario's content because you can leverage your strength over multiple questions.

A simlet is similar to a testlet in that you are given a scenario with several multiple-choice questions. However, a simlet uses a network simulator to allow you access to a simulation of the command line of Cisco IOS Software. You can then use **show** commands to examine a network's current behavior and answer the question.

A simulation also uses a network simulator, but you are given a task to accomplish, such as implementing a network solution or troubleshooting an existing network implementation. You do this by configuring one or more routers and switches. The exam then grades the question based on the configuration you changed or added. A newer form of the simulation question is the GUI-based simulation, where a graphical interface like that found on a Linksys router or the Cisco Security Device Manager is simulated.

What Topics Are Covered on the CCNA Exam

The topics of the CCNA 640-802 exam focus on the following eight key categories:

- Describe how a network works.
- Configure, verify and troubleshoot a switch with VLANs and interswitch communications.
- Implement an IP addressing scheme and IP Services to meet network requirements in a medium-size enterprise branch office network.
- Configure, verify, and troubleshoot basic router operation and routing on Cisco devices.
- Explain and select the appropriate administrative tasks required for a WLAN.
- Identify security threats to a network and describe general methods to mitigate those threats.
- Implement, verify, and troubleshoot NAT and ACLs in a medium-size enterprise branch office network.
- Implement and verify WAN links.

Although Cisco outlines general exam topics, it is possible that not all topics will appear on the CCNA exam and that topics that are not specifically listed might appear on the exam. The exam topics provided by Cisco and included in this book are a general framework for exam preparation. Be sure to check the Cisco website for the latest exam topics.

Cisco Networking Academy Student Discount Voucher

If you are a Cisco Networking Academy student, you have the opportunity to earn a discount voucher to use when registering and paying for your exam with Pearson VUE. To receive the discount voucher, you must complete all four courses of the CCNA Exploration curriculum and receive a score of 75 percent or higher on your first attempt of the final exam for the final CCNA Exploration course, *Accessing the WAN*. The amount of the discount varies by region and testing center, but typically it has been as much as 50% off the full exam price. Log in to the Academy Connection and click Help at the top of the page to research more information on receiving a discount voucher.

Registering for the CCNA 640-802 Exam

If you are starting your *31 Days to Your CCNA* today, register for the exam right now. In my testing experience, there is no better motivator than a scheduled test date staring me in the face. I'm willing to bet it's the same for you. Don't worry about unforeseen circumstances. You can cancel your exam registration for a full refund up to 24 hours before taking the exam. So if you're ready, you should gather the following information in Table I-1 and register right now!

Table I-1 Personal Information for CCNA 640-802 Exam Registration

Item	Notes
Legal Name	
Social Security or Passport Number	
Cisco Certification ID or Test ID[1]	
Cisco Academy Username[2]	
Cisco Academy ID Number[2]	
Company Name	
Valid Email Address	
Voucher Number[2]	
Method of Payment	

[1] Applies to exam candidates if you have previously taken a Cisco certification exam (such as the ICND1 exam)

[2] Applies to Cisco Networking Academy students only

To register for an exam, contact Pearson VUE via one of the following methods:

- **Online**: http://www.vue.com/cisco.
- **By phone**: In the United States and Canada call 1-800-829-6387, option 1, then option 4. Check the website for information regarding other countries.

The process and available test times will vary based on the local testing center you choose.

Remember, there is no better motivation for study than an actual test date. *Sign up today.*

Day 28

Connecting Switches and Ethernet Technology

CCNA 640-802 Exam Topics

- Explain the technology and media access control method for Ethernet networks.
- Select the appropriate media, cables, ports, and connectors to connect switches to other network devices and hosts.

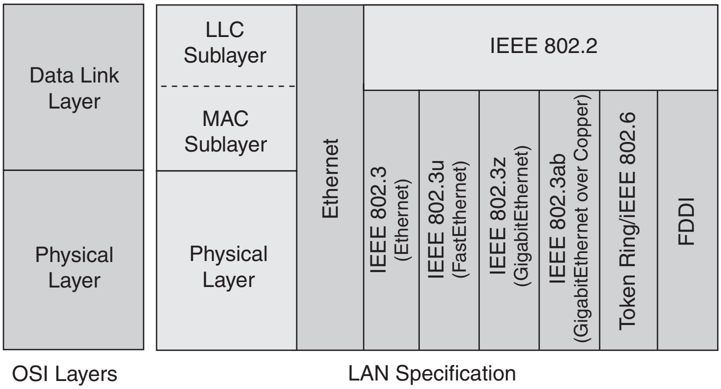
Key Topics

Ethernet has continued to evolve from the 10BASE2 flavor capable of speeds up to 185 Mbps to the newest 10GigE (10 Gigabit Ethernet) capable of speeds up to 10 Gbps. Since 1985, IEEE has continued to upgrade the 802.3 standards to provide faster speeds without changing the underlying frame structure. This feature, among others, has made Ethernet the choice for LAN implementations worldwide. Today we review Ethernet technologies and operation at both the data link and physical layer.

Ethernet Overview

802.3 is the IEEE standard for Ethernet, and both terms are commonly used interchangeably. The terms Ethernet and 802.3 both refer to a family of standards that together define the physical and data link layers of the definitive LAN technology. Figure 28-1 shows a comparison of Ethernet standards to the OSI model.

Figure 28-1 Ethernet Standards and the OSI Model



Ethernet separates the functions of the data link layer into two distinct sublayers:

- **Logical Link Control (LLC) sublayer:** Defined in the 802.2 standard.
- **Media Access Control (MAC) sublayer:** Defined in the 802.3 standard.

The LLC sublayer handles communication between the network layer and the MAC sublayer. In general, LLC provides a way to identify the protocol that is passed from the data link layer to the network layer. In this way, the fields of the MAC sublayer are not populated with protocol type information, as was the case in earlier Ethernet implementations.

The MAC sublayer has two primary responsibilities:

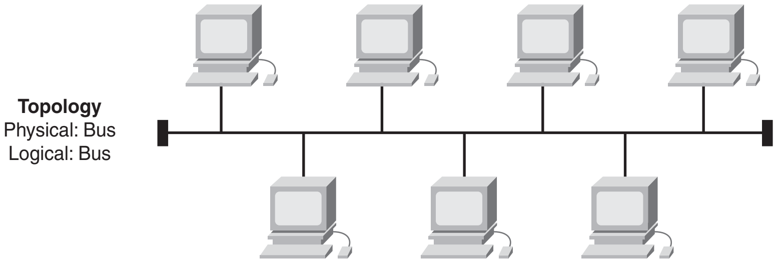
- **Data Encapsulation:** Includes frame assembly before transmission, frame parsing upon reception of a frame, data link layer MAC addressing, and error detection.
- **Media Access Control:** Because Ethernet is a shared media and all devices can transmit at any time, media access is controlled by a method called Carrier Sense Multiple Access with Collision Detection (CSMA/CD).

At the physical layer, Ethernet specifies and implements encoding and decoding schemes that enable frame bits to be carried as signals across both unshielded twisted-pair (UTP) copper cables and optical fiber cables. In early implementations, Ethernet used coaxial cabling.

Legacy Ethernet Technologies

Ethernet is best understood by first considering the two early Ethernet specifications—10BASE5 and 10BASE2. With these two specifications, the network engineer installs a series of coaxial cables connecting each device on the Ethernet network, as shown in Figure 28-2.

Figure 28-2 Ethernet Physical and Logical Bus Topology

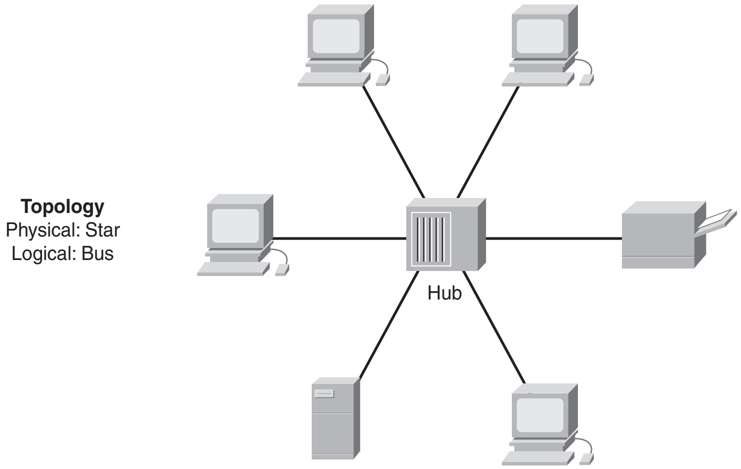


The series of cables creates an electrical circuit, called a bus, which is shared among all devices on the Ethernet. When a computer wants to send some bits to another computer on the bus, it sends an electrical signal, and the electricity propagates to all devices on the Ethernet.

With the change of media to UTP and the introduction of the first hubs, Ethernet physical topologies migrated to a star as shown in Figure 28-3.

Regardless of the change in the physical topology from a bus to a star, hubs logically operate similar to a traditional bus topology and require the use of CSMA/CD.

Figure 28-3 Ethernet Physical Star and Logical Bus Topology



CSMA/CD

Because Ethernet is a shared media where every device has the right to send at any time, it also defines a specification for how to ensure that only one device sends traffic at a time. The CSMA/CD algorithm defines how the Ethernet logical bus is accessed.

CSMA/CD logic helps prevent collisions and also defines how to act when a collision does occur. The CSMA/CD algorithm works like this:

1. A device with a frame to send listens until the Ethernet is not busy.
2. When the Ethernet is not busy, the sender(s) begin(s) sending the frame.
3. The sender(s) listen(s) to make sure that no collision occurred.
4. If a collision occurs, the devices that had been sending a frame each send a jamming signal to ensure that all stations recognize the collision.
5. After the jamming is complete, each sender randomizes a timer and waits that long before trying to resend the collided frame.
6. When each random timer expires, the process starts again from the beginning.

When CSMA/CD is in effect, it also means that a device's network interface card (NIC) is operating in half-duplex mode—either sending or receiving frames. CSMA/CD is disabled when a NIC autodetects that it can operate in—or is manually configured to operate in—full duplex mode. In full duplex mode, a NIC can send and receive simultaneously.

Legacy Ethernet Summary

Today, you might occasionally use LAN hubs, but you will more likely use switches instead of hubs. However, keep in mind the following key points about the history of Ethernet:

- The original Ethernet LANs created an electrical bus to which all devices connected.
- 10BASE2 and 10BASE5 repeaters extended the length of LANs by cleaning up the electrical signal and repeating it—a Layer 1 function—but without interpreting the meaning of the electrical signal.

- Hubs are repeaters that provide a centralized connection point for UTP cabling—but they still create a single electrical bus, shared by the various devices, just like 10BASE5 and 10BASE2.
- Because collisions could occur in any of these cases, Ethernet defines the CSMA/CD algorithm, which tells devices how to both avoid collisions and take action when collisions do occur.

Current Ethernet Technologies

Refer back to Figure 28-1 and notice the different 802.3 standards. Each new physical layer standard from the IEEE requires many differences at the physical layer. However, each of these physical layer standards uses the same 802.3 header, and each uses the upper LLC sublayer as well. Table 28-1 lists today's most commonly used IEEE Ethernet physical layer standards.

Table 28-1 Today's Most Common Types of Ethernet

Common Name	Speed	Alternative Name	Name of IEEE Standard	Cable Type, Maximum Length
Ethernet	10 Mbps	10BASE-T	IEEE 802.3	Copper, 100 m
Fast Ethernet	100 Mbps	100BASE-TX	IEEE 802.3u	Copper, 100 m
Gigabit Ethernet	1000 Mbps	1000BASE-LX, 1000BASE-SX	IEEE 802.3z	Fiber, 550 m (SX) 5 km (LX)
Gigabit Ethernet	1000 Mbps	1000BASE-T	IEEE 802.3ab	Copper, 100 m
10GigE (Gigabit Ethernet)	10 Gbps	10GBASE-SR, 10GBASE-LR	IEEE 802.3ae	Fiber, up to 300 m (SR), up to 25 km (LR)
10GigE (Gigabit Ethernet)	10 Gbps	10GBASE-T	IEEE 802.3an	Copper, 100 m

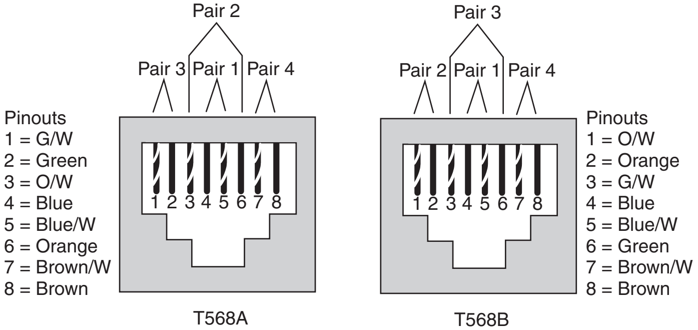
UTP Cabling

The three most common Ethernet standards used today—10BASE-T (Ethernet), 100BASE-TX (Fast Ethernet, or FE), and 1000BASE-T (Gigabit Ethernet, or GE)—use UTP cabling. Some key differences exist, particularly with the number of wire pairs needed in each case and in the type (category) of cabling.

The UTP cabling used by popular Ethernet standards include either two or four pairs of wires. The cable ends typically use an RJ-45 connector. The RJ-45 connector has eight specific physical locations into which the eight wires in the cable can be inserted, called pin positions or, simply, pins.

The Telecommunications Industry Association (TIA) and the Electronics Industry Alliance (EIA) define standards for UTP cabling, color coding for wires, and standard pinouts on the cables. Figure 28-4 shows two TIA/EIA pinout standards, with the color coding and pair numbers listed.

Figure 28-4 TIA/EIA Standard Ethernet Cabling Pinouts



For the exam, you should be well prepared to choose which type of cable (straight-through or crossover) is needed in each part of the network. In short, devices on opposite ends of a cable that use the same pair of pins to transmit need a crossover cable. Devices that use an opposite pair of pins to transmit need a straight-through cable. Table 28-2 lists typical devices and the pin pairs they use, assuming that they use 10BASE-T and 100BASE-TX.

Table 28-2 10BASE-T and 100BASE-TX Pin Pairs Used

Devices That Transmit on 1,2 and Receive on 3,6	Devices That Transmit on 3,6 and Receive on 1,2
PC NICs	Hubs
Routers	Switches
Wireless Access Point (Ethernet interface)	N/A
Networked printers (printers that connect directly to the LAN)	N/A

1000BASE-T requires four wire pairs because Gigabit Ethernet transmits and receives on each of the four wire pairs simultaneously.

However, Gigabit Ethernet does have a concept of straight-through and crossover cables, with a minor difference in the crossover cables. The pinouts for a straight-through cable are the same—pin 1 to pin 1, pin 2 to pin 2, and so on. The crossover cable crosses the same two-wire pair as the crossover cable for the other types of Ethernet—the pair at pins 1,2 and 3,6—as well as crossing the two other pairs (the pair at pins 4,5 with the pair at pins 7,8).

Benefits of Using Switches

A collision domain is a set of devices whose frames could collide. All devices on a 10BASE2, 10BASE5, or any network using a hub risk collisions between the frames that they send, so all devices on one of these types of Ethernet networks are in the same collision domain and use CSMA/CD to detect and resolve collisions.

LAN switches significantly reduce, or even eliminate, the number of collisions on a LAN. Unlike hubs, switches do not create a single shared bus. Instead, switches do the following:

- Switches interpret the bits in the received frame so that they can typically send the frame out the one required port, rather than all other ports.
- If a switch needs to forward multiple frames out the same port, the switch buffers the frames in memory, sending one at a time, thereby avoiding collisions.

In addition, switches with only one device cabled to each port of the switch allow the use of full-duplex operation. Full-duplex means that the NIC can send and receive concurrently, effectively doubling the bandwidth of a 100 Mbps link to 200 Mbps—100 Mbps for sending and 100 Mbps for receiving.

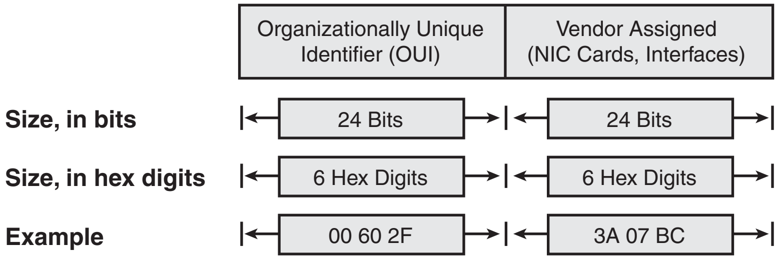
These seemingly simple switch features provide significant performance improvements as compared with using hubs. In particular:

- If only one device is cabled to each port of a switch, no collisions can occur.
- Devices connected to one switch port do not share their bandwidth with devices connected to another switch port. Each has its own separate bandwidth, meaning that a switch with 100 Mbps ports has 100 Mbps of bandwidth per port.

Ethernet Addressing

The IEEE defines the format and assignment of LAN addresses. To ensure a unique MAC address, the first half of the address identifies the manufacturer of the card. This code is called the organizationally unique identifier (OUI). Each manufacturer assigns a MAC address with its own OUI as the first half of the address. The second half of the address is assigned by the manufacturer and is never used on another card or network interface with the same OUI. Figure 28-5 shows the structure of a unicast Ethernet address.

Figure 28-5 Structure of Unicast Ethernet Address



Ethernet also has group addresses, which identify more than one NIC or network interface. The IEEE defines two general categories of group addresses for Ethernet:

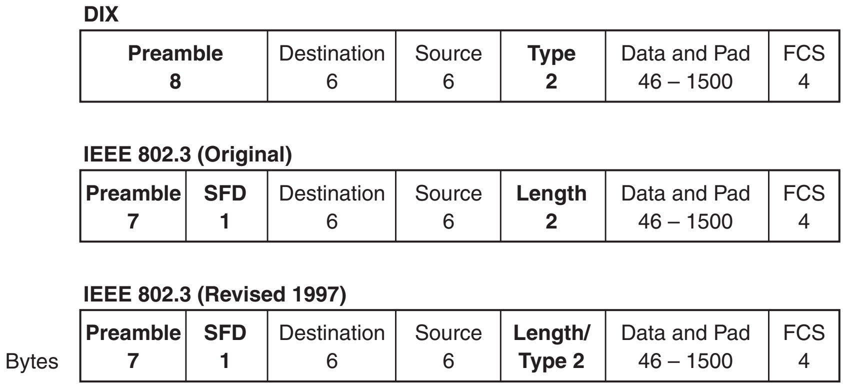
- **Broadcast addresses:** The broadcast address implies that all devices on the LAN should process the frame and has a value of FFFF.FFFF.FFFF.
- **Multicast addresses:** Multicast addresses are used to allow a subset of devices on a LAN to communicate. When IP multicasts over an Ethernet, the multicast MAC addresses used by IP follow this format: 0100.5exx.xxxx, where any value can be used in the last half of the address.

Ethernet Framing

The physical layer helps you get a string of bits from one device to another. The framing of the bits allows the receiving device to interpret the bits. The term *framing* refers to the definition of the fields assumed to be in the data that is received. Framing defines the meaning of the bits transmitted and received over a network.

The framing used for Ethernet has changed a couple of times over the years. Each iteration of Ethernet is shown in Figure 28-6, with the current version shown at the bottom.

Figure 28-6 Ethernet Frame Formats



DIX

Preamble	Destination	Source	**Type**	Data and Pad	FCS
8	6	6	**2**	46 – 1500	4

IEEE 802.3 (Original)

Preamble	**SFD**	Destination	Source	**Length**	Data and Pad	FCS
7	**1**	6	6	**2**	46 – 1500	4

IEEE 802.3 (Revised 1997)

	Preamble	**SFD**	Destination	Source	**Length/**	Data and Pad	FCS
Bytes	**7**	**1**	6	6	**Type 2**	46 – 1500	4

The fields in the last version shown in Figure 28-6 are explained further in Table 28-3.

Table 28-3 IEEE 802.3 Ethernet Field Descriptions

Field	Field Length in Bytes	Description
Preamble	7	Synchronization
Start Frame Delimiter (SFD)	1	Signifies that the next byte begins the Destination MAC field
Destination MAC address	6	Identifies the intended recipient of this frame
Source MAC address	6	Identifies the sender of this frame
Length	2	Defines the length of the data field of the frame (either length or type is present, but not both)
Type	2	Defines the type of protocol listed inside the frame (either length or type is present, but not both)
Data and Pad	46–1500	Holds data from a higher layer, typically a Layer 3 PDU (generic), and often an IP packet
Frame Check Sequence (FCS)	4	Provides a method for the receiving NIC to determine whether the frame experienced transmission errors

The Role of the Physical Layer

We have already discussed the most popular cabling used in LANs—UTP. But to fully understand the operation of the network, you should know some additional basic concepts of the physical layer.

The OSI physical layer accepts a complete frame from the data link layer and encodes it as a series of signals that are transmitted onto the local media.

The delivery of frames across the local media requires the following physical layer elements:

- The physical media and associated connectors
- A representation of bits on the media
- Encoding of data and control information
- Transmitter and receiver circuitry on the network devices

There are three basic forms of network media on which data is represented:

- Copper cable
- Fiber
- Wireless (IEEE 802.11)

Bits are represented on the medium by changing one or more of the following characteristics of a signal:

- Amplitude
- Frequency
- Phase

The nature of the actual signals representing the bits on the media will depend on the signaling method in use. Some methods may use one attribute of a signal to represent a single 0 and use another attribute of a signal to represent a single 1. The actual signaling method and its detailed operation are not important to your CCNA exam preparation.

Study Resources

For today's exam topics, refer to the following resources for more study.

Resource	Chapter	Topic	Where to Find It
Foundational Resources			
CCNA Exploration Online Curriculum: Network Fundamentals	Chapter 8, "OSI Physical Layer"	All topics within the chapter	Chapter 8
	Chapter 9, "Ethernet"	Overview of Ethernet	Section 9.1
		Ethernet—Communication through the LAN	Section 9.2
		The Ethernet Frame	Section 9.3
		Ethernet Media Access Control	Section 9.4
		Ethernet Physical Layer	Section 9.5
		Address Resolution Protocol (ARP)	Section 9.7
	Chapter 10, "Planning and Cabling Networks"	Making LAN Connections	Section 10.2.2
CCNA Exploration Online Curriculum: LAN Switching and Wireless	Chapter 2, "Basic Switch Concepts and Configuration"	Key Elements of Ethernet/ 802.3 Networks	Section 2.2.1
CCNA Exploration Network Fundamentals Companion Guide	Chapter 8, "OSI Physical Layer"	All topics within the chapter	pp. 279–306
	Chapter 9, "Ethernet"	Overview of Ethernet	pp. 315–320
		Ethernet: Communication through the LAN	pp. 320–324
		The Ethernet Frame	pp. 324–334
		Ethernet MAC	pp. 334–342
		Ethernet Physical Layer	pp. 342–347
		Address Resolution Protocol (ARP)	pp. 355–361
	Chapter 10, "Planning and Cabling Networks"	Making LAN Connections	pp. 380–384
CCNA Exploration LAN Switching and Wireless Companion Guide	Chapter 2, "Basic Switch Concepts and Configuration"	Key Elements of Ethernet/ 802.3 Networks	pp. 46–52
ICND1 Official Exam Certification Guide	Chapter 3, "Fundamentals of LANs"	All topics within the chapter	pp. 45–69
ICND1 Authorized Self-Study Guide	Chapter 1, "Building a Simple Network"	Understanding Ethernet	pp. 104–115
		Connecting to an Ethernet LAN	pp. 115–124
	Chapter 2, "Ethernet LANs"	Understanding the Challenges of Shared LANs	pp. 139–144
Supplemental Resources			
CCNA Flash Cards and Exam Practice Pack	ICND1, Section 3	Understanding Ethernet	pp. 70–84

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