

Networking Fundamentals

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CERN

an organization that is responsible for the original development of the World Wide Web.

Underwriters**Laboratories (UL)**

a nonprofit organization that tests products and materials against safety standards.

Electronic Industry Association (EIA)

a trade association that is concerned with radio communications.

Telecommunications Industry Association (TIA)

an organization that is concerned with fiber optics, user equipment, network devices, wireless communications, and satellite communications.

American National Standards Institute (ANSI)

a private, nonprofit organization that does not develop standards, but rather prompts voluntary conformity and standardization.

Open Systems Interconnection (OSI) model

a model that describes how hardware and software should work together to form a network communications system.

eXtensible Hypertext Markup Language (XHTML), and Cascading Style Sheets (CSS). The Internet uses these programming languages to present text, graphics, and sound. A protocol known as Hypertext Transport Protocol (HTTP) delivers Web pages to a user's computer.

The Internet has become a standard tool for business. An entire chapter in this textbook is devoted to Web servers. It includes an introduction to HTML and Web server communications.

CERN

CERN is an acronym for *Centre European pour la Recherche Nucléaire* (European Center for Nuclear Research). It is located in Geneva, Switzerland. One of the first Hypertext Transfer Protocol servers was placed online in Geneva and is still in operation. This organization is responsible for the original development of the World Wide Web.

UL

Underwriters Laboratories (UL) is a nonprofit organization that tests products and materials for safety standards. Typically, electrical materials and equipment must be UL approved before they can be used in many facilities or as part of a contract specification.

EIA

The **Electronic Industry Association (EIA)** began in 1948 as a trade association concerned with radio communication. It was originally formed as the Radio Manufacturers Association and was responsible for standards such as RS-232. The EIA sponsors many trade shows and conferences throughout the United States.

TIA

The **Telecommunications Industry Association (TIA)** was founded in 1924 by a small group of suppliers who wished to promote the independent telephone industry and to organize trade shows. It soon evolved into a standards maintenance organization. The main areas that TIA is concerned with are fiber optics, user equipment, network equipment, wireless communications, and satellite communications.

ANSI

In 1918, five engineering societies and three government organizations founded the **American National Standards Institute (ANSI)**. ANSI is a private, nonprofit organization that does not develop standards, but rather prompts voluntary conformity and standardization. ANSI is the official representative of many international organizations such as the ISO. ANSI is also one of the founders of the ISO organization. ANSI facilitates meetings and brings together interested parties to resolve issues and create a general census among its members to be presented to other standards committees.

OSI Model

The **Open Systems Interconnection (OSI) model** describes how hardware and software should work together to form a network communications system. It serves as a guide for troubleshooting and designing networks.

The OSI model consists of seven layers, **Figure 1-26**. Each layer in the OSI model is assigned a specific function. This section provides a brief description of each layer. It is intended as an overview of how networking components work together to send and receive information. The OSI model is referenced throughout the textbook and is discussed in detail in Chapter 17—A Closer Look at the OSI Model.

The OSI model is a joint effort of international members to standardize networking communications systems. Not all software companies follow the strict guidelines of the OSI model. Many systems were in place long before the OSI model was developed and adopted. Some models combine two or more layers into a single unit. It is important to remember that the OSI model simply serves as a guide for future development and illustrates the complexity of transmitting data between network devices.



Physical Layer

The *physical layer* is the lowest layer of the model. It consists of the cable and connectors used for constructing the network. This layer is only concerned with how digital signals, the binary 1s and 0s, are carried electrically from one networked device to another. When you think of the physical layer, think of cables, radio waves or light pulses, 1s and 0s, and digital signals.

physical layer
the lowest layer of the OSI model, which focuses on the physical characteristics of a network such as cabling and connectors.

Data Link Layer

The *data link layer* describes how the raw data is packaged for transfer from one network interface card to another. The data link layer also contains information such as the address of the source and destination and the size of the packet, and it provides for error checking. When you think of the data link layer, think of packaging and placing the packet as a stream of digital pulses on the network media.

data link layer
the layer of the OSI model that describes how raw data is packaged for transfer from one network interface card to another.

Network Layer

The *network layer* is responsible for routing packets from one network to another using the IP addressing format. Routing prevents or limits network congestion. It also can prioritize the transmission of packets. As packets are transmitted from one network to another, several different routes may be used. If there is too much traffic on one cable section, the packet may be transmitted along a different route to avoid congestion. When you think of the network layer, think of navigating between networks.

network layer
the layer of the OSI model that is responsible for routing packets from one network to another using the IP addressing format.

Application
Presentation
Session
Transport
Network
Data link
Physical

Figure 1-26.
The seven layers of the OSI model.

transport layer
the layer of the OSI model that ensures reliable data by sequencing packets and reassembling them into their correct order.

session layer
the layer of the OSI model that establishes a connection between two computers and provides security based on computer and user name recognition.

presentation layer
the layer of the OSI model that ensures character code recognition.

application layer
the highest layer of the OSI model that starts network data communications using a program such as e-mail or a Web browser.

Transport Layer

The main responsibility of the *transport layer* is to ensure reliable data by sequencing packets and reassembling them into their correct order. Packets are transmitted over many miles and may use different routes. The packets may not arrive in the same sequence they were transmitted and may require reassembly into their correct order. Reassembly into the correct order is especially important in transmitting digital images. When you think of the transport layer, think of packet quality.

Session Layer

The *session layer* establishes a connection between two different computers and provides security based on computer and user name recognition. The two computers may not normally be compatible for data exchange, such as a PC and a Macintosh. The session layer and transport layers are sometimes combined. When you think of the session layer, think of a handshake at the introduction and at the end of the meeting.

Presentation Layer

The *presentation layer* ensures character-code recognition. It is responsible for converting character codes into a code that is recognizable by a computer that uses a different character code. For example, Extended Binary Coded Decimal Interchange Code (EBCDIC) is widely used on mainframes, while most PCs use ASCII. EBCDIC uses numbers to represent characters similar to the way ASCII number codes represent character codes. When a PC communicates with a mainframe, the ASCII code must be converted to EBCDIC. When you think of the presentation layer, think of how the data must look for both parties to interpret or understand it.

Application Layer

The *application layer* should not be confused with general software applications. The application layer works with specific networking applications such as Web browser programs, file transfer programs, and e-mail. When you think of the application layer, think of establishing communication with the network.



Network+

Network+ Note:

The Network+ Certification exam by CompTIA requires extensive knowledge of the OSI model and how it relates to network devices, protocols, and network technologies. If the OSI model seems confusing to you, you are not alone. You cannot have a complete understanding of the OSI model until you have a basic understanding of all the networking technologies and how they relate to each other.

OSI Model and Network Devices

It is important to understand how the OSI model and network devices correlate. Look at **Figure 1-27**. In this figure you will see the generally accepted classifications of network devices, such as hubs, switches, and routers, as compared to the OSI model. However, some alterations in the network device's technology may cause a network device to correlate to a different OSI layer.

Network devices are classified according to whether the device makes decisions about how a packet is sent. If the network device makes no decision about where a packet is sent, it is a *layer 1 device*. The device simply moves the packet along the network path such as through cabling, hubs, and repeaters. If decisions are made based on a MAC address or a logical name, it is a *layer 2 device*. If the network device makes a decision about where to move the data based on a protocol such as the Internet protocol, it is a *layer 3 device*.

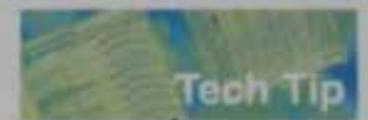
A network device is often reclassified when its normal function is altered. For example, a switch, normally classified as a layer 2 device, may be reclassified as a layer 3 device if more intelligent decision making is incorporated into it. The decision making of a layer 3 switch is based on some similar information that routers use. A hub, which is normally a layer 1 device, may be reclassified as a layer 2 device when it acts as an intelligent hub. Intelligent hubs make decisions based on MAC addresses and behave more like a switch.

layer 1 device
a network device that makes no decision about where a packet is sent.

layer 2 device
a network device that makes decisions about where a packet is sent based on a MAC address or a logical name.

layer 3 device
a network device that makes a decision about where a packet is sent based on a protocol such as the Internet protocol.

Some switches may be classified as a layer 1 device or layer 3 device. The general classification for the switch is layer 2 device; but if it has some router capabilities, it is usually labeled as a layer 3 device.



As you progress through the text and learn more about protocols and network communication, the exact placement of certain network devices on the OSI model will become clearer.

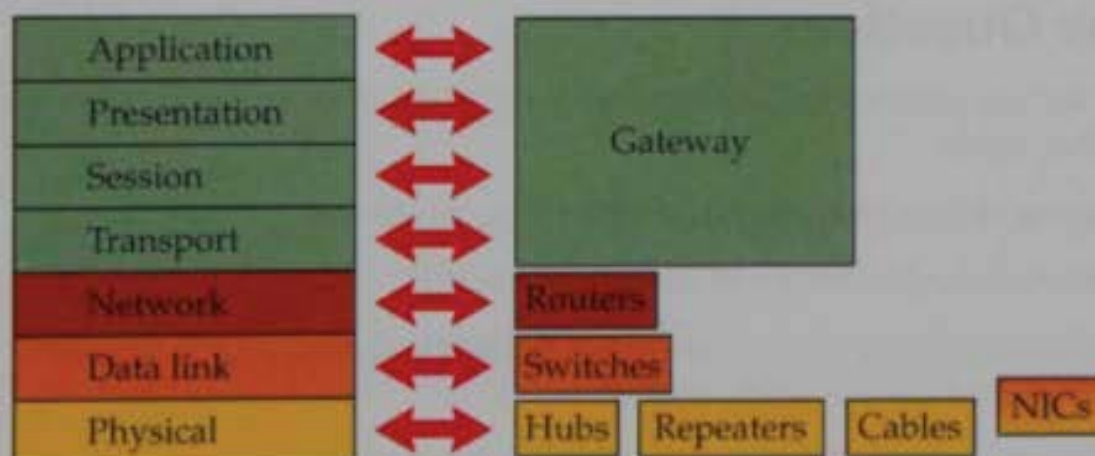


Figure 1-27.
A general correlation between network devices and the layers of the OSI model. This is only a general correlation. Some specific technologies may correlate a network device to a different OSI layer.