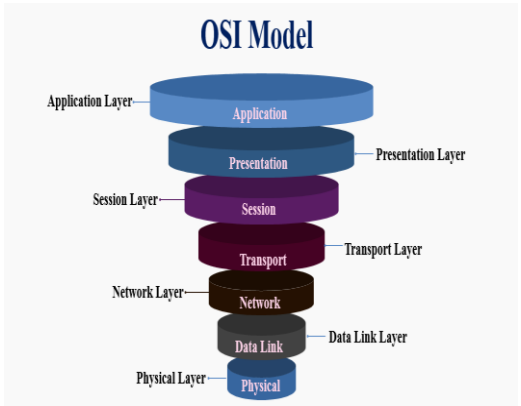
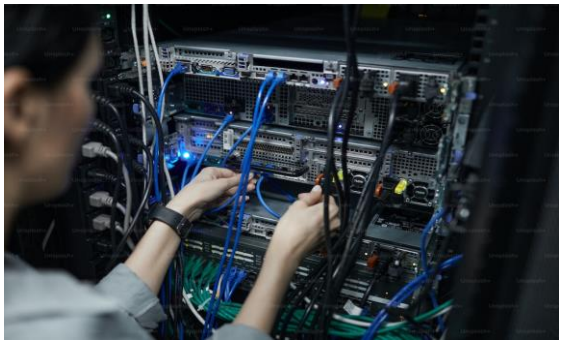
SH. A.
أكاديميـــة الشـــروق

Computer Networks (1)

First Semester 2023/2024





Computer Networks (1)

For fourth year
Electronics and Communication Engineering (ECE) Program
Computer and Control Engineering (CCE) Program
(2019 Regulation: ECE 462 and CCE 462)
(2013 Regulation: ECE 491 and CCE 491)

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Course contents

Week No.	Start date of the week (Sunday)	Event/Task	Topics
1	1-10-2023		Network definition, Importance, Components and Topology types
2	8-10-2023		Network Model (OSI model)
3	15-10-2023		OSI model vs. TCP/IP Model (Application, Transport, Internet and Network Access Layers)
4	22-10-2023		- Typical Network Model and Components. - Classification of Network Devices. - TCP/IP (Physical Layer).
5	29-10-2023	Written Quiz (1)- (Tuesday at 10:15 A.M)	Physical Layers (Cables, Standards (Card Types) and Connectors.

Course contents

Week No.	Start date of the week (Sunday)	Event/Task	Topics
6	5-11-2023		- Physical Layer (Layer (1) Devices). - Data Link Layer (MAC Address and MAC Frame).
7	Saturday 11-11-2023	**M.T Exam**	------
8	19-11-2023		Layer (2) devices, switching modes, and switching operation.
9	26-11-2023		Internet (Network) Layer (Logical Address and Routing Operation) and IPv4 (Classifications, Shortage, Solution and Subnetting).
10	3-12-2023	**Online Quiz (2)- (Tuesday at 08:30 P.M)**	IPv4 (Subnetting), Troubleshooting End to End Data Delivery, IPv6

Course contents

Week No.	Start date of the week (Sunday)	Event/Task	Topics
11	10-12-2023		Internet Layer Protocols (Layer (3)) (ICMP, DHCP/APIPA, DNS)
12	17-12-2023		Internet Layer Protocols (Layer (3)) (ARP, Commands, Add IP and DNS manual), Transport layer
13	24-12-2023	End of the Semester (28-12-2023)	Oral / Practical Exam
Start of the Final Exam: Monday, 1-1-2024			
Mid-year vacation from 27-1-2024 to 9-2-2024			

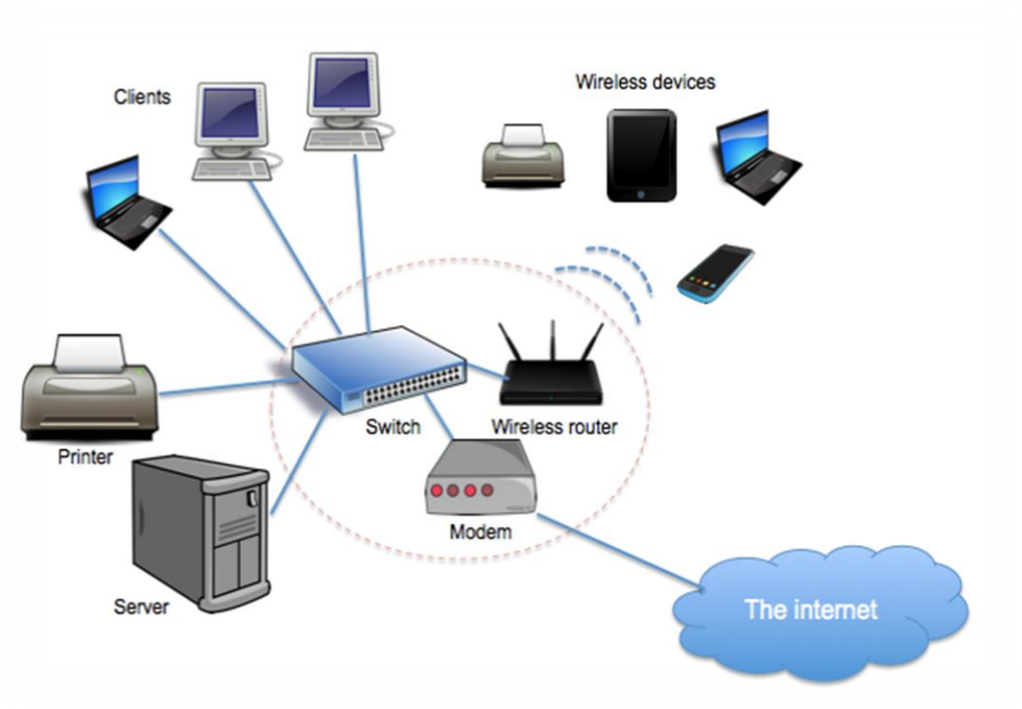
Chapter (1)

Network Fundamentals

List of Contents

Network Definition

- It is a group of components (; network components) that are connected together (; network topologies) to provide a service (; network importance).



Network Importance

- Easy sharing of files, information and data.
- Easy sharing of resources (expensive devices; printers).
- Voice over IP (VOIP).
- Video transmission and gaming.
- Smell
- Taste
- Touch

Network Components

- **End Devices**: Computers, PlayStation, IP Camera, IPTV, IP Phone, Printer, Cell Phone (Mobile).
  - It is the main component.
  - It is the source of network applications.
  - Network Applications: Service that can be done with remote device (; as Ober and Kareem).

    Example (1): http (Hyper Text Transfer Protocol) used for browsing.

Network Components (Cont.)

Example (2): ftp (File Transfer Protocol) used for upload and download

Example (3): Send/Receive e-mail

SMTP (Simple Mail Transfer Protocol)

POP3 (Post Office Protocol Version3)

Example (4): Telnet used for remote login (remote configuration).

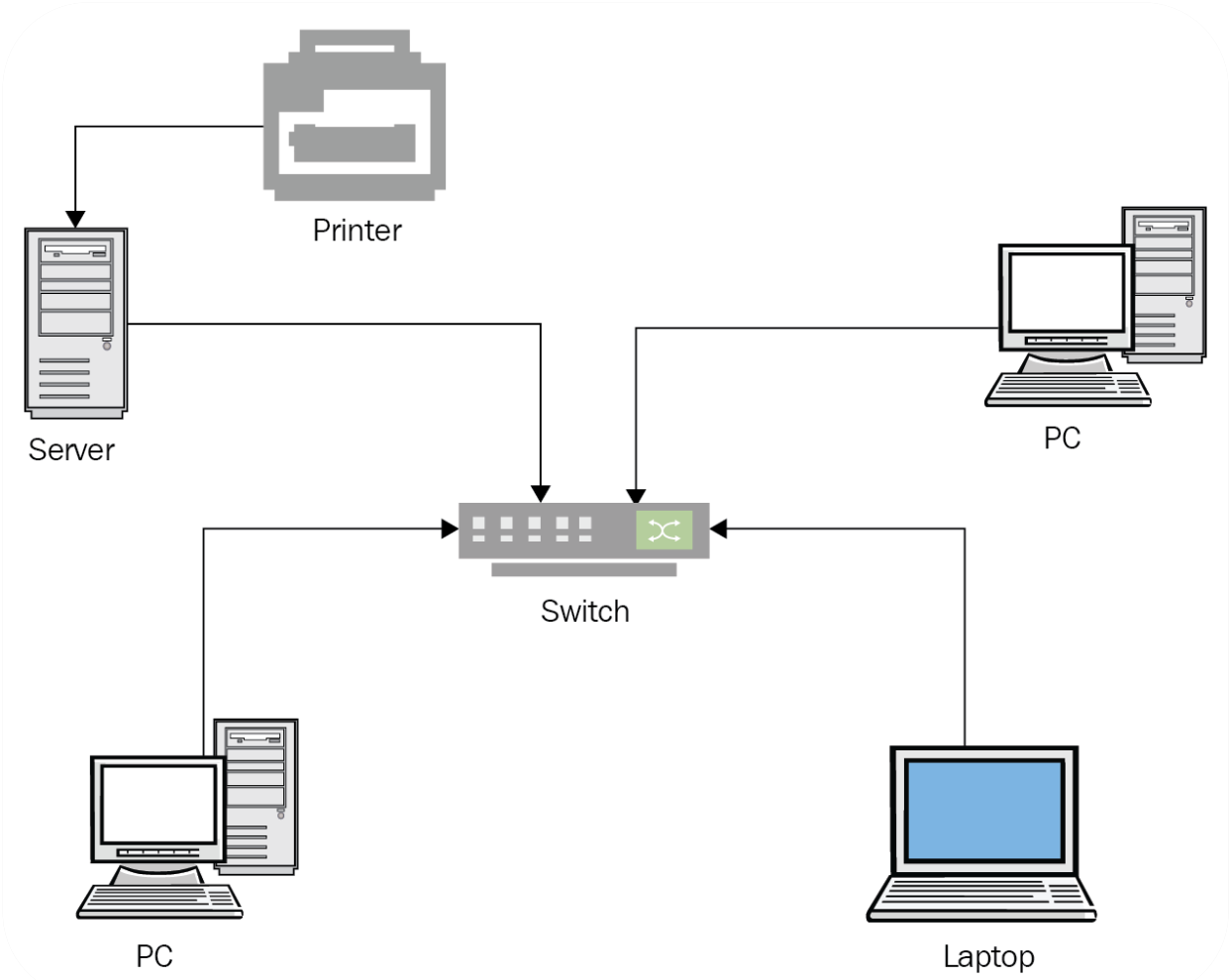
Network Components (Cont.)

- **Intermediate Devices (Network Devices)**: **Repeater, Hub, Bridge, Switch, Router, Gateway, Modem, Firewall, Intrusion detection system (IDS), Intrusion prevention system (IPS), VPN device.**
- **Connectivity: Wired or Wireless**
- **Most popular companies: Cisco, Juniper, HP ZTE, DELL, EMC, Huawei, Avaya, Alcatel, Microsoft, VM wares, and Aruba.**

Network Architectures

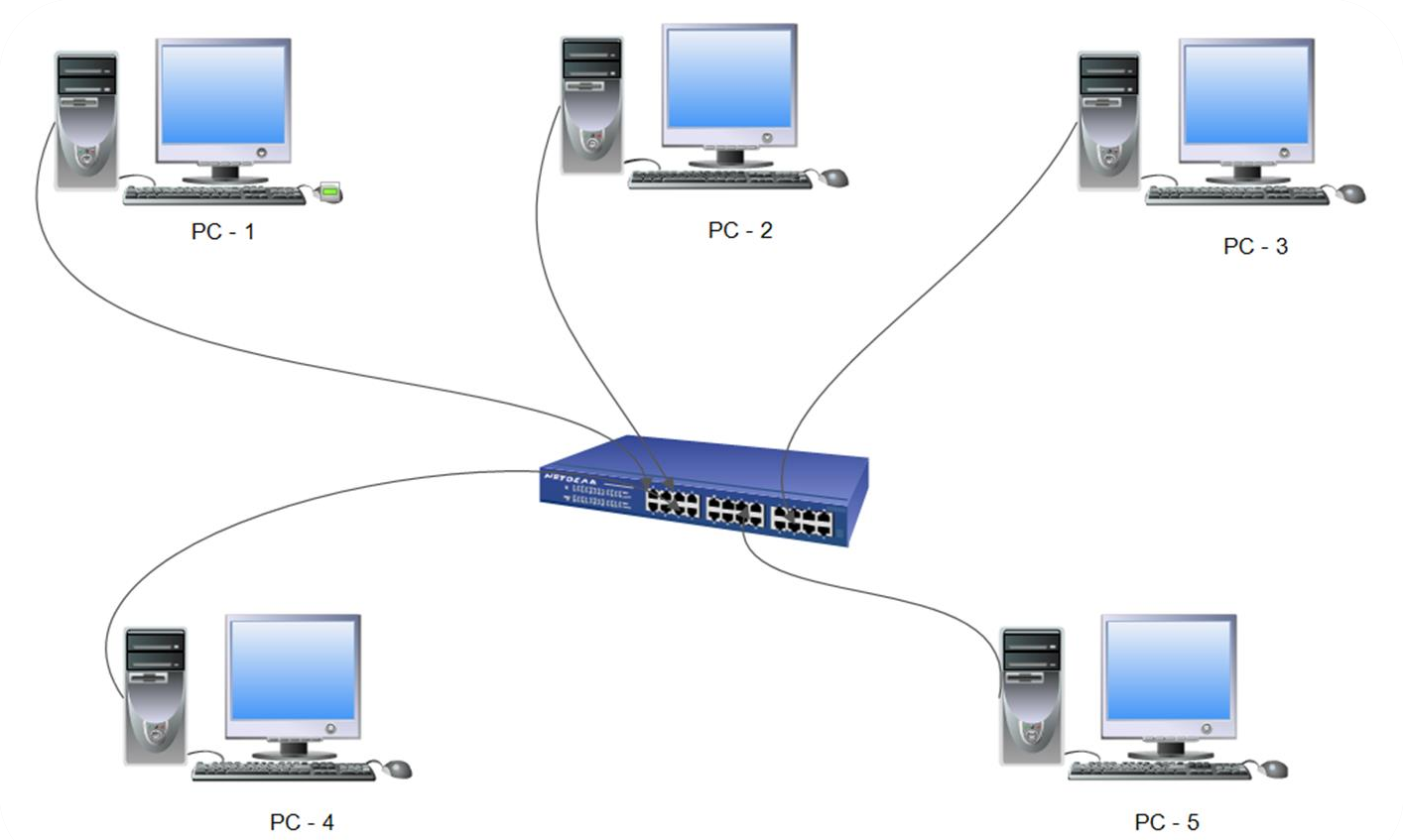
- A Computer Architecture is a design in which all computers in a computer network are organized. A architecture defines how the computers should get connected to get the maximum advantages of a computer network such as better response time, security, scalability etc. The two most popular computer architectures are P2P (Peer to Peer) and Client-Server architecture.

Network Architectures (Cont.)



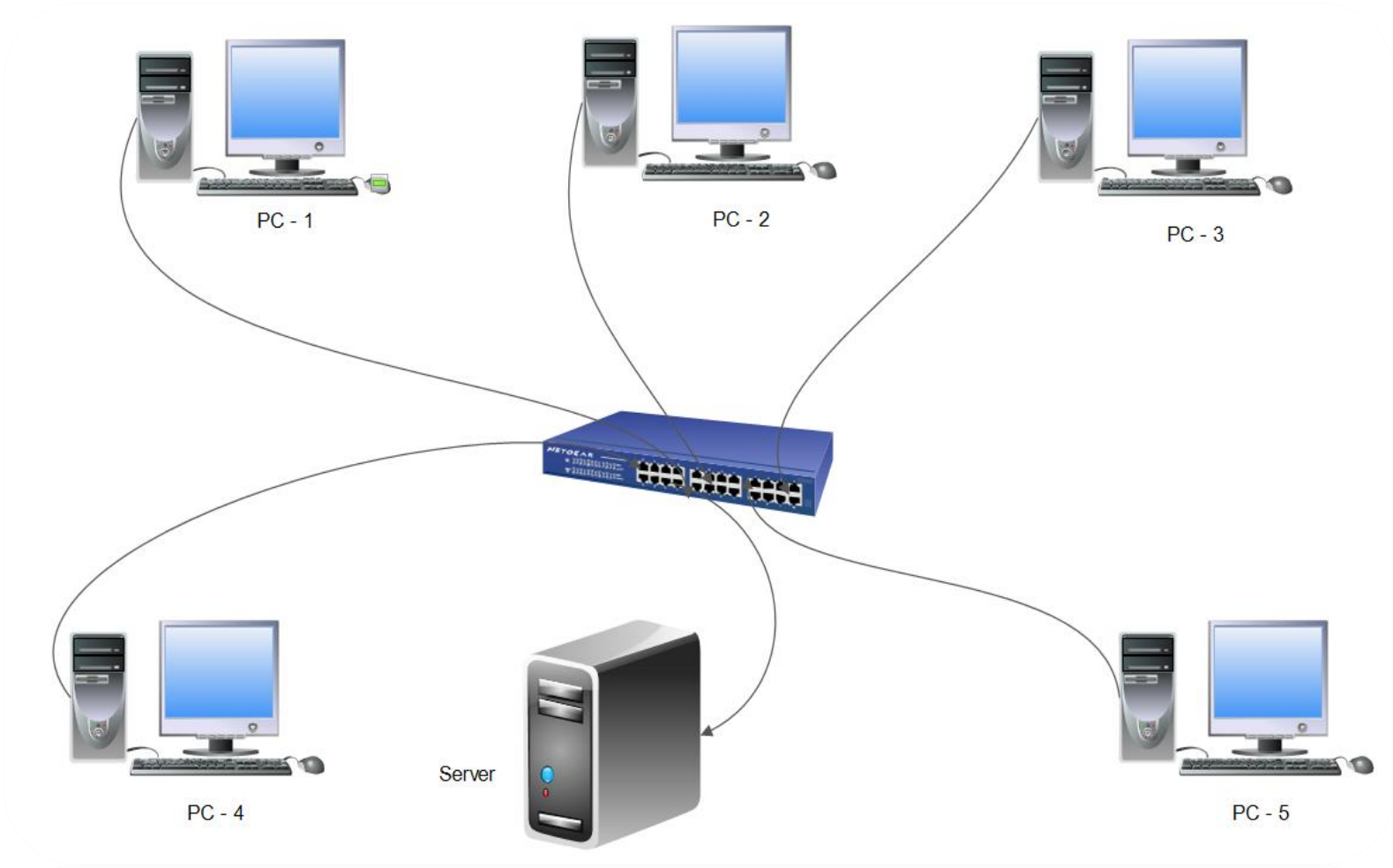
Network Architectures (Cont.)

- **Peer to Peer Networks:**



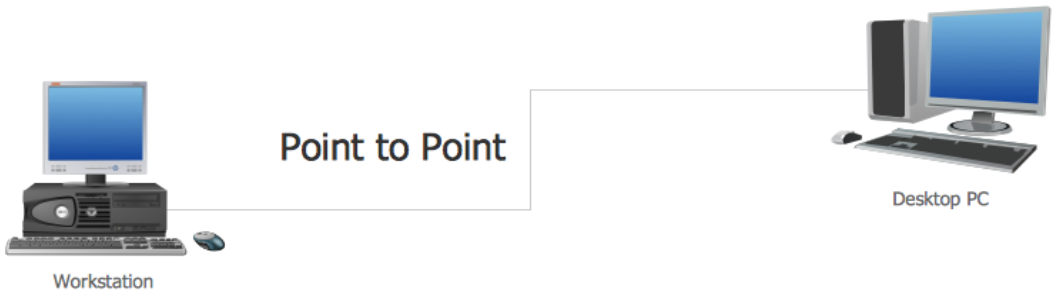
Network Architectures (Cont.)

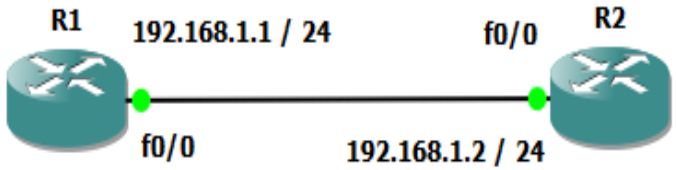
- **Client - Server Networks:**



Network Topologies

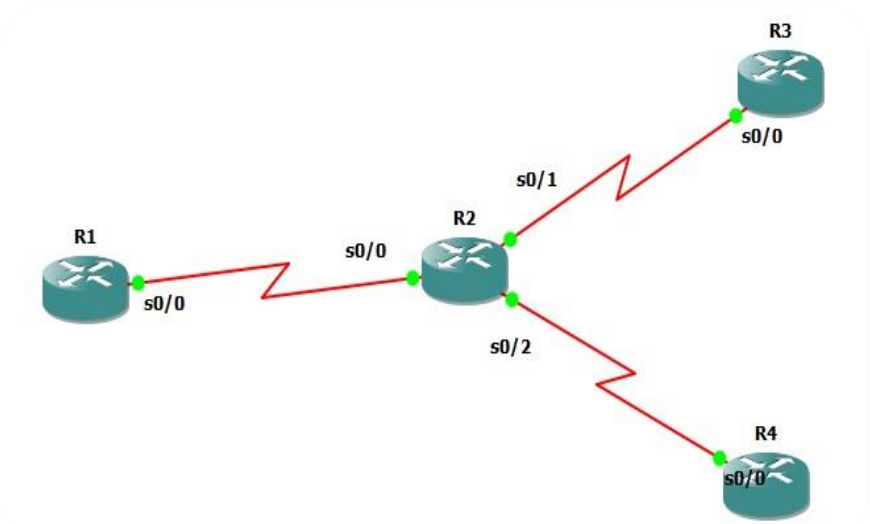
- **Point to Point topology:** **a dedicated link between two devices.**

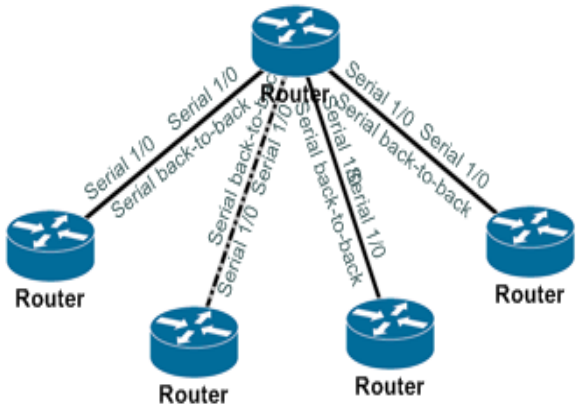




Network Topologies (Cont.)

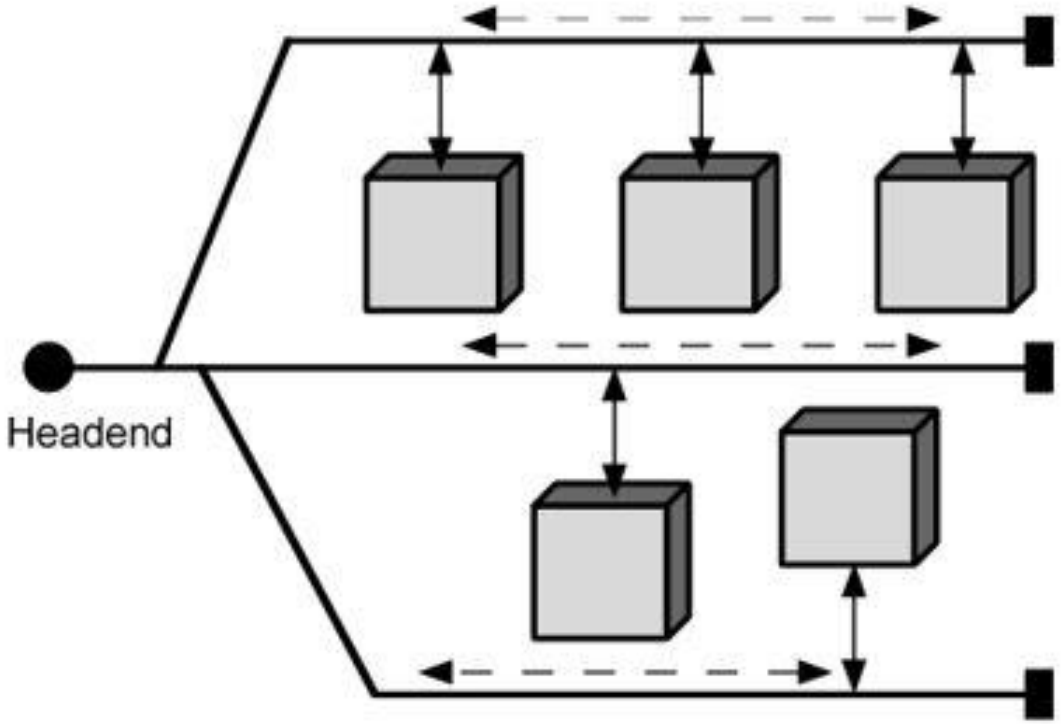
- **Point to Multi Point topology:** More than two specific devices share a single link.





Network Topologies (Cont.)

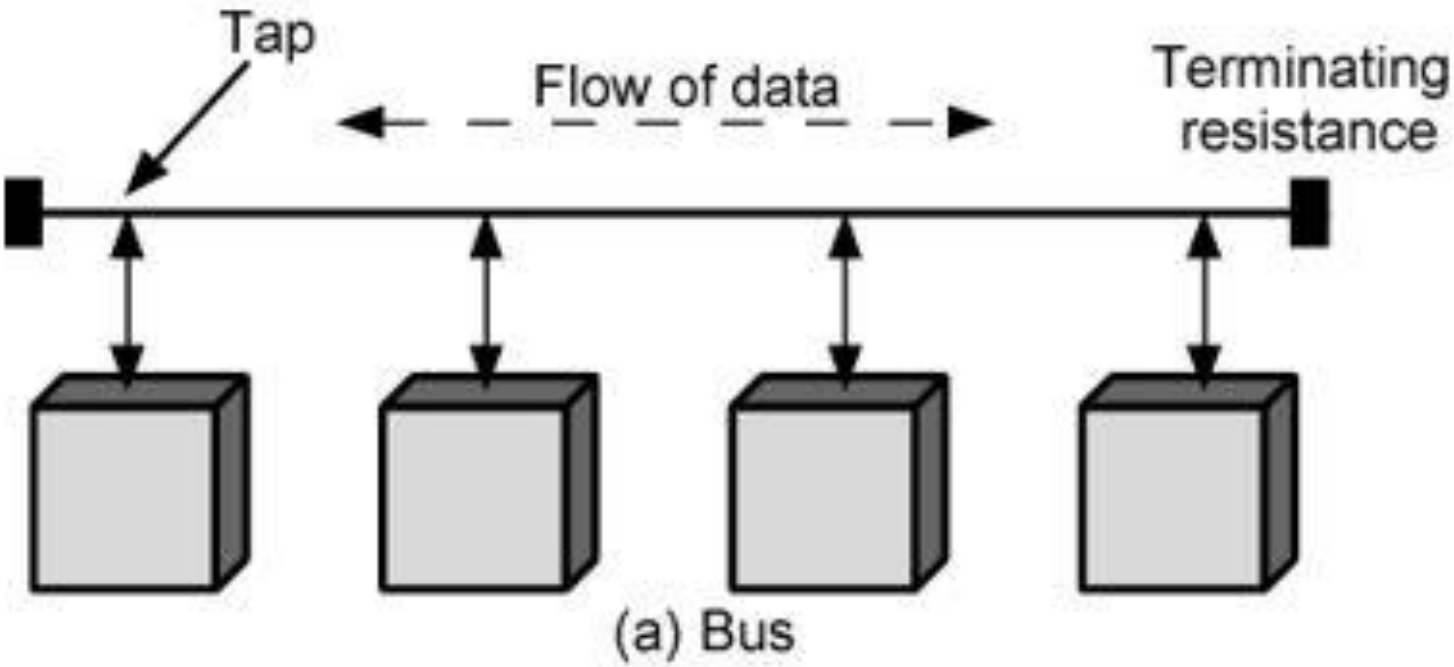
- **Tree topology:**



(b) Tree

Network Topologies (Cont.)

- **Bus topology:**



- **One sends and all receive.**
- **Special case of tree topology.**

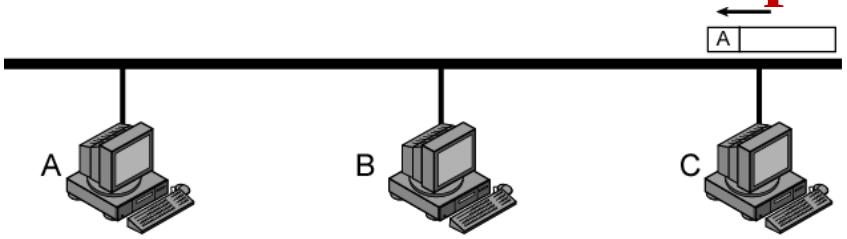
Network Topologies (Cont.)

Tree and Bus topologies

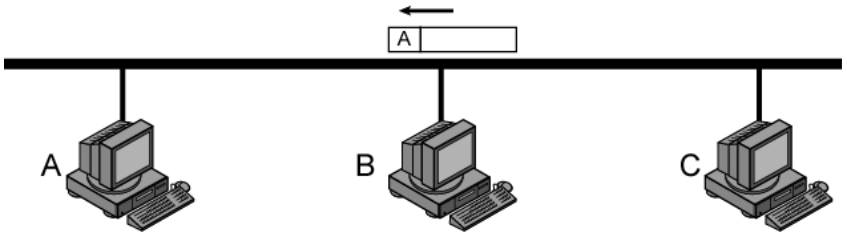
- **Multipoint medium**
- **Transmission propagates throughout medium**
- **Heard by all stations**
  - Need to identify target station
    * Each station has unique address
- **Full duplex connection between station and tap**
  - Allows for transmission and reception
- **Need to regulate transmission**
  - To avoid collisions
  - To avoid hogging
    * Data in small blocks - frames
- **Terminator absorbs frames at end of medium**

Network Topologies (Cont.)

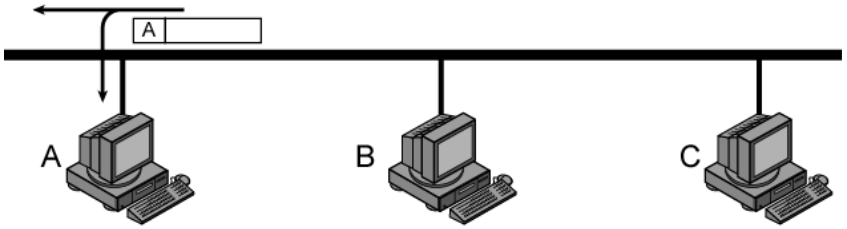
- **Frame transmission on Bus LAN topology:**



C transmits frame addressed to A



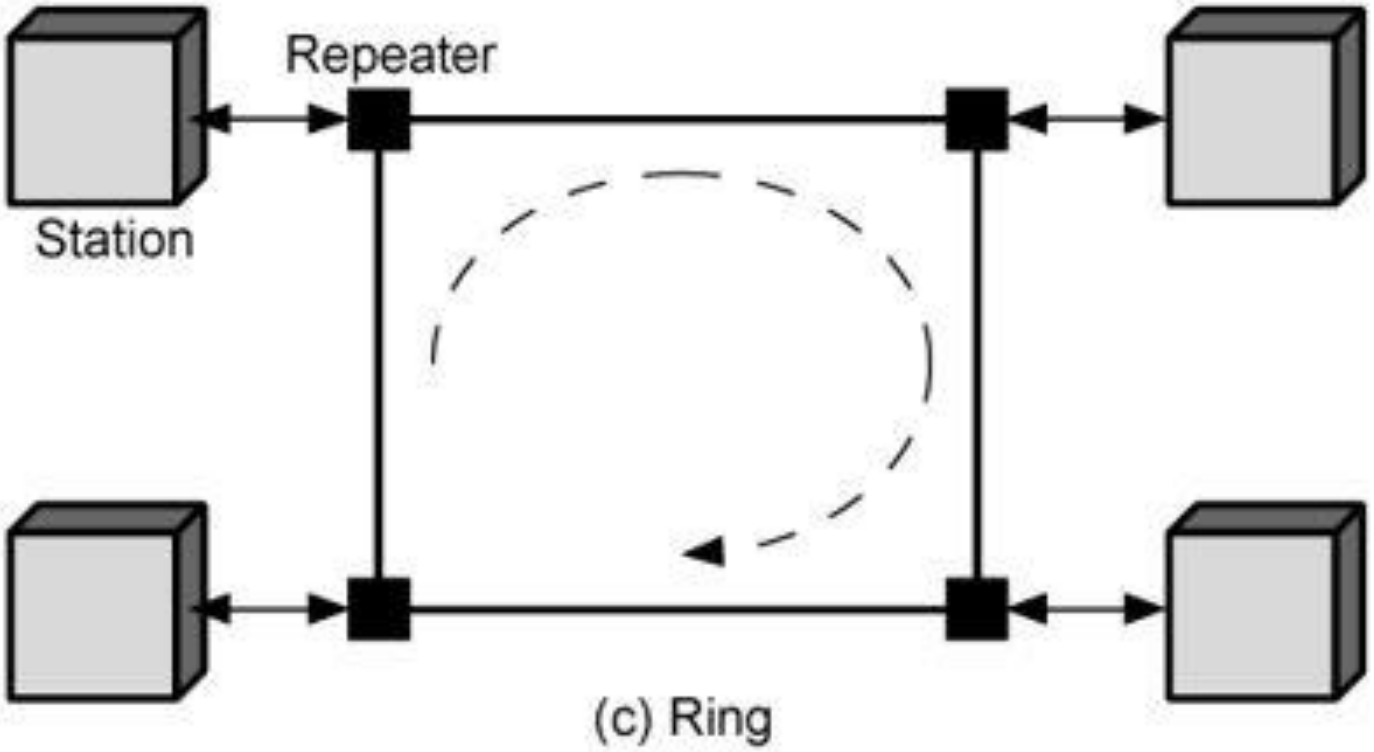
Frame is not addressed to B; B ignores it



A copies frame as it goes by

Network Topologies (Cont.)

- **Ring topology:**

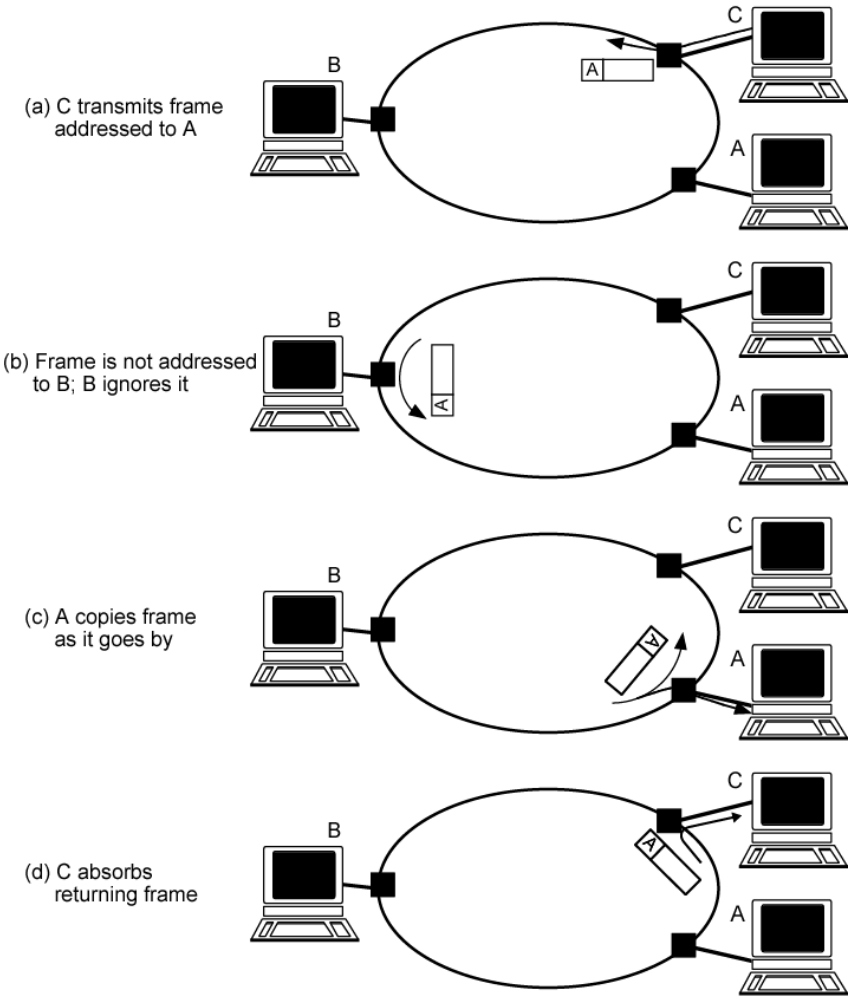


Network Topologies (Cont.)

- **Ring topology:**
  - **Repeaters joined by point-to-point links in closed loop**
    - Receive data on one link and retransmit on another
    - Links unidirectional
    - Stations attach to repeaters
  - **Data in frames**
    - Circulate past all stations
    - Destination recognizes address and copies frame
    - Frame circulates back to source where it is removed
  - **Media access control determines when station can insert frame**

Network Topologies (Cont.)

- **Frame transmission on Ring LAN topology:**



Network Topologies (Cont.)

- **Mesh topology:**

$$No.of\ cables = \frac{n(n-1)}{2}$$

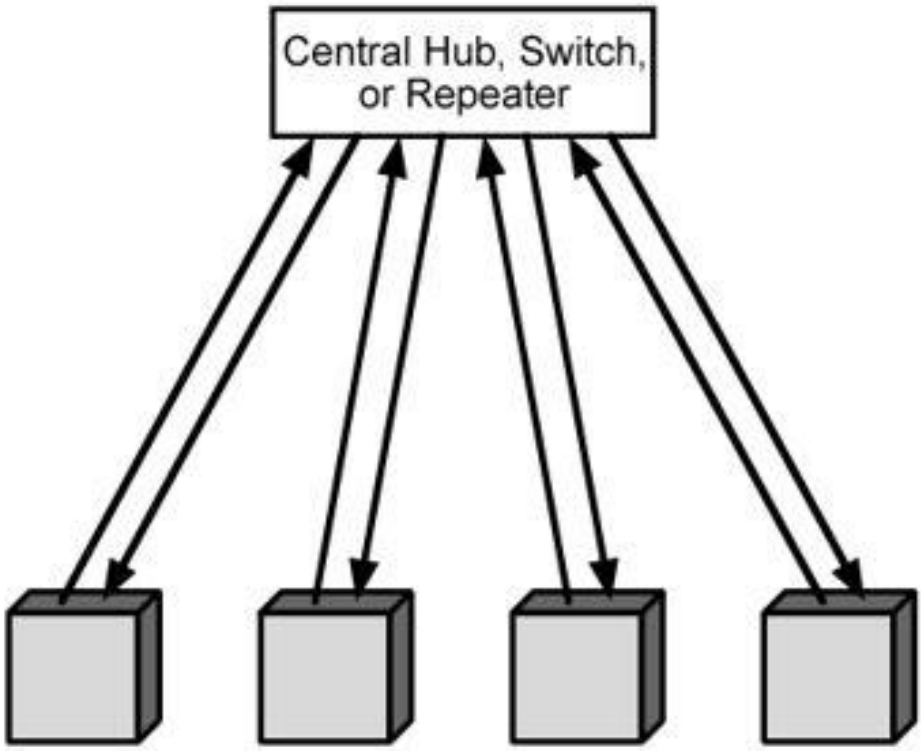
$$No.of\ cards = n(n-1)$$

where n is number of devices

Mesh

Network Topologies (Cont.)

- **Star topology:**

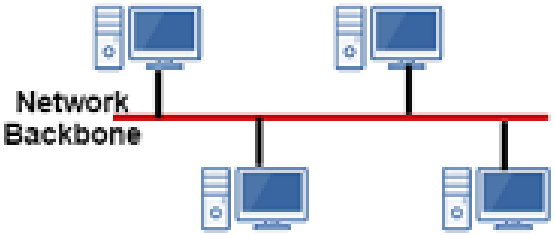


(d) Star

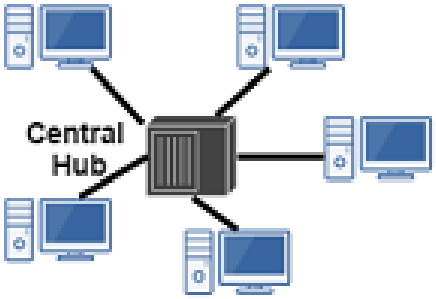
Network Topologies (Cont.)

- **Star topology:**
  - **Each station connected directly to central node**
    - Usually via two point to point links
  - **Central node can broadcast**
    - Physical star, logical bus
    - Only one station can transmit at a time
  - **Central node can act as frame switch**

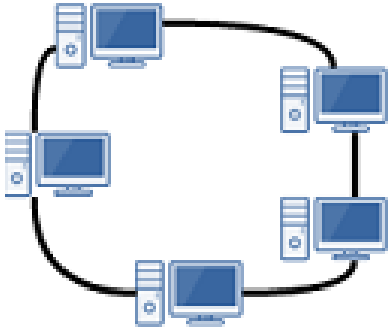
Network Topologies (Cont.)



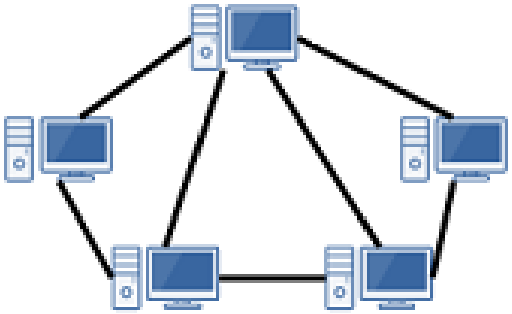
Bus



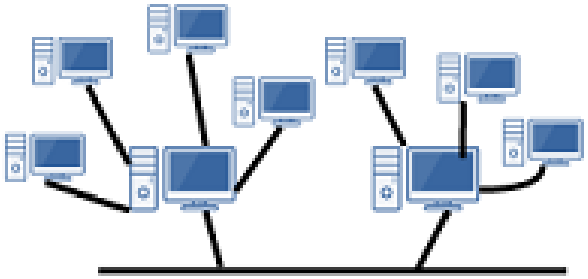
Star



Ring



Mesh



Tree

Point-to-Point

Network Topologies (Cont.)

Choice of Topology:

- **Reliability**
- **Expandability**
- **Performance**
- **Needs considering in context of:**

  - Medium
  - Wiring layout
  - Access control

Network Types

Physical Types of Network:

- **LAN (Local Area Network)….**

  It is a group of network components that work within small area.

- **MAN (Metropolitan Area Network)….**

  It is a group of LANs that are interconnected over a small area within city.

- **WAN (Wide Area Network)….**

  It is a group of LANs that are interconnected within large area.

Network Types (Cont.)

Physical Types of Network:

- **CAN (Campus Area Network)….**

  Larger than LANs, but smaller than metropolitan area networks.

- **PAN (Personal Area Network)….**

  The smallest and most basic type of network.

- **SAN (Storage-Area Network)….**

  As a dedicated high-speed network that connects shared pools of storage devices to several servers.

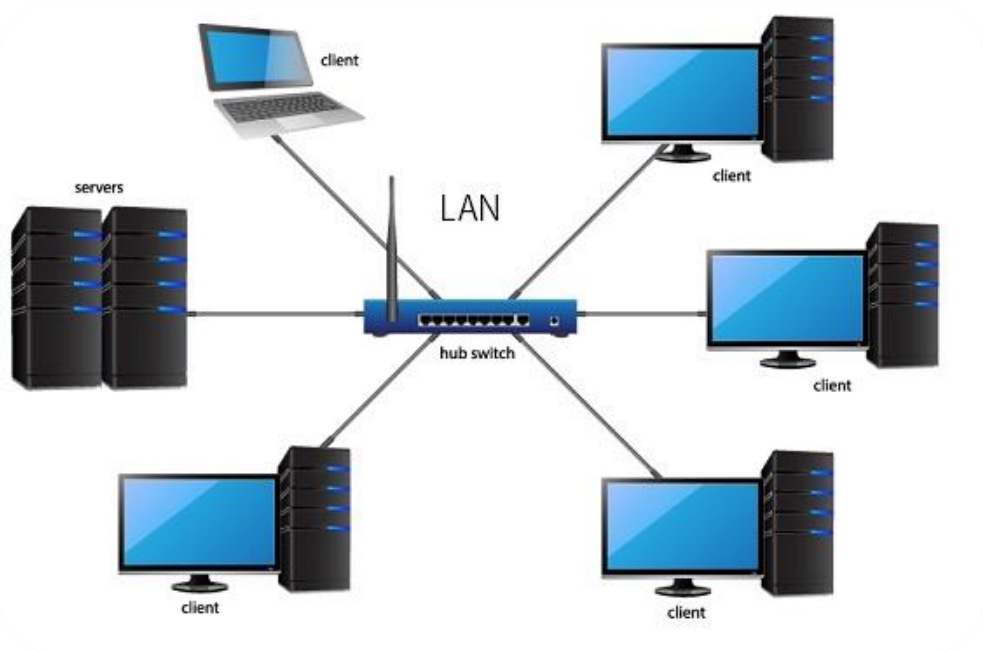
- **GAN (Global-Area Network)….**

  The biggest one.

Network Types (Cont.)

- **LAN (Local Area Network):**

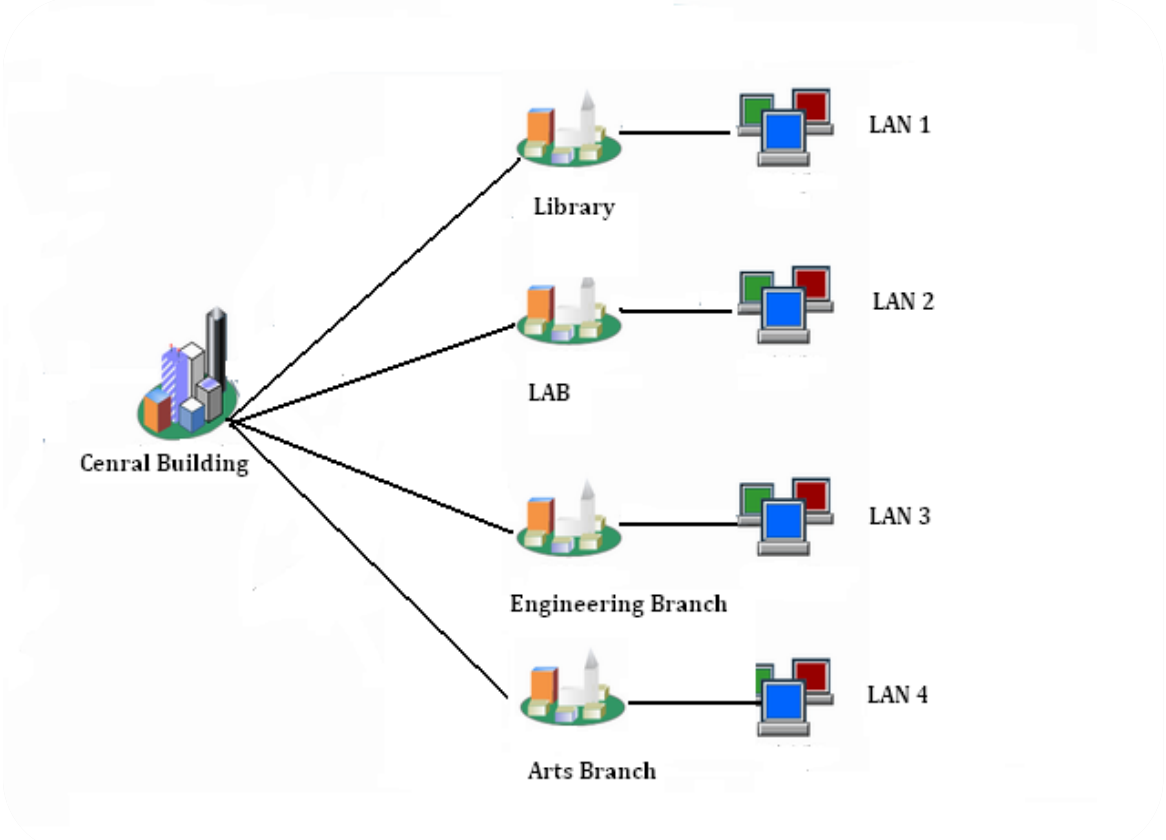
- It is a group of network components that work (connected) within small local area such as office, home, and local company.



Network Types (Cont.)

- **MAN (Metropolitan Area Network):**

  - It is a group of LANs that are interconnected over a small area within city like university have multi networks.

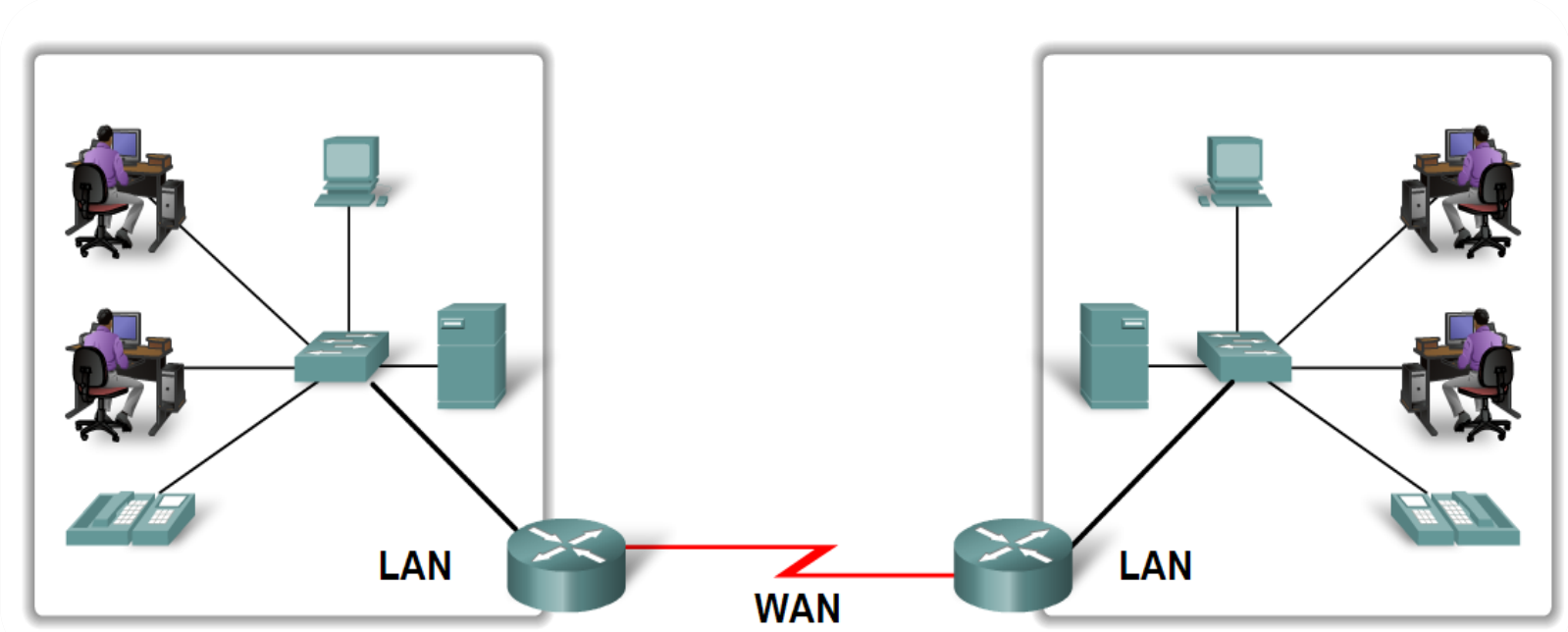


Network Types (Cont.)

- **WAN (Wide Area Network):**

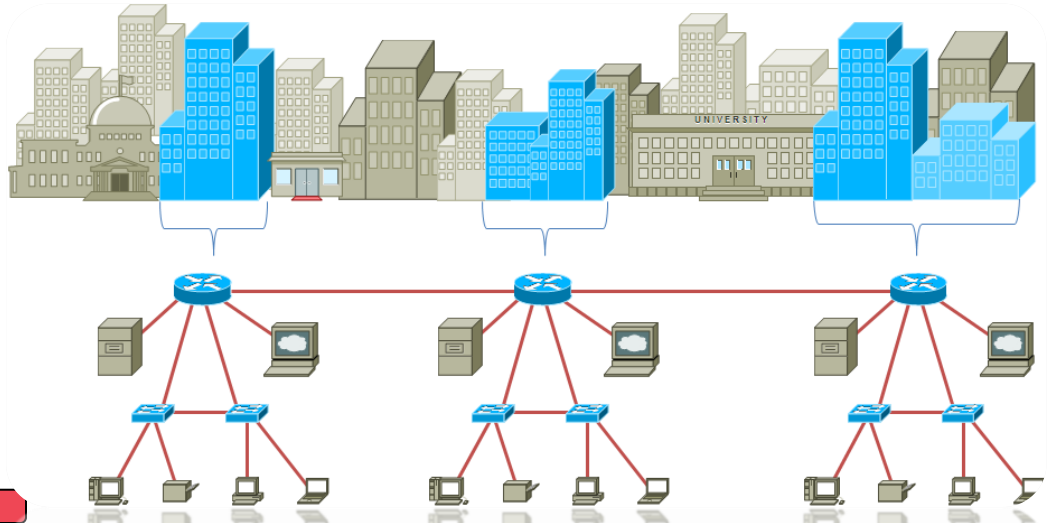
  - It is a group of LANs that are interconnected within large area (between cities, countries, and continents).

  - The biggest WAN is Internet (Public WAN).



Network Types (Cont.)

- **CAN (Campus Area Network):**
  - Larger than LANs, but smaller than metropolitan area networks.
  - Is A network that connects two or more LANs but that is limited to a specific and contiguous geographical area such as a college campus, industrial complex, office building, or a military base.

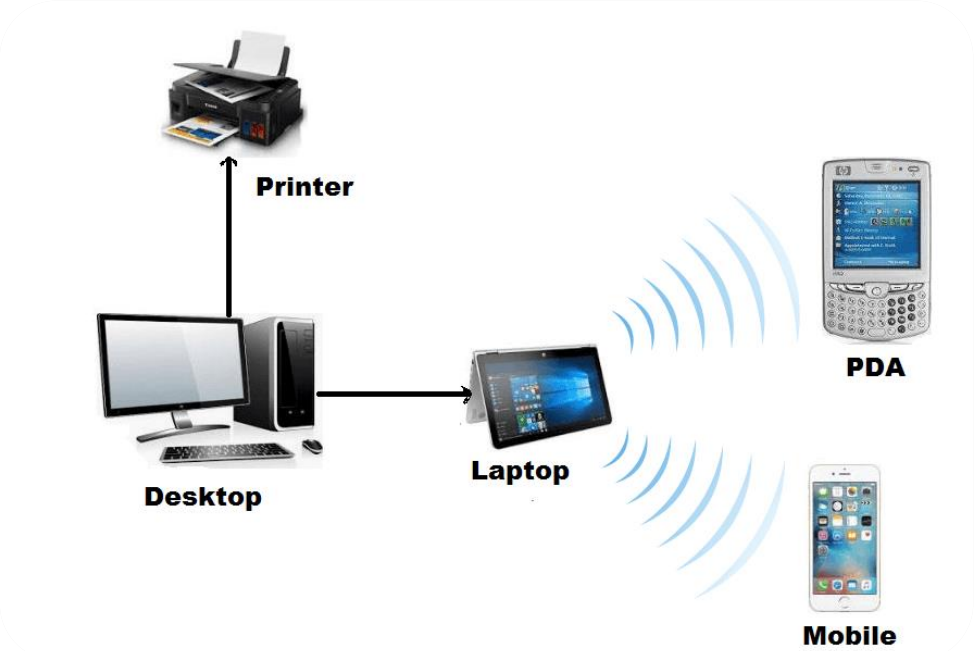


Network Types (Cont.)

- **PAN (Personal Area Network):**

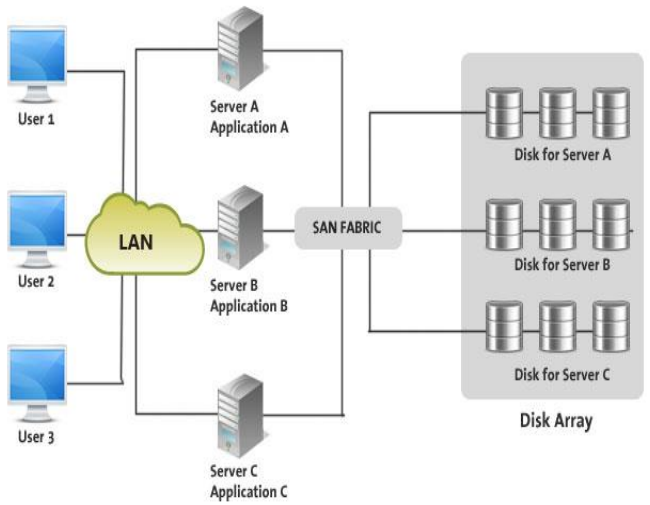
  - The smallest and most basic type of network.

  - Personal Area Network (PAN) offers to make connections of multiple devices or other equipment under the single user's environment within 10 meters.



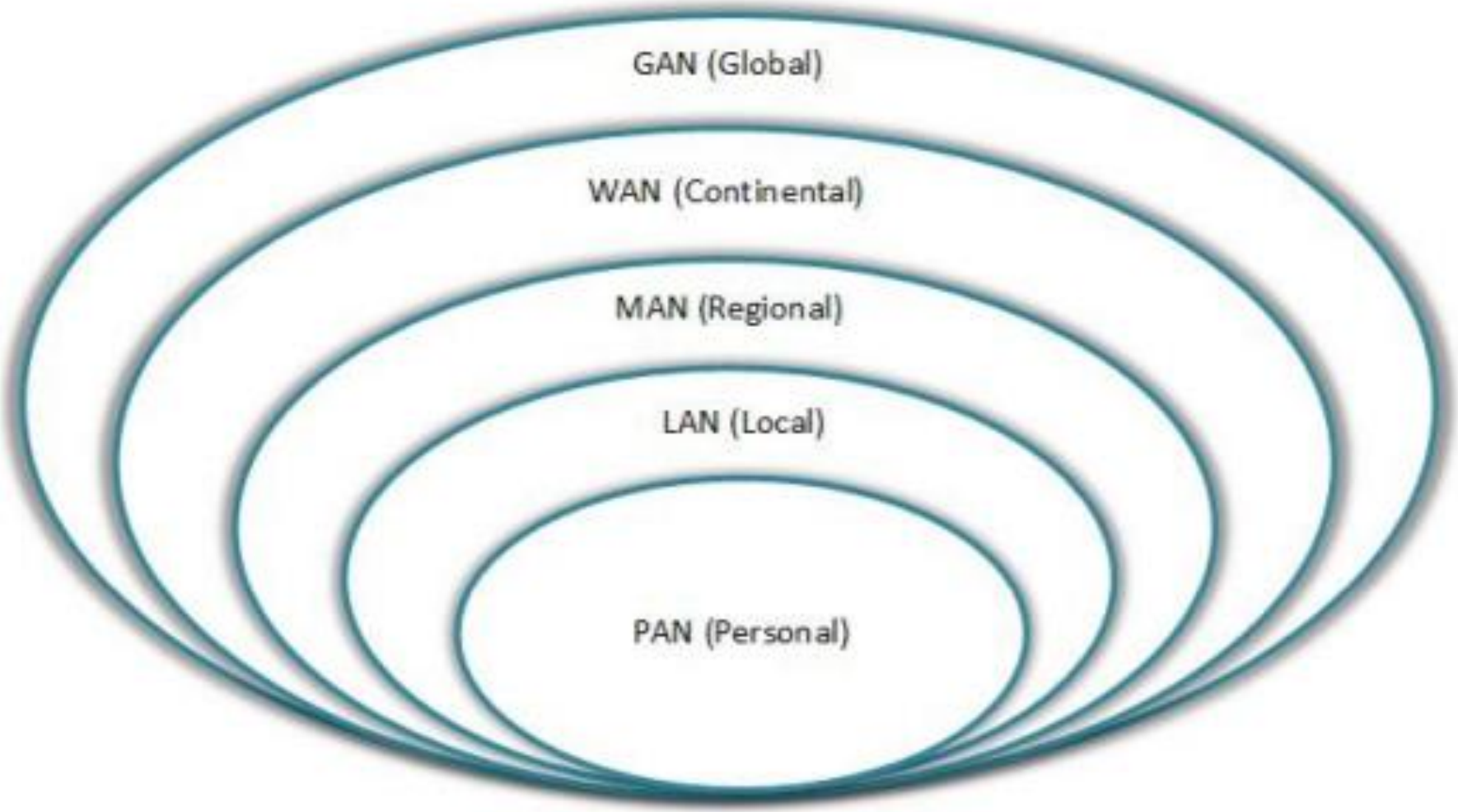
Network Types (Cont.)

- **SAN (Storage-Area Network):**
  - As a dedicated high-speed network that connects shared pools of storage devices to several servers.
  - is a specialized, high-speed network that provides block-level network access to storage.



- **GAN (Global Area Network):**
  - The biggest one.

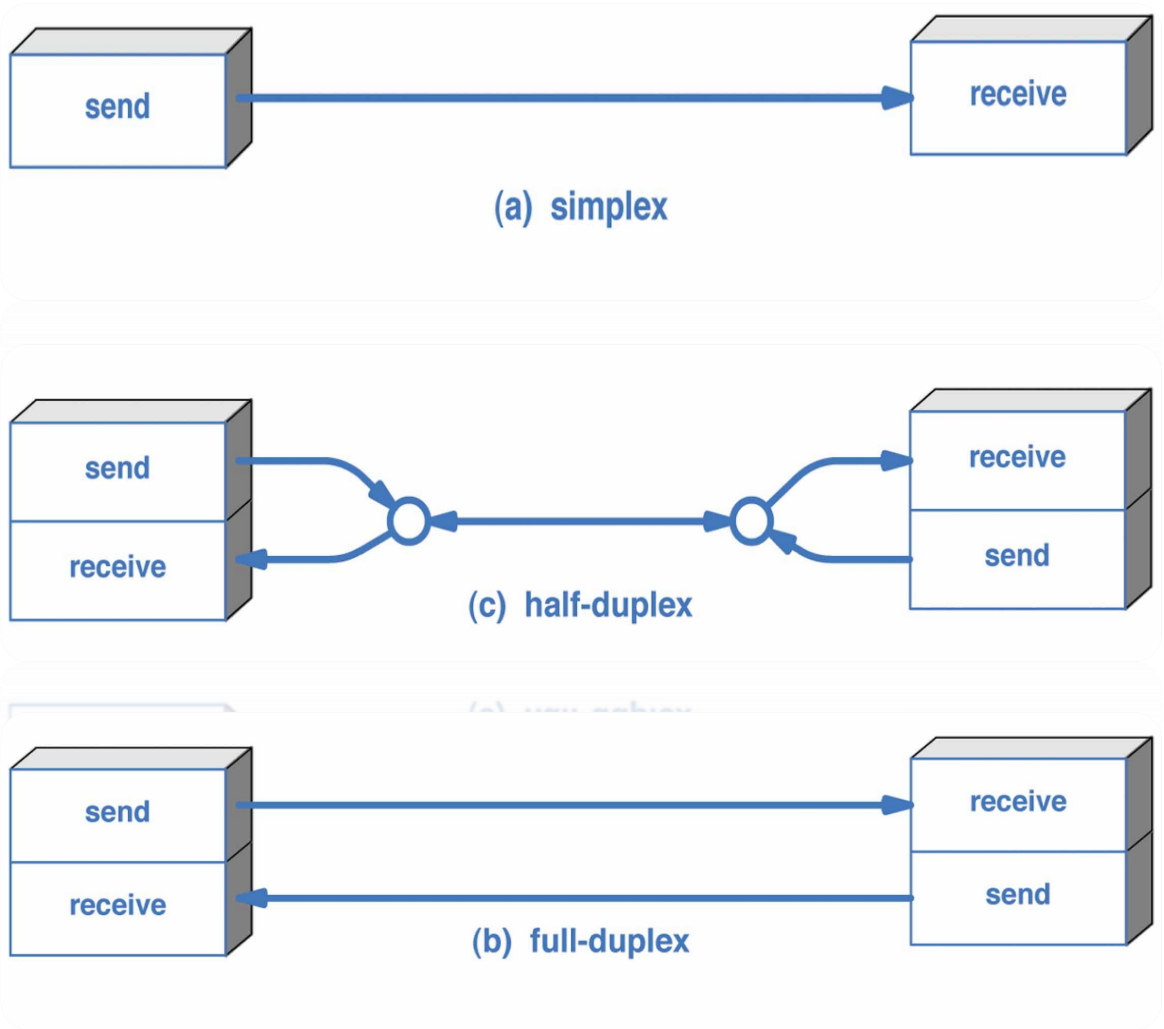
Network Types (Cont.)



Methods of Sending Data

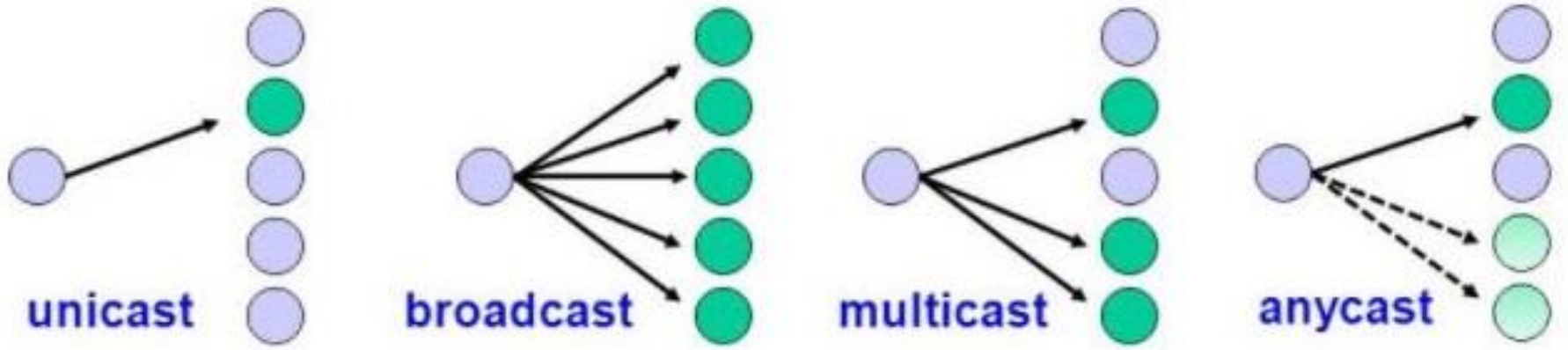
- **Methods of Sending Data in the Physical Media Networks:**

  - Simplex or Single.
  - Half Duplex.
  - Full Duplex.



Methods of Sending Data (Cont.)

- **Methods of Sending Data in Network:**
  - Unicast
  - Multicast
  - Broadcast
  - Anycast



Network Terminology

- **IP addresses:** The IP protocol is one of the fundamental protocols that allow the internet to work. IP addresses are unique on each network, and they allow machines to address each other across a network. It is implemented on the internet layer in the IP/TCP model.

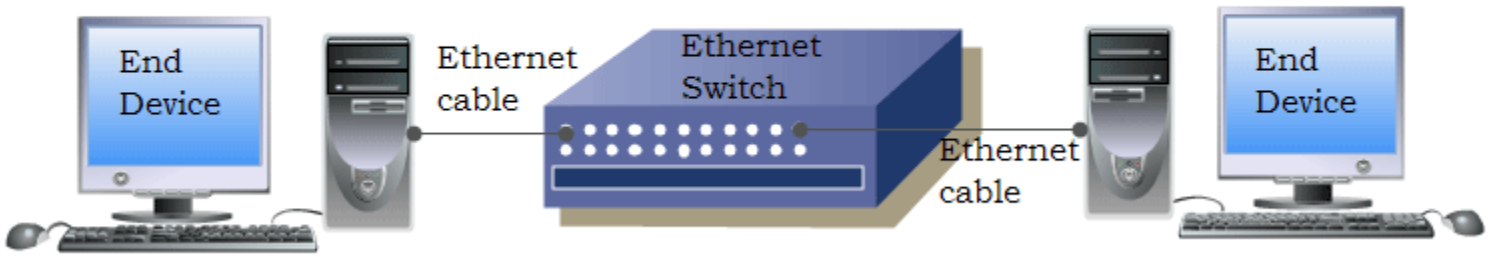
- **MAC addresses:** Media access control is a communications protocol that is used to distinguish specific devices. Each device is supposed to get a unique MAC address during the manufacturing process that differentiates it from every other device on the internet.

Network Terminology (Cont.)

- **OSI Model:** Historically, one method of talking about the different layers of network communication is the OSI model. OSI stands for Open Systems Interconnect.
- **Network Collision:** A Collision Domain is a scenario in which when a device sends out a message to the network, all other devices which are included in its collision domain have to pay attention to it, no matter if it was destined for them or not.
- **CSMA/CD:** CSMA/CD is used as a standard for Ethernet to reduce data collisions and increase successful data transmission.

Network Terminology (Cont.)

- **Protocols:** A network protocol is an established set of rules that determine how data is transmitted between different devices in the networks.
- **Ethernet:** Ethernet is a wired system that started with using coaxial cable and has successfully progressed to now using twisted pair copper wiring and fiber optic wiring.




SH. A.
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هندسة الاتصالات والحاسبات
Communications and Computers Engineering Dept .

Questions?

References

Required books:

[1] William Stallings, “Data and Computer Communications”, 10th edition, 2014

Recommended books:

[1] Forouzan B. A “Data Communications and Networking”, McGraw-Hill, 2nd Ed., 2005

Periodicals, Web sites, … etc.:

Cisco network guide (https://www.netacad.com/ar),
Huawei network guide (https://e.huawei.com/en/talent/#/),
EKB,
IEEE, … etc.

Course notes:

lecture notes after each lecture