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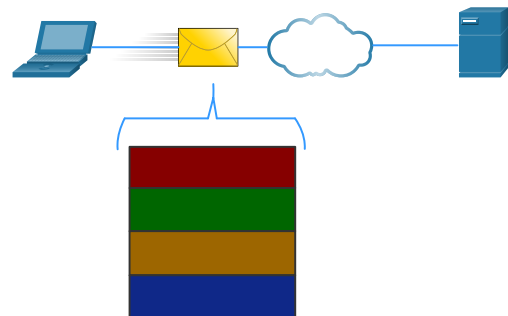
The Protocol Stack



Successful communication between hosts requires interaction between a number of protocols. These protocols are implemented in software and hardware that are installed on each host and networking device.

The interaction between the different protocols on a device can be illustrated as a protocol stack, as shown in the figure. A stack illustrates the protocols as a layered hierarchy, with each higher-level protocol depending on the services of the protocols shown in the lower levels.

The separation of functions enables each layer in the stack to operate independently of others. For example, you can use your laptop computer connected to a cable modem at home to access your favorite website, or view the same website on your laptop using a wireless connection at the library. The function of the web browser is not affected by the change in the physical location, nor the method of connectivity.



The protocols in the figure are described as follows:

- **Hypertext Transfer Protocol (HTTP)** - This protocol governs the way a web server and a web client interact. HTTP defines the content and formatting of the requests and responses that are exchanged between the client and server. Both the client and the web server software implement HTTP as part of the application. HTTP relies on other protocols to govern how the messages are transported between the client and server.
- **Transmission Control Protocol (TCP)** - This protocol manages the individual conversations.

HTTP

TCP

IP

Ethernet

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TCP is responsible for guaranteeing the reliable delivery of the information and managing flow control between the end devices.

- **Internet Protocol (IP)** - This protocol is responsible for delivering messages from the sender to the receiver. IP is used by routers to forward the messages across multiple networks.
- **Ethernet** - This protocol is responsible for the delivery of messages from one NIC to another NIC on the same Ethernet local area network (LAN).

5.3.4

The TCP/IP Model



Layered models help us visualize how the various protocols work together to enable network communications. A layered model depicts the operation of the protocols occurring within each layer, as well as the interaction with the layers above and below it. The layered model has many benefits:

- Assists in protocol design, because protocols that operate at a specific layer have defined information that they act upon and a defined interface to the layers above and below.
- Fosters competition because products from different vendors can work together.
- Enables technology changes to occur at one level without affecting the other levels.
- Provides a common language to describe networking functions and capabilities.

The first layered model for internetwork communications was created in the early 1970s and is referred to as the internet model. It defines four categories of functions that must occur in order for communications to be successful. The suite of TCP/IP protocols that are used for internet communications follows the structure of this model, as shown in the figure. Because of this, the internet model is commonly referred to as the TCP/IP model.

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TCP/IP Model Layer	Description
Application	Represents data to the user.
Transport	Supports communication between networks.
Internet	Determines the best path for data.
Network Access	Controls the hardware devices that connect to the network.

5.3.5

The OSI Reference Model

There are two basic types of models that we use to describe the functions that must occur in order for network communications to be successful: protocol models and reference models.

- Protocol model** - This model closely matches the structure of a particular protocol suite. A protocol suite includes the set of related protocols that typically provide all the functionality required for people to communicate with the data network. The TCP/IP model is a protocol model because it describes the functions that occur at each layer of protocols within the TCP/IP suite.
- Reference model** - This type of model describes the functions that must be completed at a particular layer, but does not specify exactly how a function should be accomplished. A reference model is not intended to provide a sufficient level of detail to define precisely how each protocol should work at each layer. The primary purpose of a reference model is to aid in clearer understanding of the functions and processes necessary for network communications.

The most widely known internetwork reference model was created by the Open Systems Interconnection (OSI) project at the International Organization for Standardization (ISO). It is used for data network design, operation specifications, and troubleshooting. This model is commonly referred to as the OSI model.

OSI Model Layer	Description
7 - Application	The application layer contains protocols that allow the exchange of data between applications.

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OSI Model Layer	Description
6 - Presentation	The presentation layer provides for application layer services.
5 - Session	The session layer provides service manage data exchange.
4 - Transport	The transport layer defines service communications between the end
3 - Network	The network layer provides service between identified end devices.
2 - Data Link	The data link layer protocols describe a common media
1 - Physical	The physical layer protocols describe to activate, maintain, and de-activate network device.

5.3.6

Upper and Lower Layers of the OSI Model

Moving data across a network can be visualized using the seven layers of the OSI model, as shown in the figure. The OSI model breaks network communications down into multiple processes. Each process is a small part of the larger task.

For example, in a vehicle manufacturing plant, the entire vehicle is not assembled by one person. Rather, the vehicle moves from station to station where specialized teams add specific components. The complex task of assembling a vehicle is made easier by breaking it into manageable and logical tasks. This process also makes troubleshooting easier. When a problem occurs in the manufacturing process, it is possible to isolate the problem to the specific task where the defect was introduced, and then fix it.

In a similar manner, the OSI model helps us troubleshoot by focusing on a specific layer to identify and resolve network problems. Networking teams often refer to different functions occurring on a network by the number of the OSI model layer that specifies that functionality. For example, the process of encoding the data bits for transmission across the

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media occurs at Layer 1, the physical layer. The formatting of data so it can be interpreted by the network connection in your laptop or phone is described at Layer 2, the data link layer.

Group	Layer Number	Layer Name	Com
Upper Layers	7	Application	• N
	6	Presentation	• E
	5	Session	• W
Lower Layers	4	Transport	• F
	3	Network	• N
	2	Data Link	• N
	1	Physical	• W

5.3.7

OSI Model and TCP/IP Model Comparison

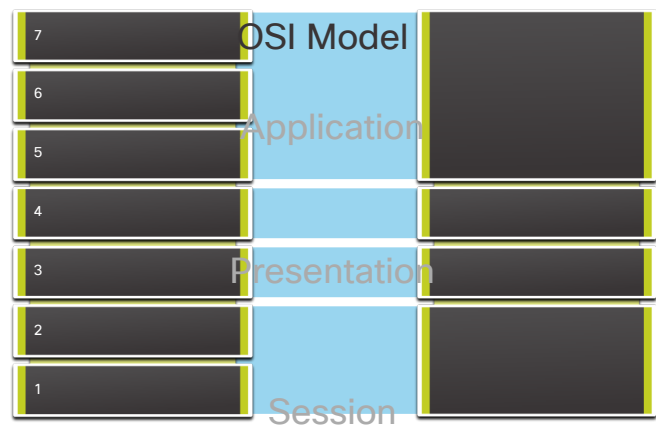
Because TCP/IP is the protocol suite in use for internet communications, why do we need to learn the OSI model as well?

The TCP/IP model is a method of visualizing the interactions of the various protocols that make up the TCP/IP protocol suite. It does not describe general functions that are necessary for all networking communications. It describes the networking functions specific to those protocols in use in the TCP/IP protocol suite. For example, at the network access layer, the TCP/IP protocol suite does not specify

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which protocols to use when transmitting over a physical medium, nor the method of encoding the signals for transmission. OSI Layers 1 and 2 discuss the necessary procedures to access the media and the physical means to send data over a network.

The protocols that make up the TCP/IP protocol suite can be described in terms of the OSI reference model. The functions that occur at the internet layer in the TCP/IP model are contained in the network layer of the OSI Model, as shown in the figure. The transport layer functionality is the same between both models. However, the network access layer and the application layer of the TCP/IP model are further divided in the OSI model to describe discrete functions that must occur at these layers.



The key similarities are in the transport and network layers; however, the two models differ in how they relate to the layers above and below each layer:

- OSI Layer 3, the network layer, maps directly to the TCP/IP internet layer. This layer is used to describe protocols that address and route messages through an internetwork.
- OSI Layer 4, the transport layer, maps directly to the TCP/IP transport layer. This layer describes general services and functions that provide ordered and reliable delivery of data between source and destination hosts.
- The TCP/IP application layer includes several protocols that provide specific functionality to a variety of end user applications. The OSI model Layers 5, 6, and 7 are used as references for application software developers and vendors to produce applications that operate on networks.
- Both the TCP/IP and OSI models are commonly used when referring to protocols at various



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Communication Principles



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Network Communication Models



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Check Your Understanding - Network Communication Models



Check your understanding of network communication models by choosing the correct answer to the following questions.

1. Which protocol is responsible for guaranteeing reliable delivery?

- ☐ HTTP
- ☐ TCP
- ☐ IP
- ☐ Ethernet

2. Which protocol is used by routers to forward messages?

- ☐ HTTP
- ☐ TCP
- ☐ IP
- ☐ Ethernet

3. Which two layers of the OSI Model maps directly as the single network access layer in the TCP/IP model? (Choose two)

- ☐ application
- ☐ presentation
- ☐

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session

transport

network

data link

physical

4. IP addressing occurs at what layer of the OSI Model?

application

presentation

session

transport

network

data link

physical

Check

Show Me

Reset

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