

# Module 5: Communication Principles

Networking Basics (BNET)



# Module Objectives

**Module Title:** Communication Principles

**Module Objective:** Explain the importance of standards and protocols in network communications.

Topic Title	Topic Objective
Communication Protocols	Describe network communication protocols.
Communication Standards	Describe network communication standards.
Network Communication Models	Compare the OSI and TCP/IP models.

# 5.1 Communication Protocols

# Communication Protocols

- Communication in our daily lives takes many forms and occurs in many environments.
- We have different expectations depending on whether we chat via the internet or participate in a job interview.
- Each situation has its corresponding expected behaviors and styles.
- Before beginning to communicate with each other, we establish rules or agreements to govern the conversation that includes the following:
  - What method of communication should we use?
  - What language should we use?
  - Do we need to confirm that our messages are received?

## Method

1. Uses sign language...

2. Writes note: *Sorry I do not understand signing.*

3. Writes note: *Can we use written notes?*

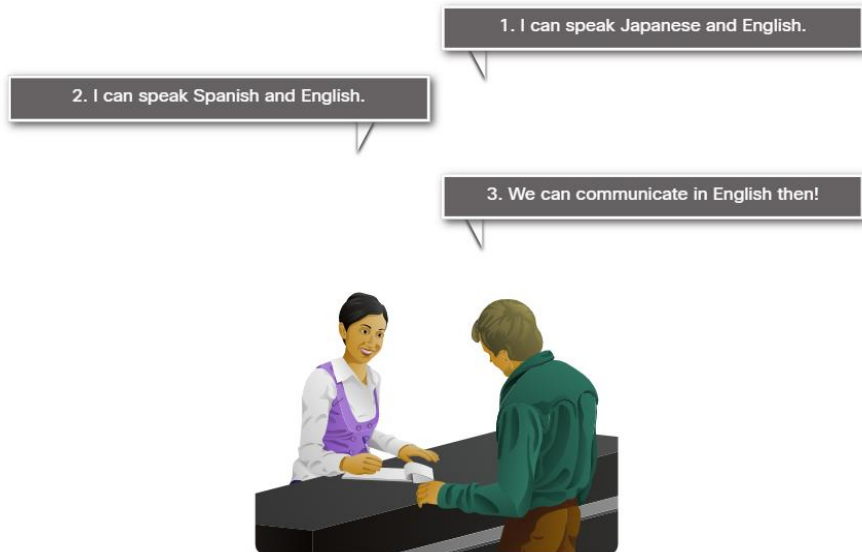
4. Writes note: *Yes, that will be fine.*



Before communication can begin, we may have to reach an agreement on the method used.

## Communication Protocols (Cont.)

### Language



Before communication can begin, we may have to reach an agreement on the language used.

### Confirmation



Communication is successful when the intended message has been received and confirmed.

# Communication Protocols (Cont.)

- These rules, or protocols, must be followed for the message to be successfully delivered and understood.
- Among the protocols that govern successful human communication are these:
  - An identified sender and receiver
  - Agreed upon a method of communicating (face-to-face, telephone, letter, photograph)
  - Common language and grammar
  - Speed and timing of delivery
  - Confirmation or acknowledgment requirements
- The techniques used in network communications share these fundamentals with human conversations.
- Think about the commonly accepted protocols for sending text messages to your friends.

# Why Protocols Matter

- Just like humans, computers use rules, or protocols, to communicate.
- Protocols are required for computers to communicate correctly across the network.
- In both a wired and wireless environment, a local network is defined as an area where all hosts must "speak the same language," which, in computer terms, means they must "share a common protocol."
- If everyone in the same room spoke a different language, they would not be able to communicate.
- Likewise, if devices in a local network did not use the same protocols, they would not be able to communicate.
- Networking protocols define many aspects of communication over the local network.

## Why Protocols Matter (Cont.)

Protocol Characteristic	Description
Message format	A sent message uses a specific format or structure. It depends on the message type, and the channel used to deliver the message.
Message size	The rules that govern the size of the pieces communicated across the network are stringent. They are different, depending on the channel used. A long message sent from one host to another over a network is necessary to break the message into smaller pieces, ensuring that the message is delivered reliably.
Timing	Many network communication functions are dependent on it. Timing determines the speed at which the bits are transmitted across the network. It also affects when an individual host sends data and the total amount of data sent in any transmission.
Encoding	Messages sent across the network are converted into bits by the sending host. Each bit is encoded into a pattern of sounds, light waves, or electrical impulses depending on the network media over which the bits are transmitted. The destination host receives and decodes the signals to interpret the message.
Encapsulation	Each message transmitted on a network includes a header that contains addressing information that identifies the source and destination hosts; otherwise, it cannot be delivered. Encapsulation is adding this information to the data that make up the message. In addition to addressing, there may be other information in the header that ensures the message is delivered to the correct application on the destination host.
Message pattern	Some messages require an acknowledgment before the following message can be sent. This request/response pattern is a common aspect of many networking protocols. However, other types of messages are streamed across the network without concern about whether they reach their destination.



# 5.2 Communication Standards

# Video - Devices in a Bubble

This video will explain the protocols devices use to see their place in the network and communicate with other devices.

# The Internet and Standards

- With the increasing number of new devices and technologies coming online, how is it possible to manage all the changes and still reliably deliver services such as email?
- The answer is internet standards.
- A standard is a set of rules determining how something must be done.
- Networking and internet standards ensure that all devices connecting to the network implement the same set of rules or protocols in the same manner.
- Different devices send information to each other over the internet using standards.

# Network Standards Organizations

- A comprehensive discussion, problem-solving, and testing cycle results in an internet standard.
- These different standards are developed, published, and maintained by various organizations, as shown in the figure.
- A proposed standard's development and approval process are recorded in a numbered RFC document, which tracks the evolution of the standard.
- RFCs for internet standards are published and managed by the IETF.



# 5.3 Network Communication Models

# Network Communication Models

## Video - Network Protocols

This video explains how network protocols help to govern the communication between two devices.

# Video - The Protocol Stack

This video explains the TCP/IP stack and how a device uses protocols from these stacks when creating a message to be sent over the network.

# The TCP/IP Model

- Layered models help us visualize how the various protocols work together to enable network communications.
- Layered models depict protocol operations occurring within each layer and the interaction with the layers above and below it.
- The layered model has many benefits:
  - It assists protocol design because protocols that operate at a specific layer have defined information that they act upon and a limited interface to the layers above and below.
  - It 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 referred to as the internet model.
- It defines four categories of functions that must occur for communications to be successful.



# The TCP/IP Model (Cont.)

- The suite of TCP/IP protocols used for internet communications follows the structure of this model, as shown in the table.
- Because of this, the internet model refers to the TCP/IP model.

TCP/IP Model Layer	Description
Application	Represents data to the user, plus encoding and dialog control.
Transport	Supports communication between various devices across diverse networks.
Internet	Determines the best path through the network.
Network Access	Controls the hardware devices and media that make up the network.

# The OSI Reference Model

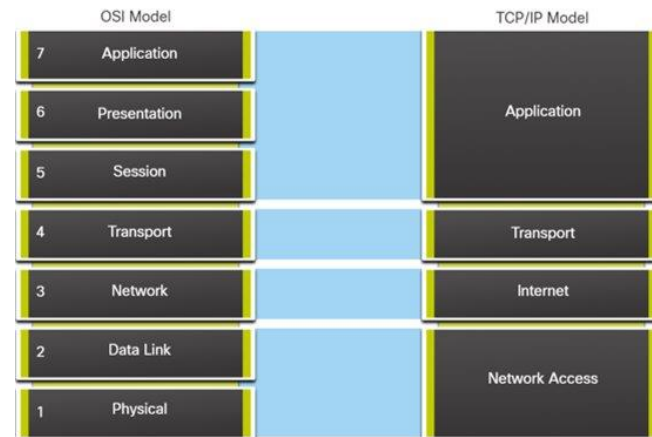
- There are two basic types of models that we use to describe the functions that must occur for network communications to be successful:
  - **Protocol model** - It closely matches the structure of a particular protocol suite. A protocol suite includes a set of related protocols that typically provide 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 at each layer of protocols within the TCP/IP suite.
  - **Reference model** – It describes the functions that must be completed at a particular layer but needs to specify exactly how a function should be accomplished. This model does not intend to provide sufficient detail to define precisely how each protocol should work at each layer. The primary purpose of a reference model is to aid in a clearer understanding of the functions and processes necessary for network communications.
- The OSI project at the ISO created the most widely known internetwork reference model.
- It is used for data network design, operation specifications, and troubleshooting.
- This model refers to the OSI model.

# The OSI Reference Model (Cont.)

OSI Model Layer	Description
7 - Application	The application layer contains protocols used for process-to-process communications.
6 - Presentation	The presentation layer provides a typical representation of the data transferred between application layer services.
5 - Session	The session layer provides services to the presentation layer to organize its dialogue and manage data exchange.
4 - Transport	The transport layer defines services to segment, transfer, and reassemble the data for individual communications between the end devices.
3 - Network	The network layer provides services to exchange individual data over the network between identified end devices.
2 - Data Link	The data link layer protocols describe methods for exchanging data frames between devices over shared media.
1 - Physical	The physical layer protocols describe the mechanical, electrical, functional, and procedural means to activate, maintain, and de-activate physical connections for a bit transmission to and from a network device.

# OSI Model and TCP/IP Model Comparison

- Because TCP/IP is the protocol suite used for internet communications, why do we need to learn the OSI model as well?
  - The TCP/IP model visualizes 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 the TCP/IP protocol suite.
  - The protocols that make up the TCP/IP protocol suite describes in terms of the OSI reference model.
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- 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.



# OSI Model and TCP/IP Model Comparison (Cont.)

- 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 describes protocols that address and route messages through the internetwork.
  - OSI Layer 4, the transport layer, maps directly to the TCP/IP transport layer. This layer describes general services and functions that deliver ordered and reliable data between source and destination hosts.
  - The TCP/IP application layer includes several protocols that provide specific functionality to various end-user applications. Application software developers and vendors use the OSI model Layers 5, 6, and 7 as references to produce applications that operate on networks.
  - The TCP/IP and OSI models commonly refer to protocols at various layers because the OSI model separates the data link layer from the physical layer, which commonly refers to these lower layers.

# 5.4 Communication Principles Summary

# What Did I Learn in this Module?

- Protocols are required for computers to communicate correctly across the network.
- These include message format, size, timing, encoding, encapsulation, and message patterns.
- Topologies allow us to see the networking using a representation of end and intermediary devices.
- The only thing a device sees is its addressing information.
- How does the device know it is on the same network as another device?
- The answer is network protocols.
- Most network communications break up into smaller data units or packets.
- A standard is a set of rules determining how something must be done.
- Networking and internet standards ensure that all devices connecting to the network implement the same set of rules or protocols in the same manner.
- Using standards, different types of devices can send information to each other over the internet.
- A comprehensive discussion, problem-solving, and testing cycle results in an internet standard.
- These different standards are developed, published, and maintained by various organizations.
- Each stage of the development and approval process records in a numbered RFC document, which tracks the evolution of the standard when a new standard proposes.
- Protocols are the rules that govern communications.

# What Did I Learn in this Module? (Cont.)

- Successful communication between hosts requires interaction between several protocols, including HTTP, TCP, IP, and Ethernet.
- Each host and networking device installs software and hardware that implements these protocols.
- A protocol stack illustrates interactions between different protocols on a device.
- Stacks illustrate 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.
- The suite of TCP/IP protocols used for internet communications has four layers: application, transport, internet, and network access.
- A reference model describes the functions that must be completed at a particular layer but do not specify precisely how a function should be accomplished.
- The primary purpose of a reference model is to aid in a more precise understanding of the functions and processes necessary for network communications.
- The OSI project at the ISO created the most widely known internetwork reference model.
- It is used for data network design, operation specifications, and troubleshooting.
- This model commonly referred to as the OSI model, has seven layers: application, presentation, session, transport, network, data link, and physical.