

# Module 1: Communications in a Connected World

Networking Essentials (NETESS)



# Module Objectives

Module Title: Communications in a Connected World

Module Objective: Explain the concept of network communication.

Topic Title	Topic Objective
Network Types	Explain the concept of a network.
Data Transmission	Describe network data.
Bandwidth and Throughput	Explain the network transmission speed and capacity.
Clients and Servers	Explain the roles of clients and servers in a network.
Network Components	Explain the roles of network infrastructure devices.

# 1.1 Network Types

# Everything is Online

The internet has become such a part of everyday life that we almost take it for granted.

Normally, when people use the term internet, they are not referring to the physical connections in the real world. Rather, they tend to think of it as a formless collection of connections. It is the “place” people go to find or share information.



# Who Owns “The Internet”?

The internet is not owned by any individual or group. The internet is a worldwide collection of interconnected networks (internetwork or internet for short), cooperating with each other to exchange information using common standards.



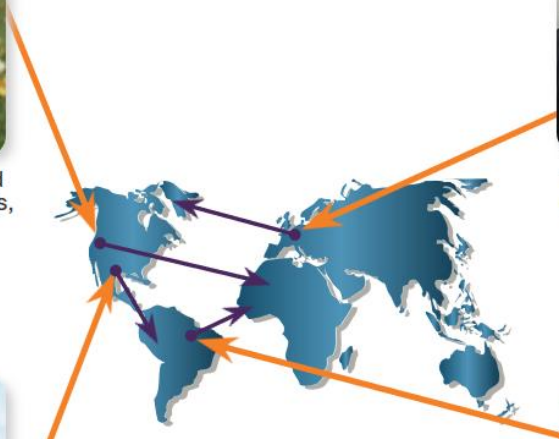
Intelligent networks allow handheld devices to receive news and emails, and to send text.



Video conferencing instantly connects people around the globe.



Phones connect globally to share voice, text, and images.



Online gaming connects thousands of people seamlessly.

## Network Types

# Local Networks

Small home networks connect a few computers to each other and to the internet.



The SOHO network allows computers in a home office or a remote office to connect to a corporate network, or access centralized, shared resources.



# Local Networks (Cont.)

Medium to large networks, such as those used by corporations and schools, can have many locations with hundreds or thousands of interconnected hosts.



The internet is a network of networks that connects hundreds of millions of computers world-wide.





# Video - Different Network Connections





# Mobile Devices

Smart phones combine the functions of many different products together, such as a telephone, camera, GPS receiver, media player, and touch screen computer.



Tablets come with on-screen keyboards, so users are able to do many of the things they used to do on their laptop computer, such as composing emails or browsing the web.



# Mobile Devices (Cont.)

A smartwatch can connect to a smart phone to provide the user with alerts and messages and other functions, such as heart rate monitoring and counting steps, can help people who are wearing the device to track their health.



A wearable computer in the form of glasses, such as Google Glass, contains a tiny screen that displays information to the wearer in a similar fashion to the Head-Up Display (HUD) of a fighter pilot.



# Connected Home Devices

With a connected security system, many items in a home, such as lighting and climate controls, can be monitored and configured remotely using a mobile device.



Household appliances such as refrigerators, ovens, and dishwashers can be connected to the internet.



# Connected Home Devices (Cont.)

A smart TV can be connected to the internet to access content without the need for TV service provider equipment.



Gaming consoles can connect to the internet to download games and play with friends online.

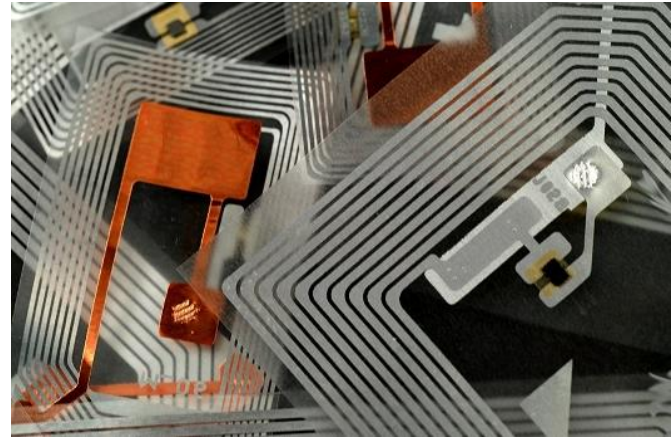


# Other Connected Devices

Many modern cars, known as Smart Cars, can connect to the internet to access maps, audio and video content, or information about a destination.



Radio frequency identification (RFIDs) tags can be placed in or on objects to track them or monitor sensors for many conditions.



# Other Connected Devices (Cont.)

Connected sensors can provide temperature, humidity, wind speed, barometric pressure, and soil moisture data. Actuators can then be automatically triggered based on current conditions



Medical devices such as pacemakers, insulin pumps, and hospital monitors provide users or medical professionals with direct feedback or alerts when vital signs are at specific levels.





# 1.2 Data Transmission

# Video - Types of Personal Data



# Types of Personal Data

The following categories are used to classify types of personal data:

- **Volunteered data** - This is created and explicitly shared by individuals, such as social network profiles. This type of data might include video files, pictures, text or audio files.
- **Observed data** - This is captured by recording the actions of individuals, such as location data when using cell phones.
- **Inferred data** - This is data such as a credit score, which is based on analysis of volunteered or observed data.

# The Bit

Did you know that computers and networks only work with binary digits, zeros and ones? Each bit can only have one of two possible values, 0 or 1. The term bit is an abbreviation of “binary digit” and represents the smallest piece of data. Humans interpret words and pictures, computers interpret only patterns of bits. Each group of eight bits, such as the representations of letters and numbers, is known as a byte.

Using the American Standard Code for Information Interchange (ASCII), each character is represented by eight bits. For example:

Capital letter: A = 01000001

Number: 9 = 00111001

Special character: # = 00100011

This page includes an ASCII bit translation engine where you can enter any character and see the 8 bit translation.

# Common Methods of Data Transmission

After the data is transformed into a series of bits, it must be converted into signals that can be sent across the network media to its destination. Media refers to the physical medium on which the signals are transmitted. Examples of media are copper wire, fiber-optic cable, and electromagnetic waves through the air. A signal consists of electrical or optical patterns that are transmitted from one connected device to another.

There are three common methods of signal transmission used in networks:

- **Electrical signals** - Transmission is achieved by representing data as electrical pulses on copper wire.
- **Optical signals** - Transmission is achieved by converting the electrical signals into light pulses.
- **Wireless signals** - Transmission is achieved by using infrared, microwave, or radio waves through the air.



# 1.3 Bandwidth and Throughput



# Bandwidth

Bandwidth is the capacity of a medium to carry data. Digital bandwidth measures the amount of data that can flow from one place to another in a given amount of time. Bandwidth is typically measured in the number of bits that (theoretically) can be sent across the media in a second.

Unit of Bandwidth	Abbreviation	Equivalence
Bits per second	bps	1 bps = fundamental unit of bandwidth
Kilobyte: Thousands of bits per second	kbps	1 kbps = 1,000 bps = $10^3$ bps
Megabyte: Millions of bits per second	Mbps	1 Mbps = 1,000,000 bps = $10^6$ bps
Gigabyte: Billions of bits per second	Gbps	1 Gbps = 1,000,000,000 bps = $10^9$ bps
Terabyte: Trillions of bits per second	Tbps	1 Tbps = 1,000,000,000,000 bps = $10^{12}$ bps

# Bandwidth and Throughput

## Video - Throughput

**CISCO** Networking Essentials | Throughput

0:01

CC [Volume] [Settings] [Full Screen]

# Throughput

Like bandwidth, throughput is the measure of the transfer of bits across the media over a given period of time. However, due to a number of factors, throughput does not usually match the specified bandwidth. Many factors influence throughput including:

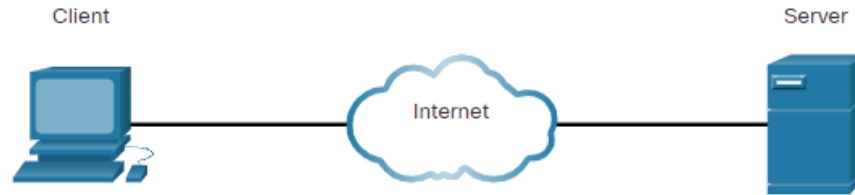
- The amount of data being sent and received over the connection
- The types of data being transmitted
- The latency created by the number of network devices encountered between source and destination

Latency refers to the amount of time, including delays, for data to travel from one given point to another.

# 1.4 Clients and Servers

# Clients and Server Roles

Clients are computer hosts that have software installed that enables the hosts to request and display the information obtained from the server. Servers are hosts that have software installed which enable them to provide information, like email or web pages, to other hosts on the network.



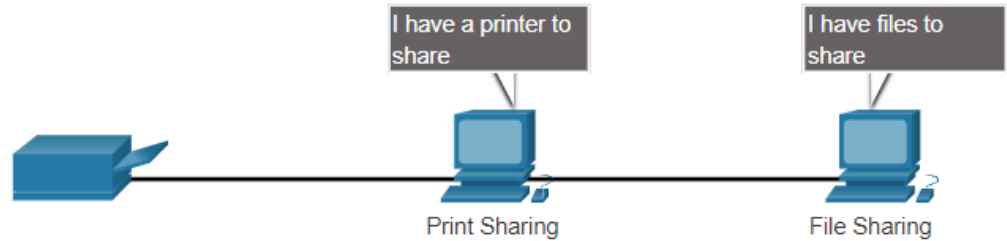
Type	Description
<b>Email</b>	The email server runs email server software. Clients use mail client software, such as Microsoft Outlook, to access email on the server.
<b>Web</b>	The web server runs web server software. Clients use browser software, such as Windows Internet Explorer, to access web pages on the server.
<b>File</b>	The file server stores corporate and user files in a central location. The client devices access these files with client software such as the Windows File Explorer.

# Peer-to-Peer Networks

In small businesses and homes, many computers function as the servers and clients on the network. This type of network is called a peer-to-peer (P2P) network. The simplest P2P network consists of two directly connected computers using either a wired or wireless connection.

### Advantages of P2P:

- Easy to set up
- Less complex than other networks
- Lower cost because network devices
- Can be used for simple tasks such as transferring files and sharing printers



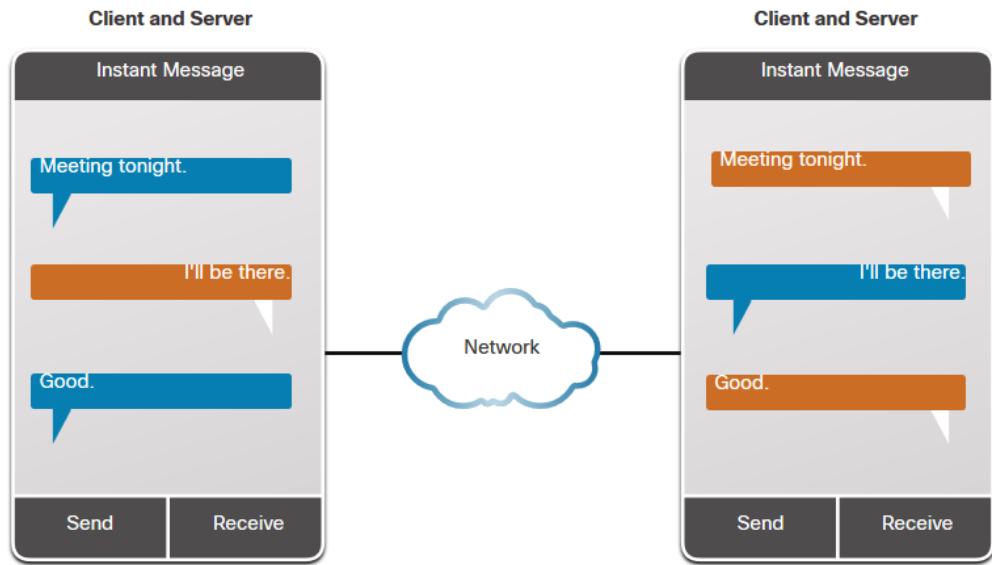
### Disadvantages of P2P:

- No central administration
- Not as secure as other networks
- Not scalable
- All devices may act as both clients and server which can slow their performance



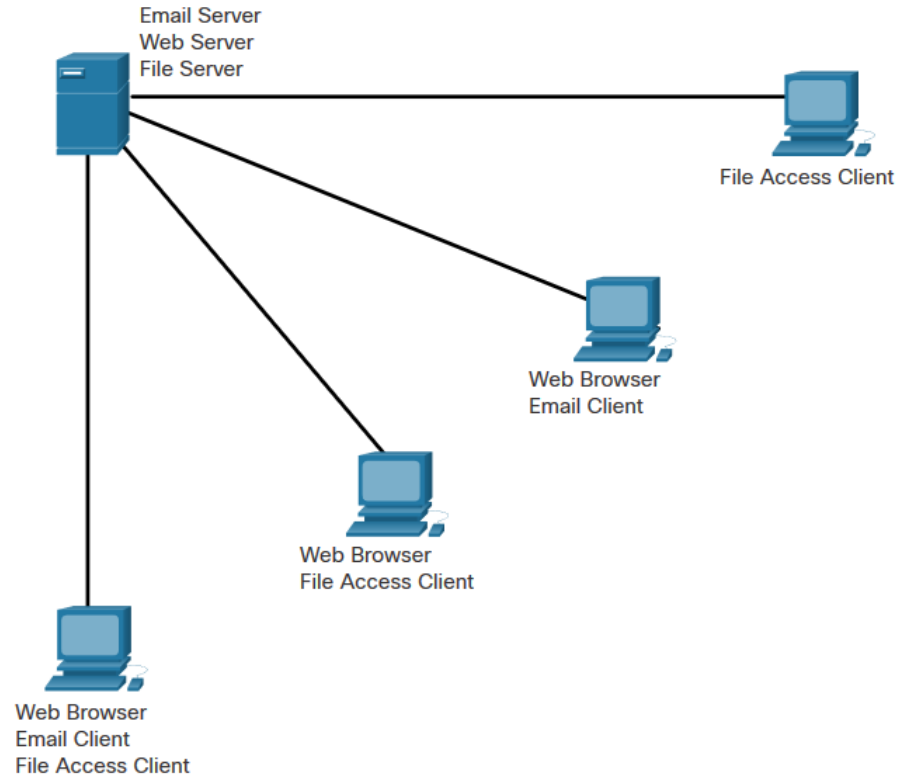
# Peer-to-Peer Applications

A P2P application allows a device to act as both a client and a server within the same communication, as shown in the figure. In this model, every client is a server and every server is a client. P2P applications require that each end device provide a user interface and run a background service. In the figure, both clients can simultaneously send and receive messages.



# Multiple Roles in the Network

A computer with server software can provide services simultaneously to one or many clients, as shown in the figure. Additionally, a single computer can run multiple types of server software. In a home or small business, it may be necessary for one computer to act as a file server, a web server, and an email server.



# 1.5 Network Components

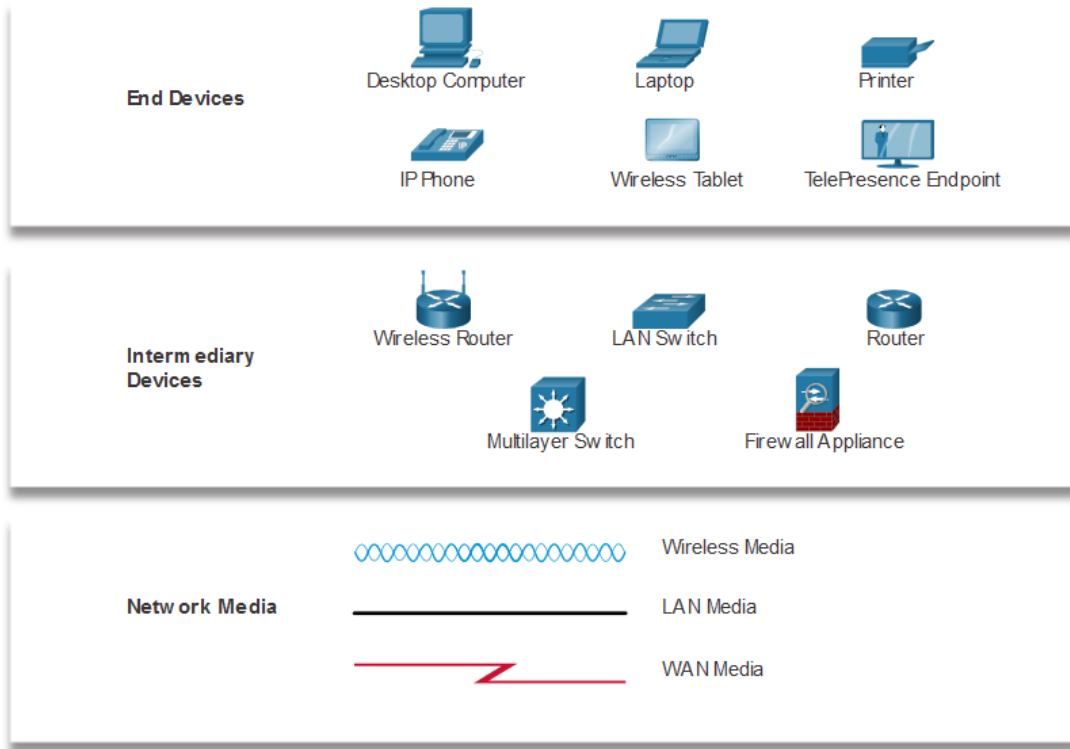
# Video - Network Infrastructure Symbols



## Network Infrastructure

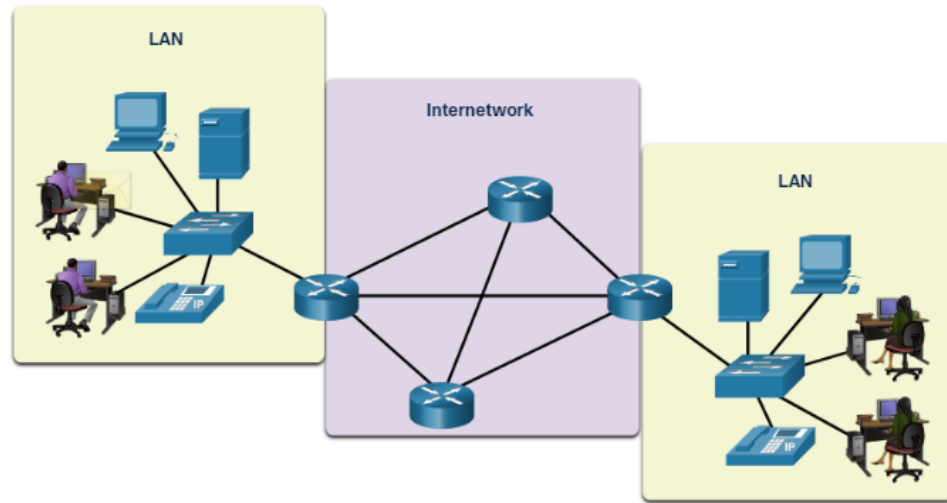
The network infrastructure contains three categories of hardware components, as shown in the figure:

- End devices
- Intermediate devices
- Network media



# Network Components

## End Devices



The network devices that people are most familiar with are called end devices, or hosts. These devices form the interface between users and the underlying communication network.

Some examples of end devices are as follows:

- Computers (workstations, laptops, file servers, web servers)
- Network printers
- Telephones and teleconferencing equipment
- Security cameras
- Mobile devices (such as smart phones, tablets, PDAs, and wireless debit/credit card readers and barcode scanners)



# Lab - My Local Network

In this lab, you will complete the following objectives:

- Record all the different network-attached devices in your home or classroom.
- Investigate how each device connects to the network to send and receive information.
- Create a diagram showing the topology of your network.
- Label each device with its function within the network.

# 1.6 Communications in a Connected World Summary

# What Did I Learn in this Module?

- The internet is a worldwide collection of interconnected networks cooperating with each other to exchange information using common standards.
- Some types of networks that you may use are small home, SOHO, medium to large networks such as those created by corporations and schools, and the internet.
- Mobile devices include smart phones, tablets, smart watches, and smart glasses.
- Connected home devices include security systems, smart appliances and TVs, and gaming consoles.
- Other connected devices include smart cars, RFIDs, sensors/actuators, and medical devices.
- Types of personal data are categorized as volunteered, observed, and inferred.
- Each bit can only have one of two possible values, 0 or 1. Each group of eight bits is known as a byte.
- There are three common methods of signal transmission used in networks: electrical signals, optical signals, and wireless signals.
- Bandwidth is typically measured in the number of bits that (theoretically) can be sent across the media in a second.
- Many factors influence throughput including: the amount of data being sent and received over the connection, the types of data being transmitted, and the latency created by the number of network devices encountered between source and destination. You can measure your throughput by going to [speedtest.net](https://www.speedtest.net).

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

- Clients are computer hosts that have software installed that enables the hosts to request and display the information obtained from the server. Servers are hosts that have software installed which enable them to provide information, like email or web pages, to other hosts on the network.
- The simplest P2P network consists of two directly connected computers using either a wired or wireless connection.
- A P2P application allows a device to act as both a client and a server within the same communication.
- A computer with server software can provide services simultaneously to one or many clients. Additionally, a single computer can run multiple types of server software.
- The network infrastructure contains three categories of hardware components: end devices, intermediate devices, and network media.
- The network devices that people are most familiar with are called end devices, or hosts. These devices form the interface between users and the underlying communication network.

# Module 1 – New Terms and Commands

- internet
- small home network
- small office and home office (SOHO) network
- medium to large network
- smartphone
- tablet
- smartwatch
- smart glasses
- connected home devices
- smart car
- RFID tag
- sensor
- actuator
- volunteered data
- observed data
- inferred data
- bit
- American Standard Code for Information Interchange (ASCII)
- media
- electrical signal
- optical signal
- wireless signal
- bandwidth
- throughput
- bits per second (bps)
- kilobyte (kbps)
- megabyte (Mbps)
- gigabyte (Gbps)
- terabyte (TBps)
- client
- server
- email server
- web server
- file server
- peer-to-peer (P2P) network
- peer-to-peer applications
- end device
- intermediate (intermediary) device
- network media
- wireless router
- LAN switch
- router
- multilayer switch
- firewall appliance
- wireless media
- LAN media
- WAN media

