

Mustansiriyah University
College of Engineering.
Electrical Engineering Department

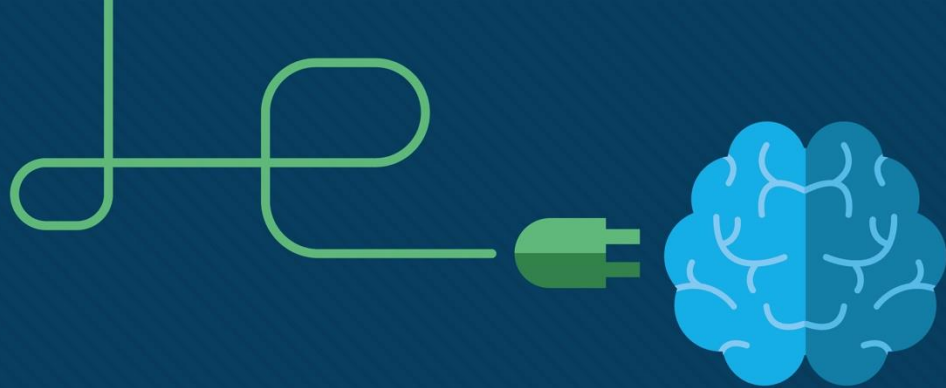


Computer Networks

4th stage

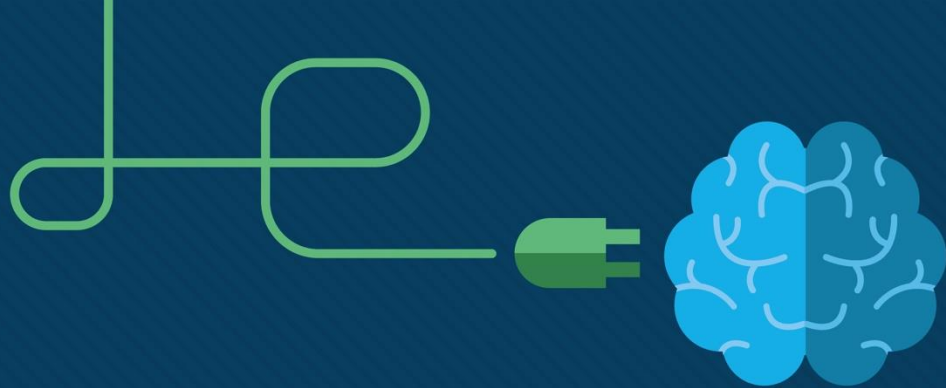
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Module 1: Network Fundamentals





1.1 Introduction to Network



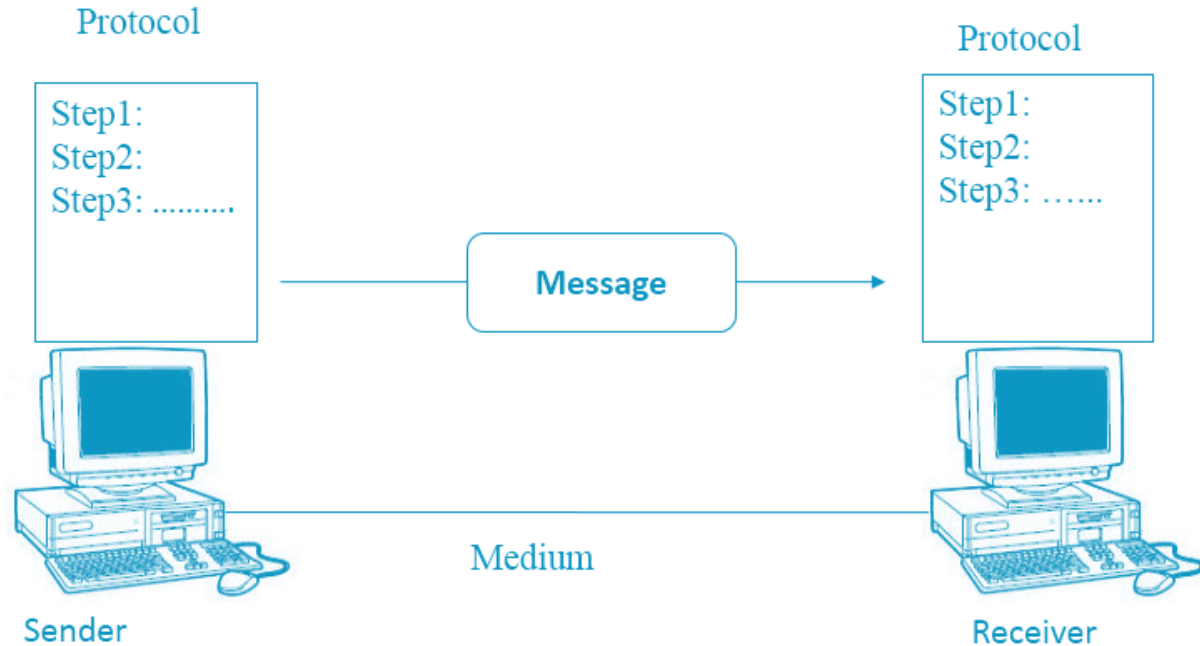
Introduction to Networking

- A **computer network** is a set of [computers](#) sharing resources located on or provided by [network nodes](#).
- Computers use common [communication protocols](#) over [digital interconnections](#) to communicate with each other. These interconnections are made up of [telecommunication network](#) technologies based on physically wired, [optical](#), and wireless [radio-frequency](#) methods that may be arranged in a variety of [network topologies](#).
- The nodes of a computer network can include [personal computers](#), [servers](#), [networking hardware](#), or other specialized or general-purpose [hosts](#). They are identified by [network addresses](#) and may have [hostnames](#).
- Computer networks support many [applications](#) and [services](#), such as access to the [World Wide Web](#), [digital video](#) and [audio](#), shared use of [application and storage servers](#), [printers](#) and [fax machines](#), and use of email and instant messaging applications.

Network component

A data communication system is made up of five components:

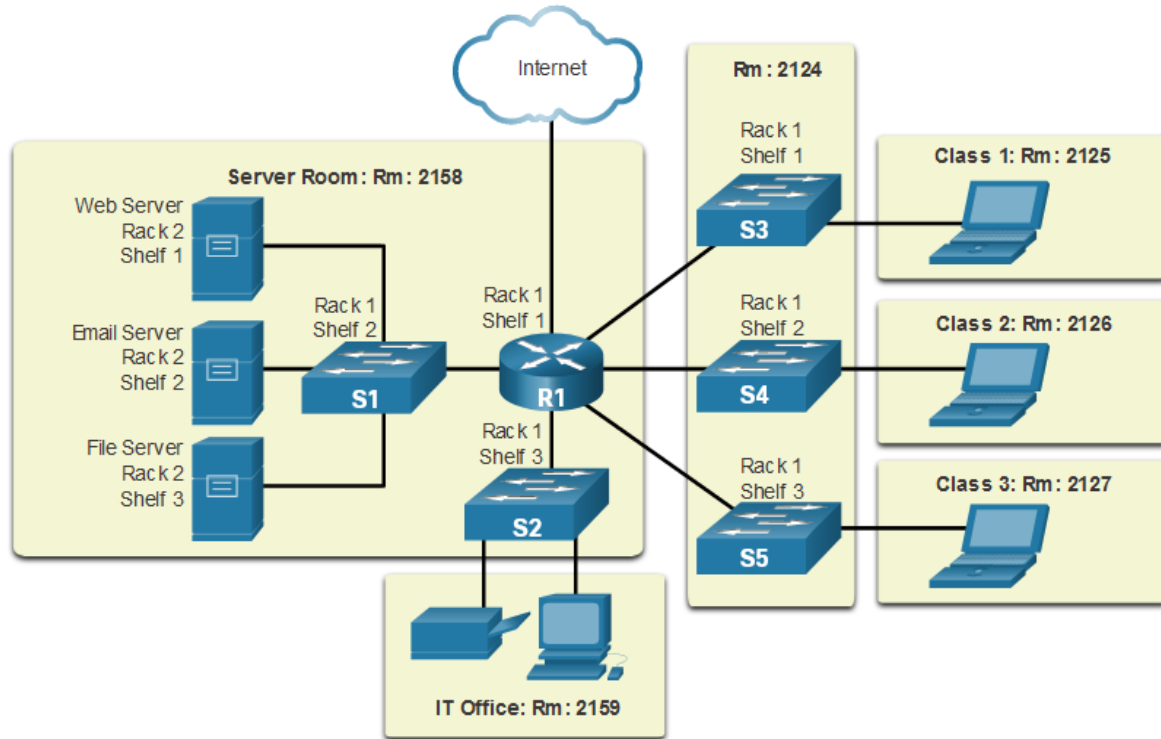
1. Message
2. Sender
3. Receiver
4. Medium
5. Protocol



Network Fundamentals

Basic concepts

- Line configuration.
- Topology.
- Transmission mode.
- Categories of networks.
- Internetworks.

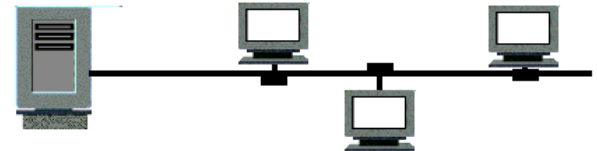
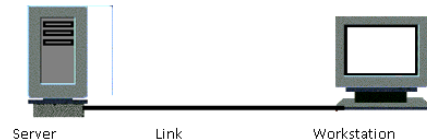


Basic Concepts

Line configuration

- **Point-to-Point**
- **Multipoint**

	Point to point communication	Multipoint Communication
1.	The channel is shared between two devices.	The channel is shared among multiple devices or nodes.
2.	There is dedicated link between two nodes.	Link is provided at all times for sharing the connection among nodes.
3.	The entire capacity is reserved between these connected two devices with the possibility of waste of network bandwidth	The entire capacity isn't reserved by any two nodes and the network bandwidth is maximum utilized.
4.	There is one transmitter and one receiver.	There is one transmitter and many receivers.
5.	The smallest distance is most important to reach the receiver.	The smallest distance is not important to reach the receiver.
6.	Provides security and privacy because communication channel is not shared.	Does not provide security and privacy because communication channel is shared.

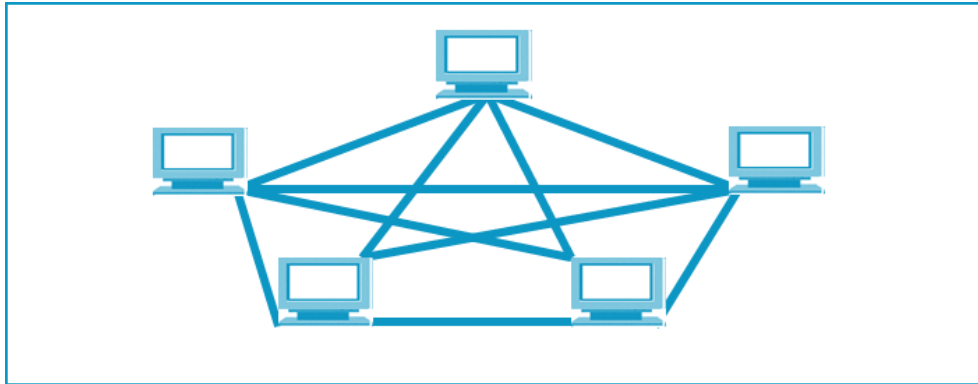


Basic concepts

Topology

Physical topology describes the actual or the physical layout of a network, such as the physical arrangement of wires, media (computers), or cables in a network. Two or more devices can connect to a link, and when the number of links exceeds two, they form a physical topology.

1. Mesh Topology



Advantages:

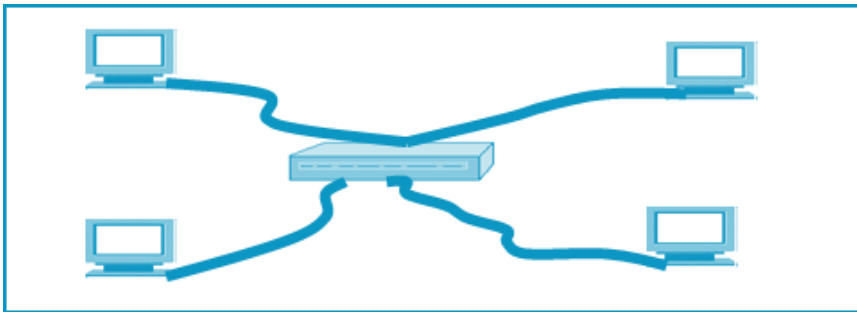
- Robust
- Secure
- Fault identification

Disadvantages:

- Expensive
- Need of I/O ports
- Complex

Topology (contd.)

2. Star Topology



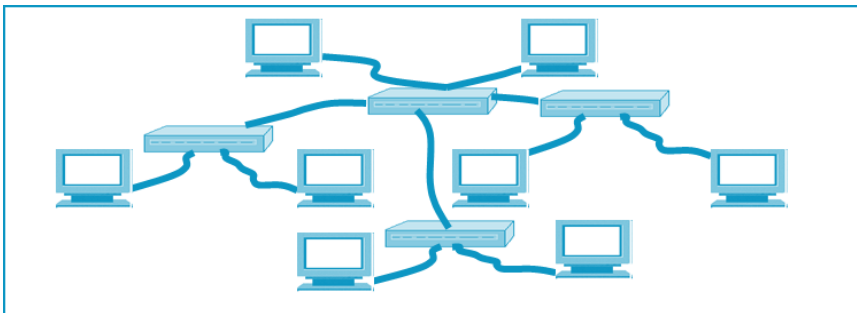
Advantages:

- Less expensive
- Easy to install
- Robust

Disadvantages:

- Dependency on single point
- Expensive

3. Tree Topology



Advantages:

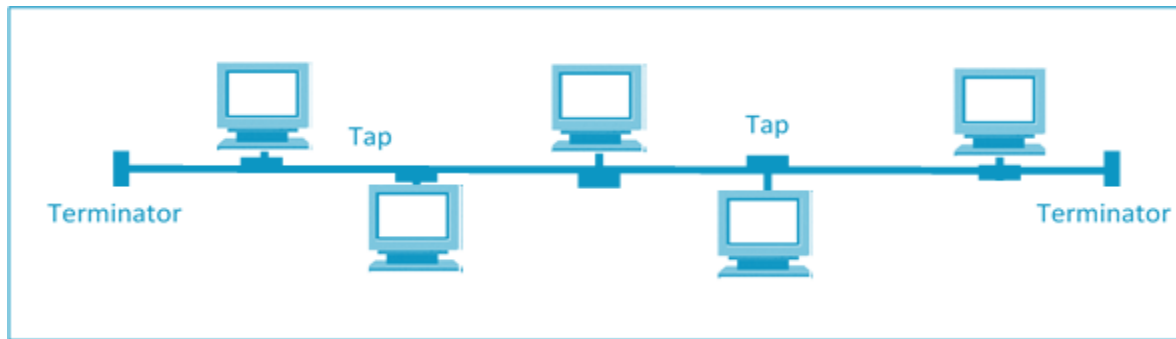
- Scalable
- Secure
- Robust

Disadvantages:

- Expensive
- Complex

Topology (contd.)

4. Bus Topology



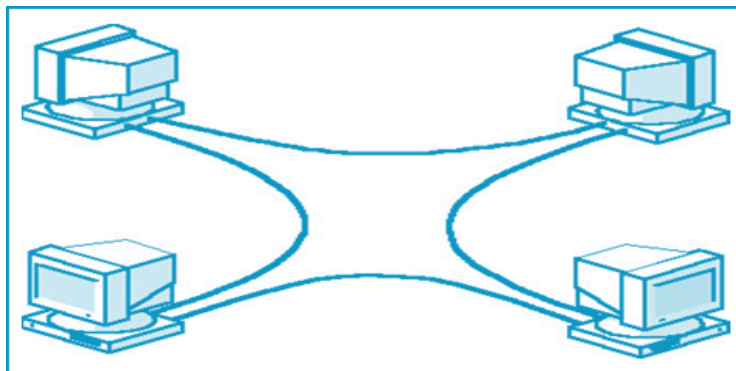
Advantages:

- Ease to install
- Less cabling
- Fault isolation

Disadvantages:

- Signal reflection
- Dependency on single cable

5. Ring Topology



Advantages:

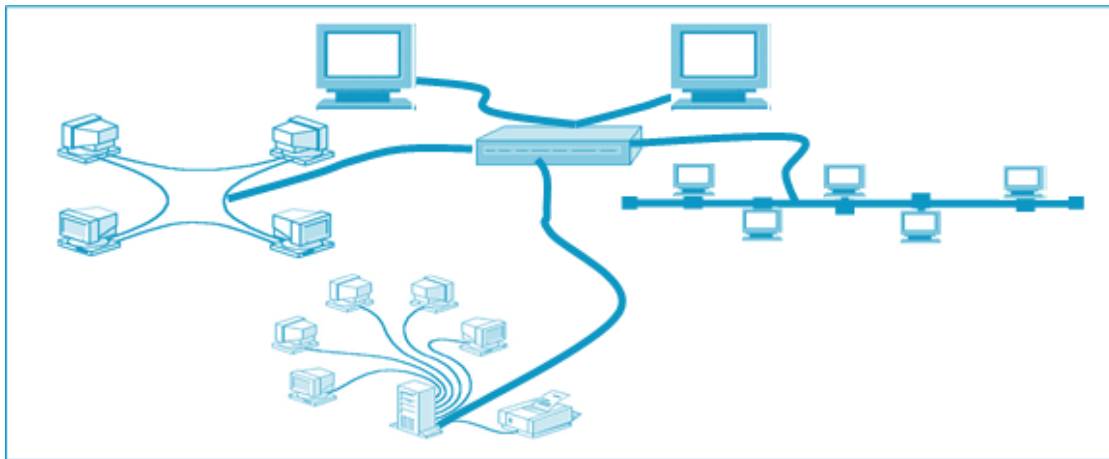
- Ease to install
- Fault isolation
- Less cost

Disadvantages:

- Unidirectional traffic
- Difficult to maintain

Topology (contd.)

6. Hybrid Topologies



Advantages & Disadvantages:

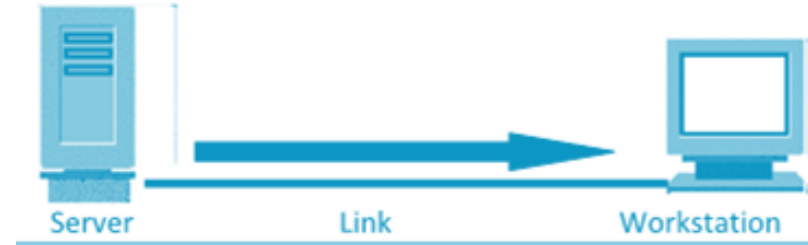
the advantages and disadvantages of a hybrid topology are a combination of the merits and demerits of the topologies used to structure it.

Transmission Modes

1. **Simplex**
2. **Half-Duplex**
3. **Full-Duplex**

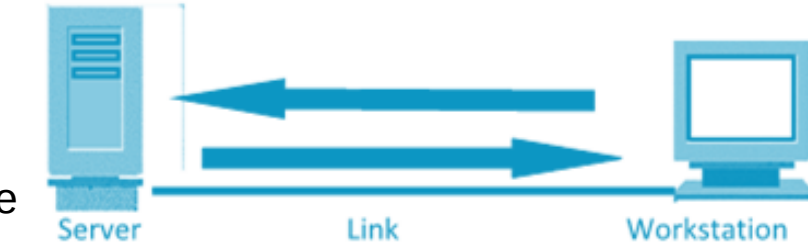
Simplex communication mode

- Only allows servers to send to the connected devices without any received data



Half-duplex communication mode

- Only allows one device to send or receive at a time on a shared medium.



Full-duplex communication mode

- Allows both devices to simultaneously transmit and receive on a shared medium.



Network Categories

- According to its size.
- According to its physical architecture (center of control).
- According to transmission technology.
- According to its ownership.
- According to service providing.

According to the size:

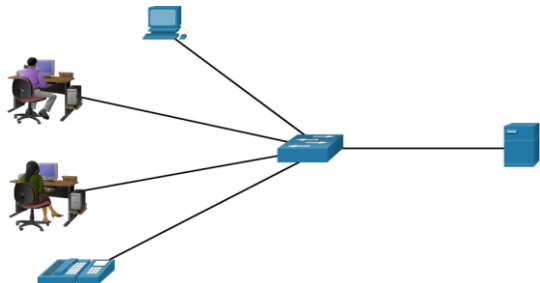
We are generally referring to three primary categories:

- ❖ *Local area networks (LANs).*
- ❖ *Metropolitan area networks (MANs).*
- ❖ *Wide area networks (WANs).*

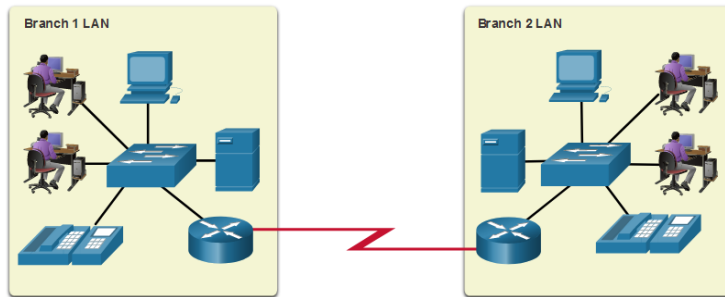
Categories of networks (contd.)

LANs and WANs

A **LAN** is a network infrastructure that spans a small geographical area.



A **WAN** is a network infrastructure that spans a wide geographical area.



LAN

Interconnect end devices in a limited area.

Administered by a single organization or individual.

Provide high-speed bandwidth to internal devices.

WAN

Interconnect LANs over wide geographical areas.

Typically administered by one or more service providers.

Typically provide slower speed links between LANs.

Categories of networks (contd.)

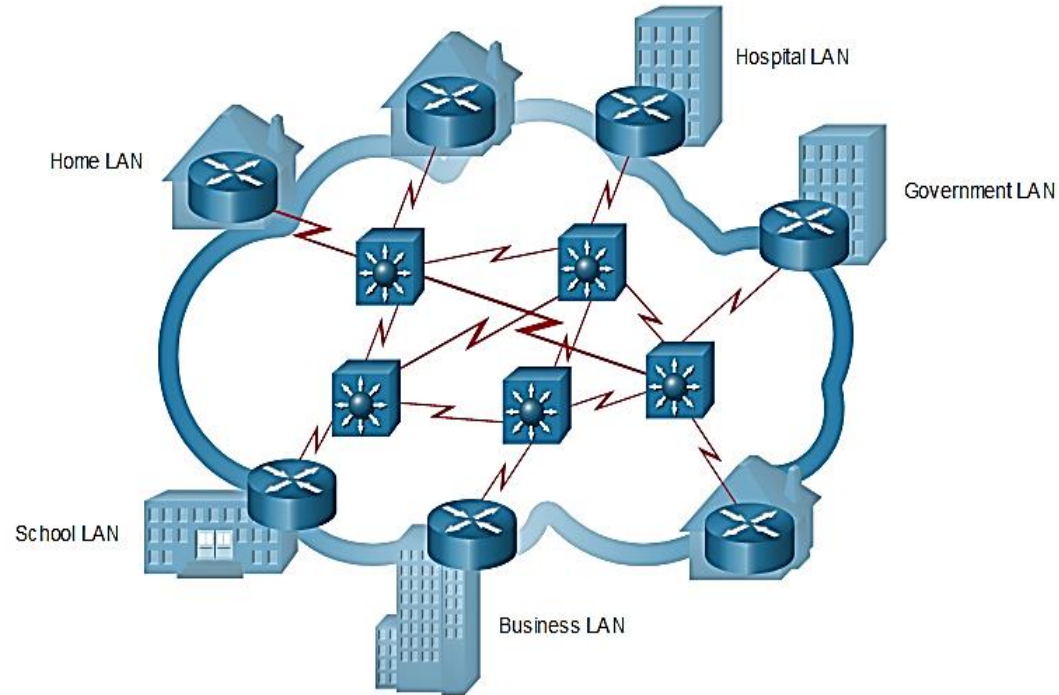
The Internet

The internet is a worldwide collection of interconnected LANs and WANs.

- LANs are connected to each other using WANs.
- WANs may use copper wires, fiber optic cables, and wireless transmissions.

The following groups were developed to help maintain structure on the internet:

- IETF
- ICANN
- IAB



Categories of networks (contd.)

According to the physical architecture (center of control)

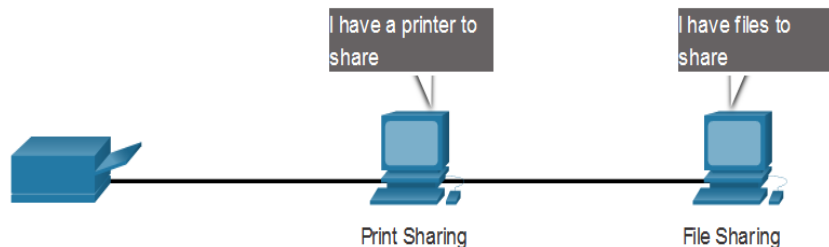
- **Peer to Peer Network**
- **Client/Server Network**

Peer-to-Peer

This type of network design is only recommended for very small networks.

Advantages

- Easy to set up
- Less complex
- Lower cost
- Used for simple tasks



Disadvantages

- No centralized administration
- Not as secure
- Not scalable
- Slower performance

Categories of networks (contd.)

Client / Server Network

Every computer on a network is called a **host** or **end device**.

Servers are computers that provide information to end devices:

- email servers
- web servers
- file server



Clients are computers that send requests to the servers to retrieve information:

- web page from a web server
- email from an email server

1.2 Network Representations

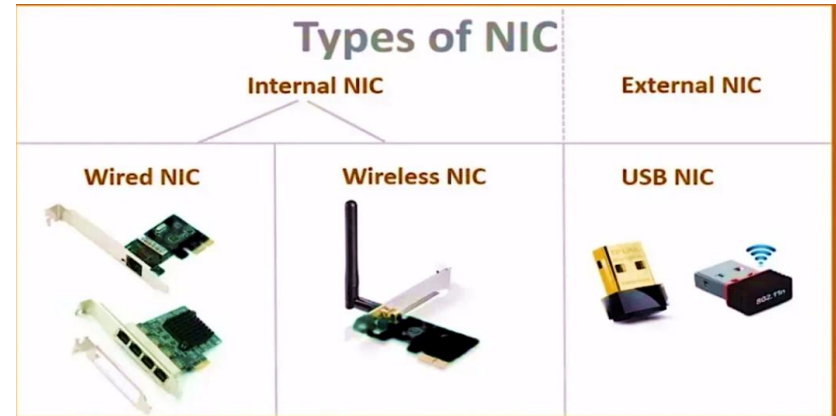
Network Representations

Network Interface Card (NIC)

- A network interface card is a piece of hardware that allows computers to communicate with other devices on a network. It can also be called an Ethernet card, LAN card, or network adaptor.
- A NIC provides a dedicated connection to a network. It contains the circuits necessary to translate the computer's digital data into the signals used to transfer data in the network, like Ethernet or Wi-Fi.

Types of NICs

1. Wired
2. Wireless (Wi-Fi)
3. USB
4. Fiber Optic



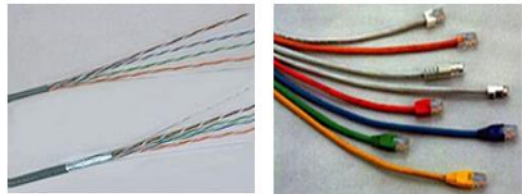
Network Representations (contd.)

Network Media

Communication across a network is carried through a medium which allows a message to travel from source to destination.

Media Types	Description
Metal wires within cables	Uses electrical impulses
Glass or plastic fibers within cables (fiber-optic cable)	Uses pulses of light.
Wireless transmission	Uses modulation of specific frequencies of electromagnetic waves.

Copper



Fiber-optic



Wireless



Network Representations (contd.)

Intermediary Network Devices

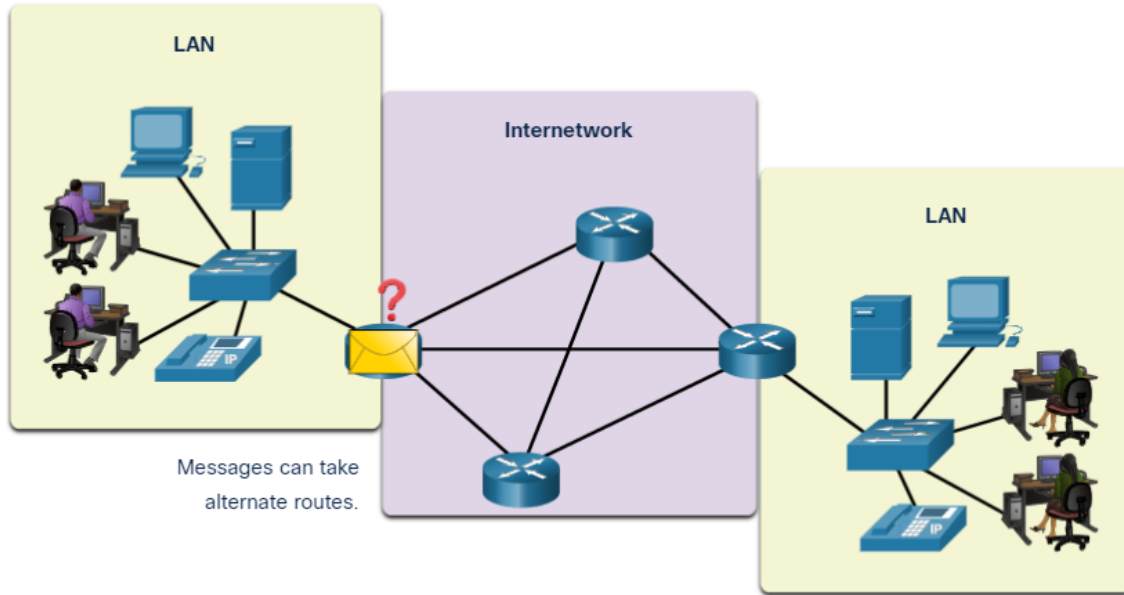
- An intermediary device interconnects end devices. Examples include switches, wireless access points, routers, and firewalls.
- Management of data as it flows through a network is also the role of an intermediary device, including:
 - Regenerate and retransmit data signals.
 - Maintain information about what pathways exist in the network.
 - Notify other devices of errors and communication failures.



Network Representations (contd.)

End Devices

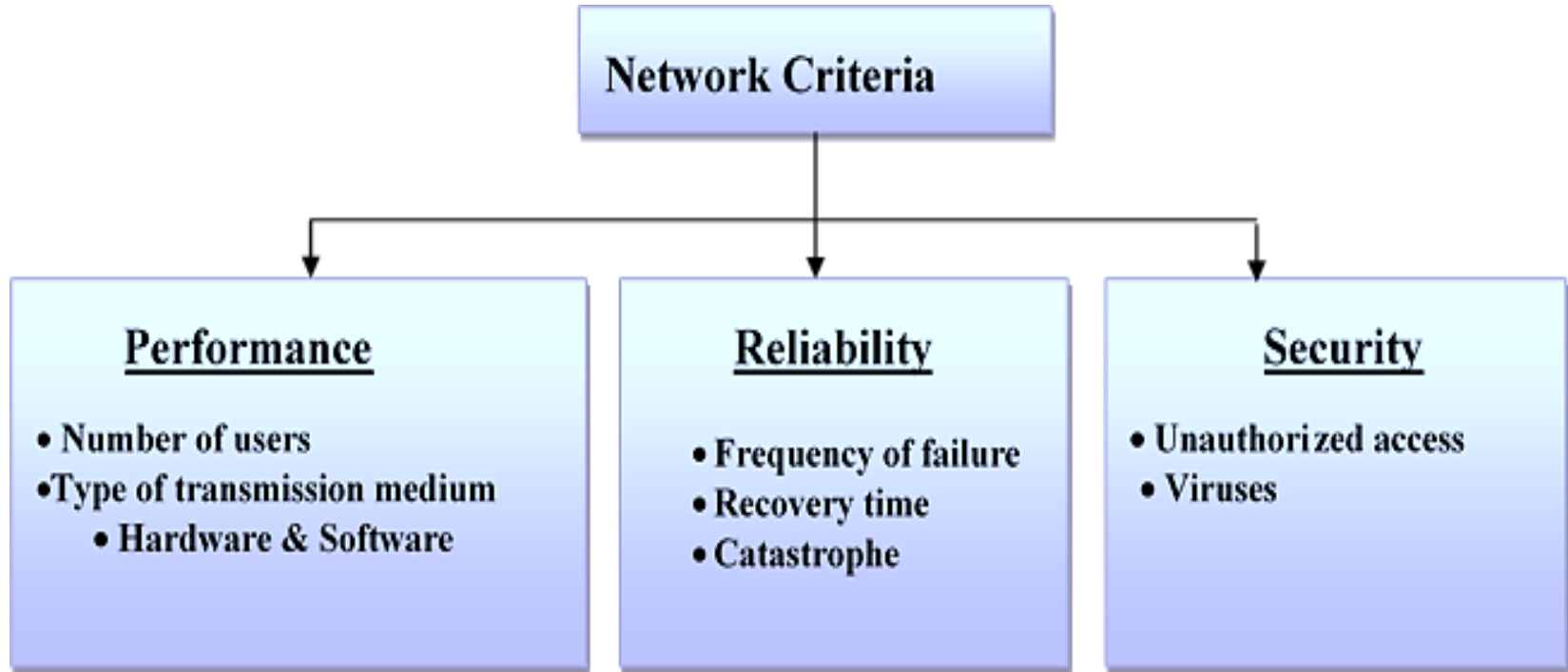
An end device is where a message originates from or where it is received. Data originates with an end device, flows through the network, and arrives at an end device.



1.3 Networks Criteria

Network Fundamentals

Network criteria



1.4 The IT Professional

The IT Professional

CCNA

The Cisco Certified Network Associate (CCNA) certification:

- demonstrates that you have a knowledge of foundational technologies
- ensures you stay relevant with skills needed for the adoption of next-generation technologies.

The new CCNA focus:

- IP foundation and security topics
- Wireless, virtualization, automation, and network programmability.



1.5 Network Standards

Network Standards

Networking standards define how communication occurs during transmission and between devices. When you want devices to communicate with each other, you need to be able to connect them, and there's a variety of ways to do that.

Standards Organizations:

Organization Name	Prefix	Specialized in
International Standards Organization	ISO	OSI model
International Telecommunications Union	ITU	WAN
Internet Architecture Board	IAB	Internet
Telecommunications Industry Association	TIA	Cabling
Institute of Electrical and Electronics Engineers	IEEE	LAN



1.6 Networks Applications

Networks applications

1. Marketing and sales.
2. Financial services.
3. Manufacturing.
4. Electronic messaging.
5. Information services.
6. Cellular telephone.
7. Cable television.

