



# جامعة بوليتكنك فلسطين



## COMPUTER NETWORKS AND THE INTERNET

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## CHAPTER FOUR

# COMPUTER NETWORKS AND THE INTERNET

### PREFACE:

*This chapter introduces basic networking principles, including what a computer network is, how it works, and what it can be used for. It emphasizes on the Internet as a main and daily used network around the world. Moreover, the chapter's purpose is to cover the main terminologies, topologies, and networking architectures. Furthermore, it covers the communication channels, protocols, and networking devices.*

### INTENDED LEARNING OUTCOMES:

After completing this chapter students will be able to:

- 1) Define the main terminologies, topologies, and network architectures.
- 2) Identify the most common communications protocols and networking standards.
- 3) Describe physical and wireless communication channels.
- 4) Differentiate among physical transmission media: twisted-pair cable, coaxial cable, and fiber-optic cable.
- 5) Describe commonly used communications devices.

### FURTHER READING:

- 1) Discovering Computers ©2018: Digital Technology, Data, and Devices.
- 2) Computing Essentials 2017-McGraw-Hill (2017) Daniel O'Leary, Linda I. O'Leary, Timothy J O'Leary.
- 3) Understanding Computers Today And Tomorrow Comprehensive, Deborah Morley, Charles S. Parker - Cengage Learning, (2016).

## WHAT IS A COMPUTER NETWORK

- A **computer network** is a collection of computers and other hardware devices connected together so that network users can share resources (hardware, software, and data).
- Benefits of a computer network:
  - Share hardware
  - Share data and files, and exchange information
  - Share applications and software
  - Support collaboration and interpersonal communication

## THE INTERNET

- The **Internet** is a worldwide collection of networks that connects millions of businesses, government agencies, educational institutions, and individuals.
- The Internet is a network of networks.
- After the Internet was founded, many applications and services were widely adopted and used, like:
  - Websites: collection of webpages the user can browse and navigate.
  - Messaging and chatting.
  - Voice calls, video calls, webinars and videoconferencing.
  - E-mail.
  - Forums and blogs.
  - Social networks.
  - E-Commerce: includes online shopping, online auctions, and online payment.
  - Entertainment: Online gaming, TV, movies, music, ...
  - Online Education: like Google classroom, Blackboard, and Moodle ...
  - Telemedicine.

## Classification of Computer Networks:

- Computer Networks can be classified according to the following factors:
  - o Geographical span
  - o Topology (Inter-connectivity)
  - o Architecture

### Geographical Span:

A computer network may be classified based on geographical span into:

- 1) LAN (Local Area Network)
- 2) WAN (Wide Area Network)

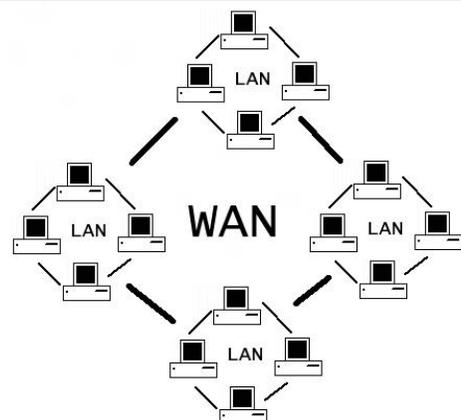
### LAN (Local Area Network):

- LAN is a computer network that covers small geographical area.
- Example: a network in a home or office, or what spans a floor, building or even two close buildings.



### WAN (Wide Area Network):

- WAN is a computer network that extends over large geographical region.
- Example: a network that connects computers and networks across a city or a country.
- Usually, WAN connects multiple LANs together.



## Network Topology:

- Network Topology is the physical arrangement in which computer systems or network devices are connected to each other.
- A computer network may be classified based on topology into:
  - Bus Topology
  - Ring Topology
  - Star Topology

### Bus Topology

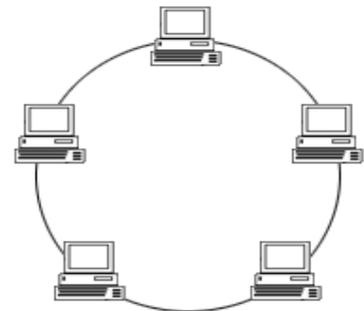
- Uses a central cable to which all network devices connect.
- If the bus line fails, then the network cannot function.



### Ring Topology

- Device connections create a circular data path.

Ring Topology



### Star Topology

- Uses a central device to which all network devices connect and through which all network data is sent.
- If the central device fails, the network cannot function.

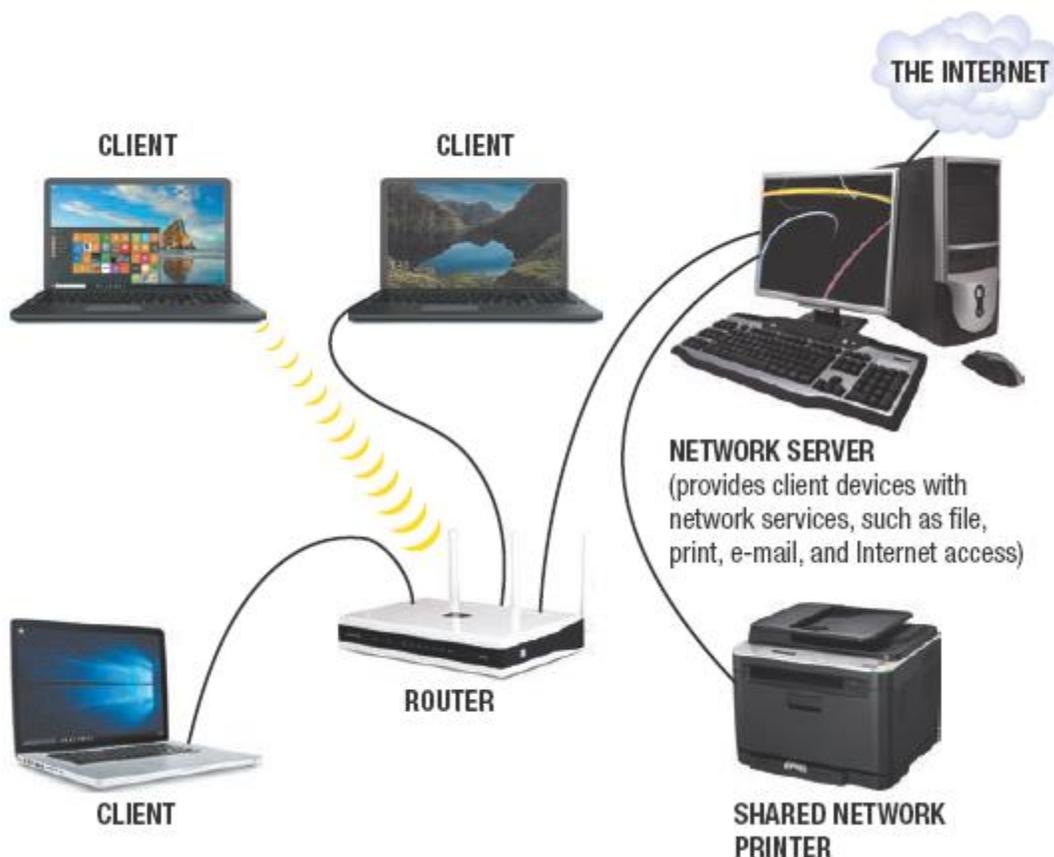


## Network Architecture:

- Network Architecture is the way the computers in a network are **configured and designed**.
- A computer network may be classified based on architecture into:
  - Client-Server
  - Peer-to-Peer

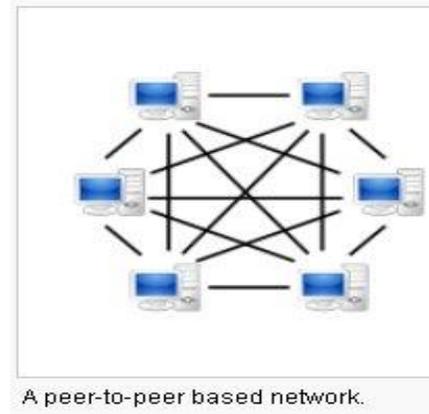
## Client-Server Architecture

- Client: a computer or device that requests a service from a server.
- Server: a powerful computer that receives clients requests and responds accordingly.



## Peer-to-Peer (P2P) Architecture

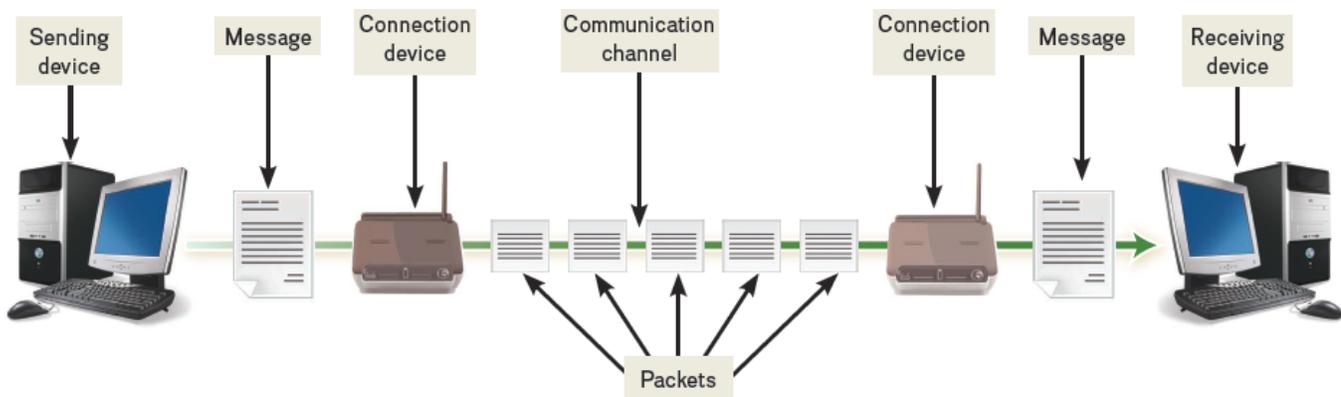
- In a P2P architecture, all computers have equal level of functionality, with no dedicated server.
- This type of architecture works well with few devices connected to each other (Usually less than 10 computers).
- The most common way to share games, movies, and music over the Internet is to use a P2P network.



## Network Components:

To establish communication between devices on a network we need:

- Protocols
- Data (messages)
- Transmission Devices
- Transmission Medium (channel)



## Communication Protocols (Standards)

- A Protocol is a set of rules and procedures that govern correct communication between different parties.
- Internet Protocols (or standards) determine how computers communicate successfully through the Internet
- Examples of Internet protocols:
  - TCP/IP
  - HTTP
  - FTP

### Activity:

Write the full text for each of the following abbreviations:

- TCP/IP: \_\_\_\_\_
- HTTP: \_\_\_\_\_
- FTP: \_\_\_\_\_

## IP Address

- Each computer on a network is identified by an address called *IP address*.
- The IP address is a 23 bit address, written as four numbers separated by a dot (or period).
- Each number ranges from 0 to 255.
- IP Example:
  - 212.37.84.129

### Activity:

**69.514.96.2** is an invalid IP address, why?

## Data Packets

- When data is sent over a network connection, the data is decomposed into smaller units called: Packets.
- Each packet has:
  - Sequence number
  - Source address
  - Destination address
  - Data

## Transmission Media

- The communication channel at which data travel through the network.
- Communication channel can be:
  - Wired:
    - Twisted Pairs cable
    - Coaxial cable
    - Fiber Optics
  - Wireless:
    - IR
    - Bluetooth
    - WiFi
    - Cellular
    - Satellite

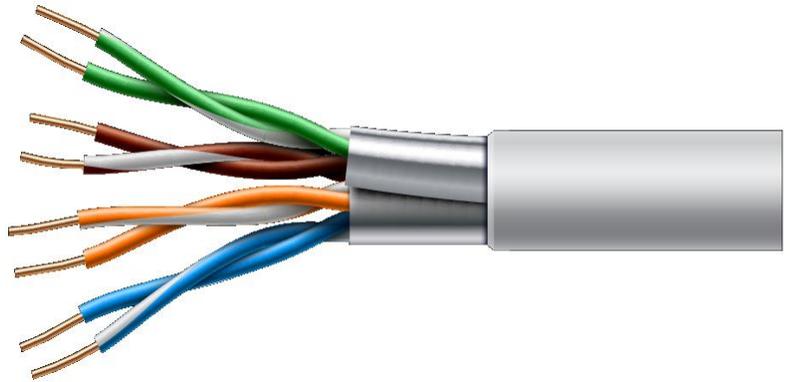
### Activity:

What is the Global Positioning System (GPS) service?



## Twisted pair cable

- Technology: Copper wires.
- Most common used cable.
- Cheap.
- Speed: 100 Mbps.
- Distance limit: 100 meters.



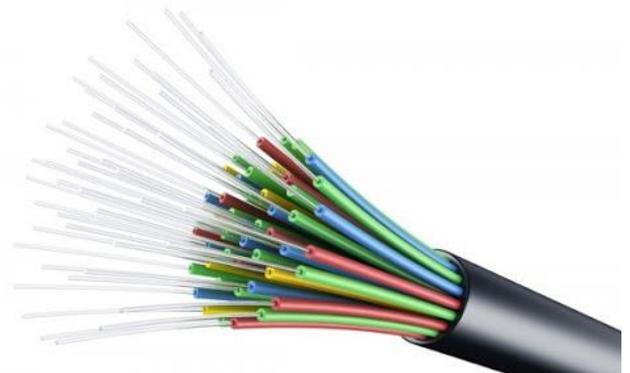
## Coaxial cable

- Technology: Copper wires.
- Initially used for TV signal transmission.
- More expensive than twisted pairs.
- Speed: 10 Mbps.
- Distance limit: 500 meters.



## Fiber Optics

- Technology: Uses glass threads (fibers) to transmit data as light waves.
- Speed: 10 Gbps.
- Distance: 100 Km.
- Very Expensive.



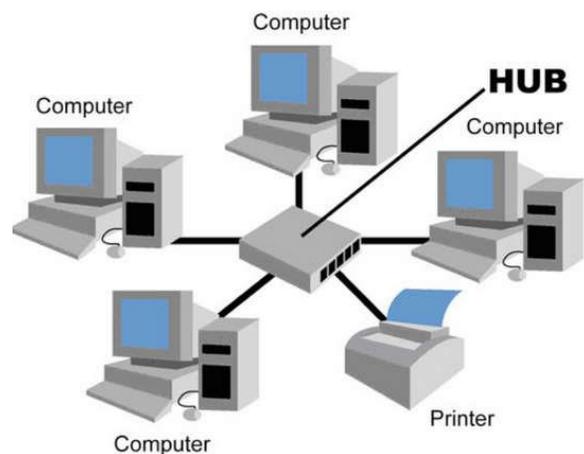
## Network Devices

Devices used to create the network, it connects computers and devices together, or connects network with other networks, and most used devices are:

- 1) Hub
- 2) Switch
- 3) Repeater
- 4) Access Point
- 5) Router
- 6) Modem

### Hub

- Used in LANs to connect two or more computers.
- Represents a central point.
- It receive messages from one computer and sends it out to all other connected computers.



## Switch

- It is an intelligent Hub.
- Unlike hubs, a switch forwards data packets just to the desired destination.



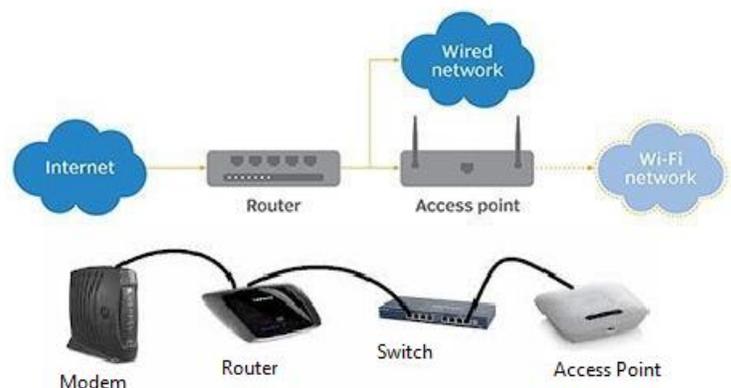
## Repeater

- A repeater is a network device that boosts the signal to extend the distance it will travel.
- Repeaters are available for both wired and wireless networks.



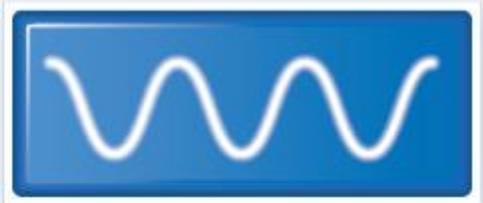
## Access Point

A wireless access point (AP), allows Wireless devices to connect to a wired network.

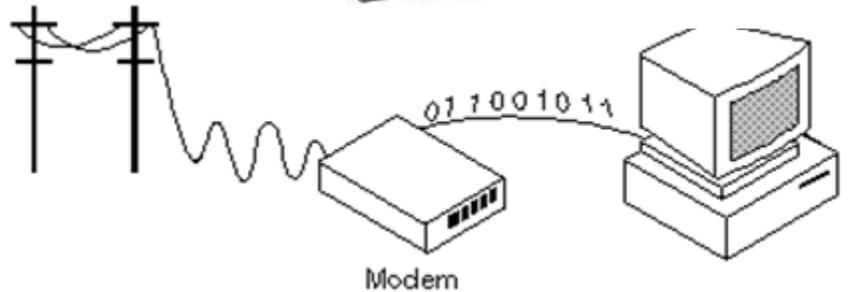


## Modem

- MODulator – DEModulator (Modem)
- Telephone lines transmit data in the form of analog waves, whereas the computer is a digital device.



Analog



Digital

-The Modem converts signal from analog to digital and vice versa.

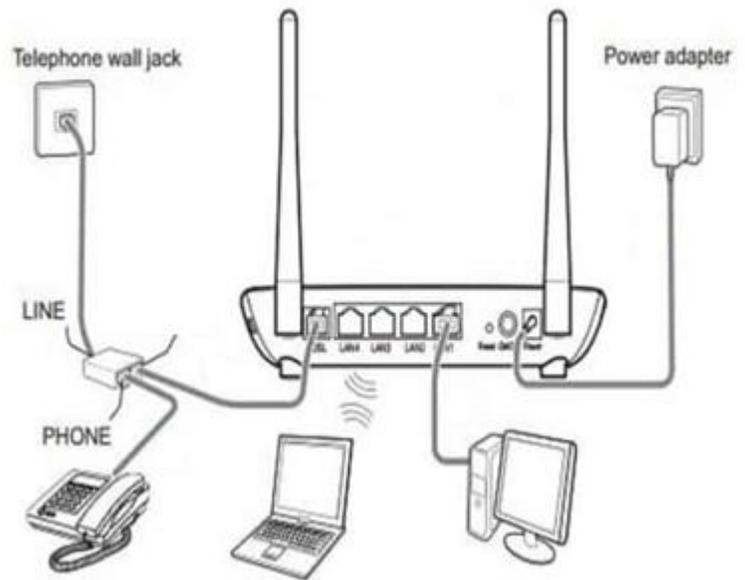
## Router

- Connects two or more networks together.



## ADSL Service

- ADSL: Asymmetric Digital Subscriber Line
- ADSL is a technology used for transmitting digital information on an existing phone line.
- A special filter is installed on a subscriber's telephone line to allow both ADSL and regular voice (telephone) services to be used at the same time.
- The faster technology of ADSL is called VDSL.



## Note:

Today, most home ADSL routers combines also an internal modem and a WiFi access point.



## ISP (Internet Service Provider):

- ISP is a company that provides the Internet service.

## Network Bandwidth

- The amount of information that can be transmitted over a network in a given amount of time, usually expressed in *bits per second* (bps).
- *Downstream* denotes the speed of downloading data from a network.
- *Upstream* denotes the speed of sending data to other devices on a network.
- For the ADSL connections, the upstream is usually 1/8 of the downstream (why?).



Your Internet speed is

91 Mbps



## Activity:

- Which ISP you are subscribing in your home?
- What is the speed (bandwidth) of this subscription?
- Is it denoting the downstream speed or the upstream speed of the connection?





**CHAPTER QUESTIONS:**

Q1) State whether each of the following statements is **TRUE** or **FALSE**.

	<b>Statement</b>	<b>TRUE / FALSE</b>
[1]	The Internet is the largest WAN in the world.	
[2]	The type of cable used inside most homes for telephone service is twisted-pair wire.	
[3]	HTTP is an internet protocol.	
[4]	In the ring topology, if the shared line failed the whole network will fail.	
[5]	192.186.100.0 is a valid IP address	
[6]	Twisted pair cable is more expensive than fiber-optics cable.	
[7]	The speed of the upstream is 8 times the speed of the downstream.	
[8]	Switch is an intelligent device, since it can determine the destination of the data packets and forward them appropriately.	
[9]	Coaxial Cable is made of four pairs plastic wires twisted together to send data.	
[10]	Modem is a device that connects two or more networks together.	

Q2) What is the device used in each of the following cases:

a. A device used to connect multiple devices on a wired network. \_\_\_\_\_

b. A device that enables a computer to communicate over telephone lines. \_\_\_\_\_

c. A device used to connect wireless devices to a network. \_\_\_\_\_

d. A device used to amplify signals on a network. \_\_\_\_\_