Introduction to Networks

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1 What's a Network?

What's a Network?

A **network** is two or more computer systems linked together by some form of the transmission medium that enables them to share information

What's a Network?

Provides services like:

- Access to shared files/folders
- Access to printers/scanners
- Email applications
- Database applications
- Web applications
- Voice over IP (VoIP)
- Multimedia conferencing

What's a Network?

Features of Computer Network

- **Performance** → Response time
- **Data Sharing**
- **Backup**
- **Reliability** → No failures!
- **Security** → Keep data safe!
- **Scalability** → New systems can be added
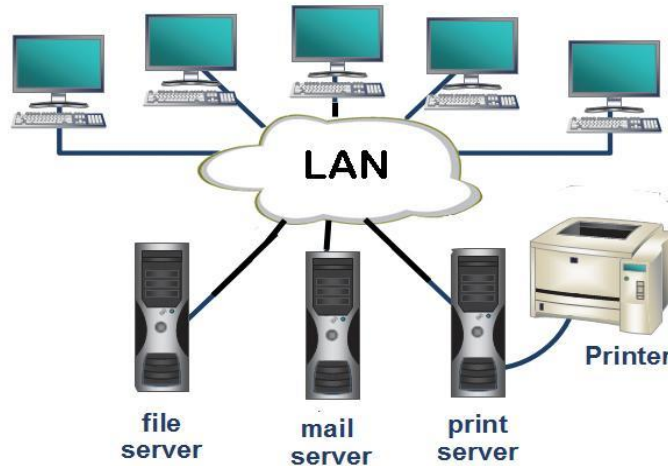- **Software and hardware compatibility**

Local Area Network (LAN)

Local Area Network (LAN)

A LAN is a **local** network

- Could be as small as two computers or large, with thousands of devices connected
- Usually restricted to spanning a particular geographic location

A company in a single building is considered as LAN

True

False

A company consisting of multiple buildings in the same area is considered as LAN
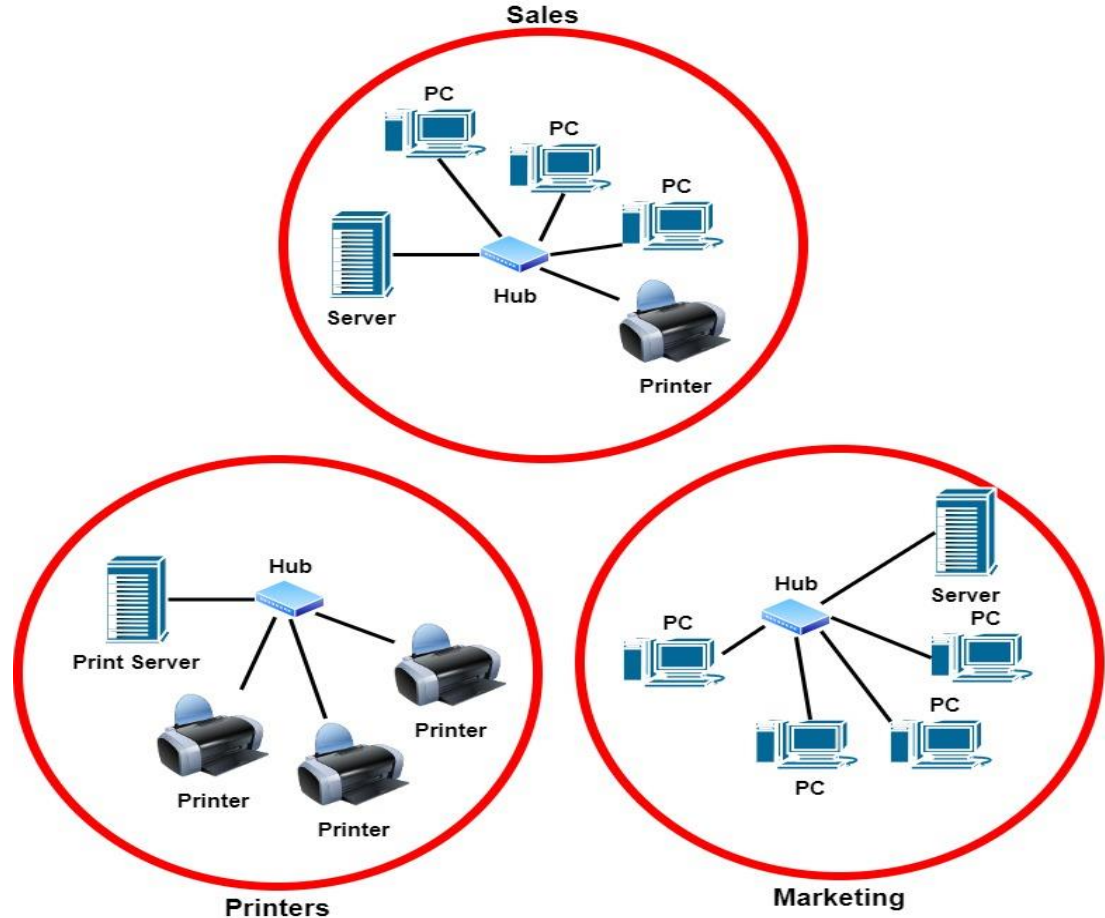
True

False

Local Area Network (LAN)

LAN's size and the distance a LAN can span is not restricted

But it's best to split a big LAN into smaller logical zones known as **workgroups** to make administration easier
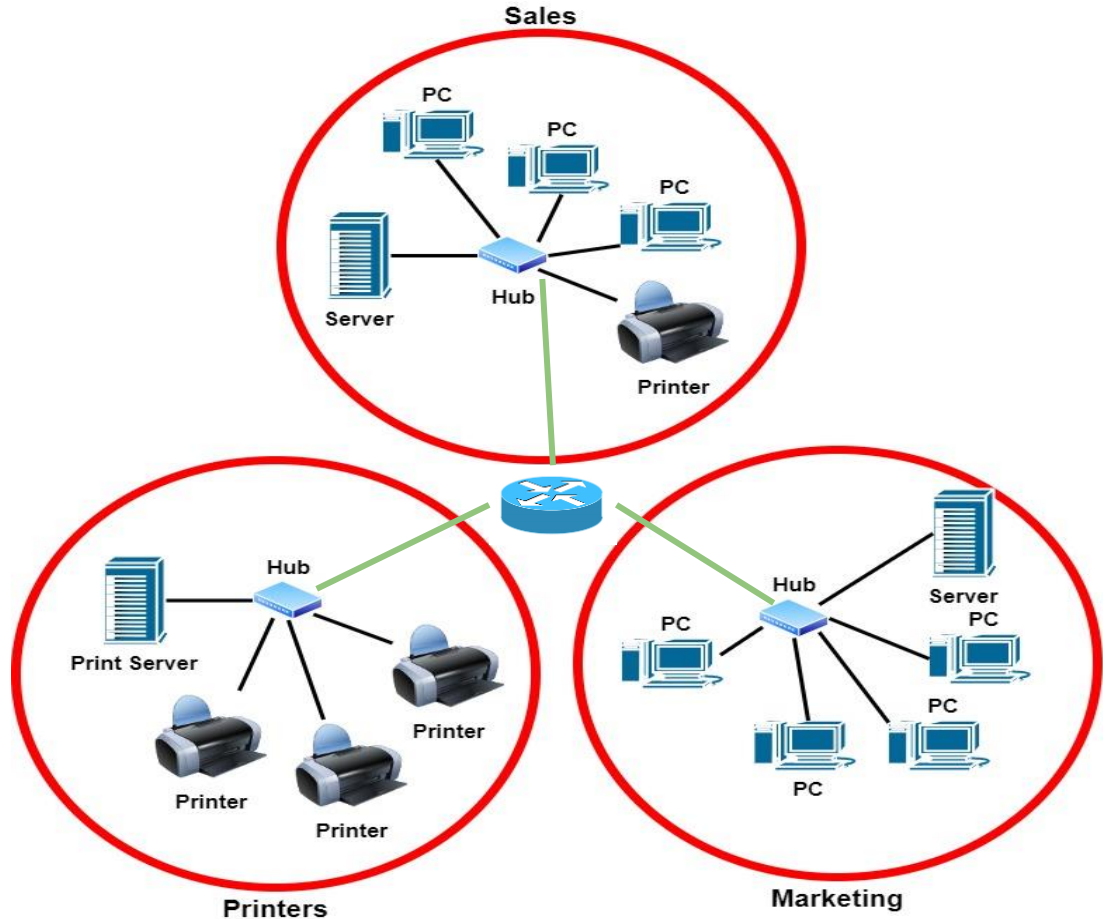
Local Area Network (LAN)

3 LANs, each has its own workgroup

Local Area Network (LAN)

A LAN with 3 workgroups

3 Common Network Components

Common Network Components

- **Node**   ⟶   - A point or joint where a connection takes place
  - Can be a computer or device

- **Station**   ⟶   A node on a wireless network

- PC	- Printer
- Laptop	- Router
- Server	-
Switch Smartphone	-
etc.	

Some examples of Node

Common Network Components

- **Host** ➡ - Requires IP Address
  - Can be a client or server

- **Workstation** ➡ - Powerful computer designed for technical or scientific applications
  - Used by one person at a time

Common Network Components

- **Server** ⟶ A powerful computer used to store files and run programs centrally

- **Client** ⟶ A device that makes request from a server

- Web Server   - Application Server
- Proxy Server   - DNS Server
- Mail Server   - File Server
- Print Server   - Telephony Server

Common types of servers

Common Network Components

- **Segment** ⟶ - Refers to a specific physical region of a network
  - Typical usage is to describe the link between a computer and a switch
  - Another usage is to refer to a region of the network where all the nodes use the same type of transmission media

- **Backbone** ⟶ A fast link between other segments of a network

Common Network Components

- **Transmission Media** ➡️
  - A communication channel between **nodes** that carries the information from the sender to the receiver
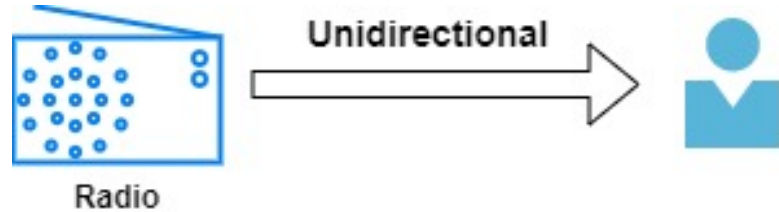 - Data is transmitted through the electromagnetic signals
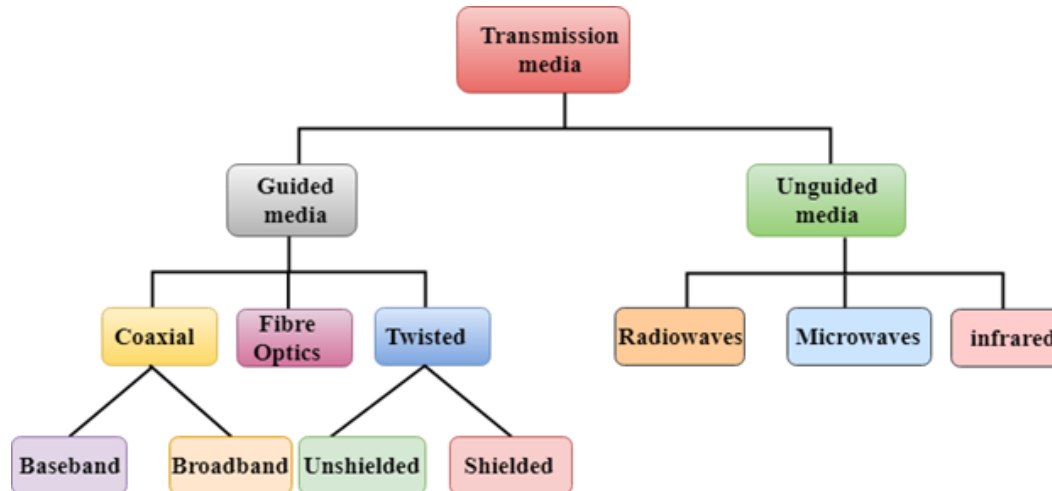
Cable Properties

Simplex

Unidirectional

Radio

Half-duplex

Sending

Receiving

Full-duplex

Simultaneously
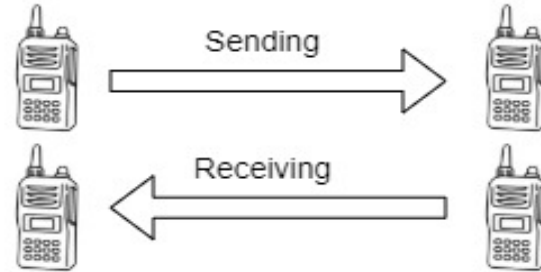
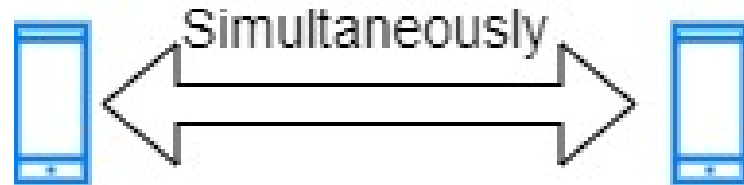# 4 Wide Area Network (WAN)

Wide Area Network (WAN)

A **WAN** is a collection of computers and devices connected by a communications network over a wide geographic area

WANs are commonly connected either through the Internet or special arrangements made with phone companies or other service providers

The **Internet** is considered the **largest WAN** in the world

5 Network Topology

Network Topology

Network topology is the description of the arrangement of **nodes** and **connections** in a network

```
                    ┌─────────────┐
                    │   Network   │
                    │  Topology   │
                    └─────────────┘
                           │
              ┌────────────┴────────────┐
      ┌───────────────┐         ┌───────────────┐
      │   Physical    │         │    Logical    │
      │   Topology    │         │   Topology    │
      └───────────────┘         └───────────────┘
```
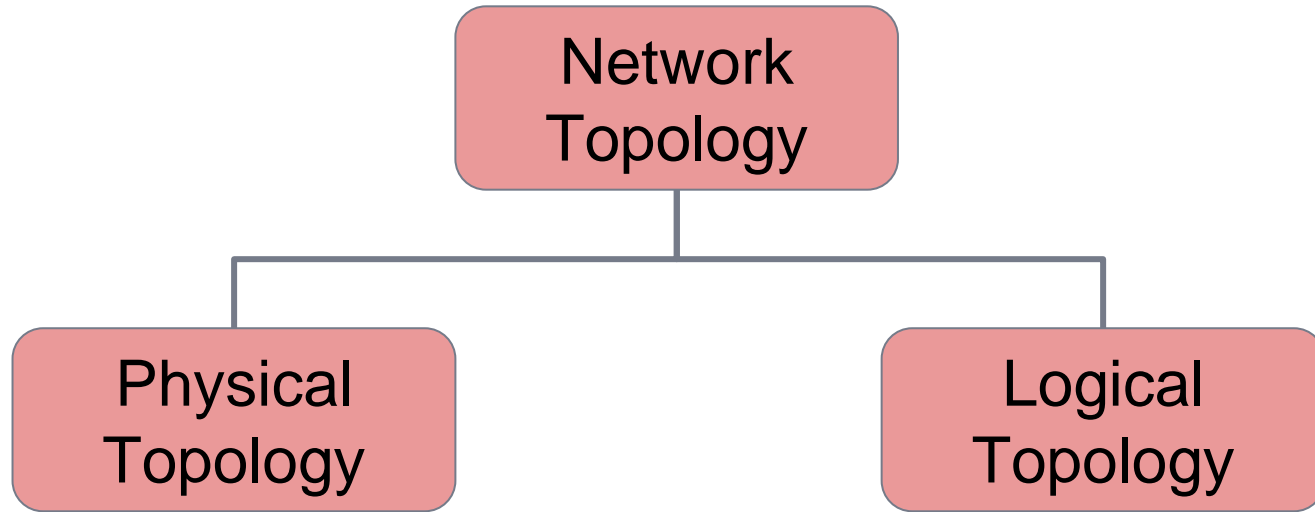
Network Topology

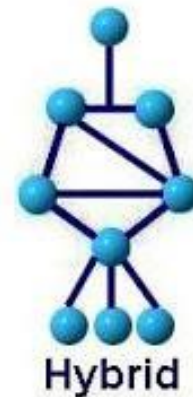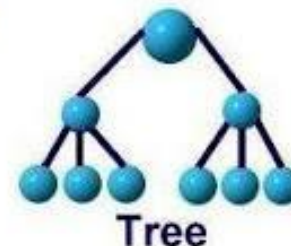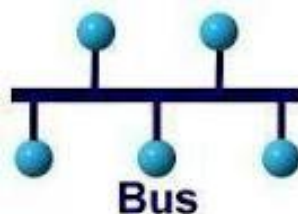A **physical topology** details how devices are physically connected

Depends on:
- Office layout
- Troubleshooting techniques
- Cost of installation
- Type of cable used

Bus

Star

Tree

Ring

Mesh

Hybrid

Network Topology

Logical topology describes the way in which a network transmits information from network/computer to another

It's not the way the network looks or how it is laid out

6 Physical Network Topologies

Bus Topology

Ring Topology

Tree Topology

Star Topology

Mesh Topology

Hybrid Topology

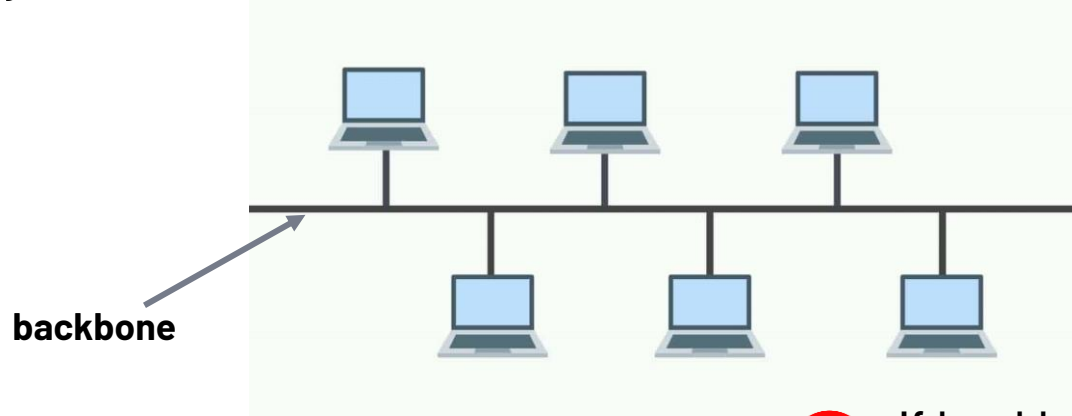# Physical Network Topologies

Bus Topology:

Every node is connected in series along a linear path

backbone

✅ Keeps the layout simple

✅ Cost effective

❌ If backbone fails entire network goes down

❌ Decreased network performance
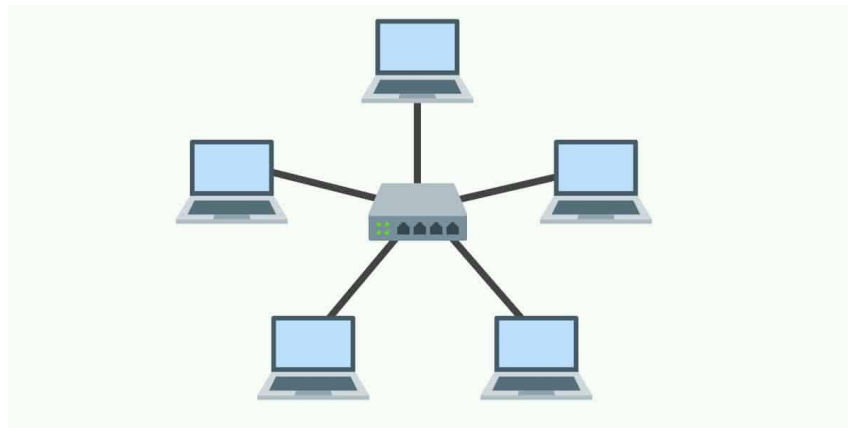
❌ Not scalable

Physical Network Topologies

Star Topology:

Every node in the network is connected to one central switch

✅ Easy to manage

✅ Requires fewer cables

❌ If central switch fails entire network goes down

❌ Performance is up to central switch

Physical Network Topologies

Ring Topology:

Every node is connected to each other in a circular format.
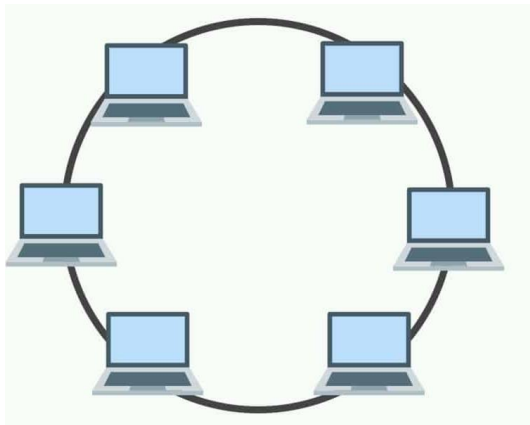
✅ Low risk of packet collision

✅ Easy to install
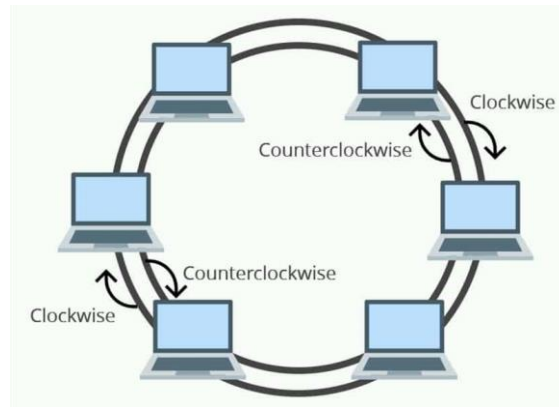
❌ Vulnerable to failure

❌ The more devices added the more communication delay

❌ To make changes the network should be shut down

Physical Network Topologies

Mesh Topology:

A point-to-point connection where nodes are interconnected
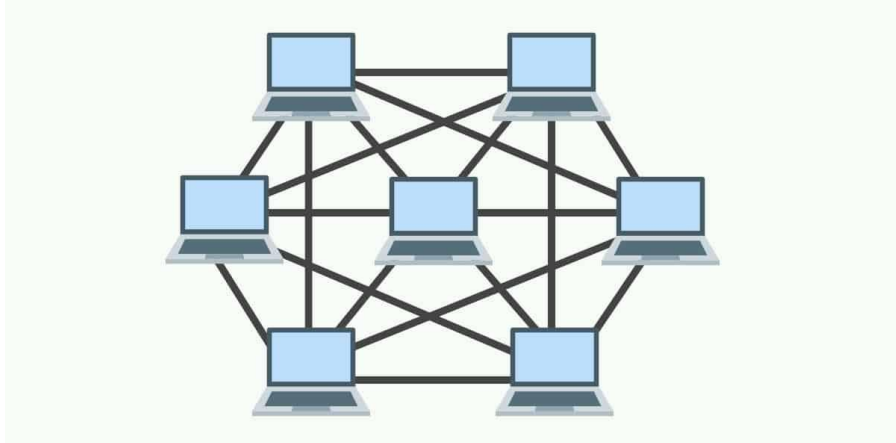
✅ Reliable

❌ Configuration is complex

❌ Expensive

Physical Network Topologies

Tree (Hierarchy) Topology:

A network structure that is shaped like a tree with its many branches
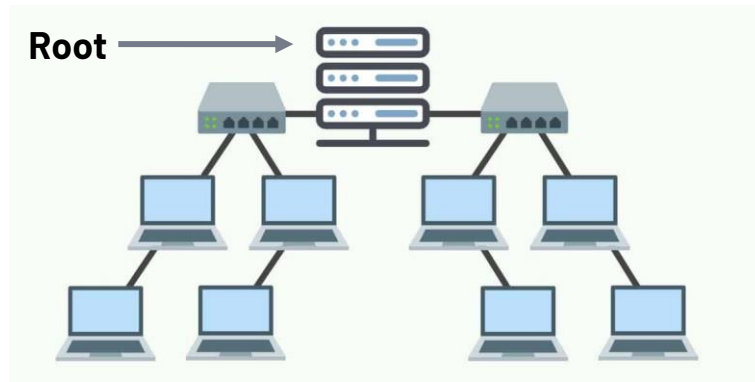
✅ Scalable

✅ Manageable

❌ Hard to maintain

❌ If root fails entire network goes down

Physical Network Topologies

Hybrid Topology:

A combination of two or more types of physical or logical network topologies working together within the same network
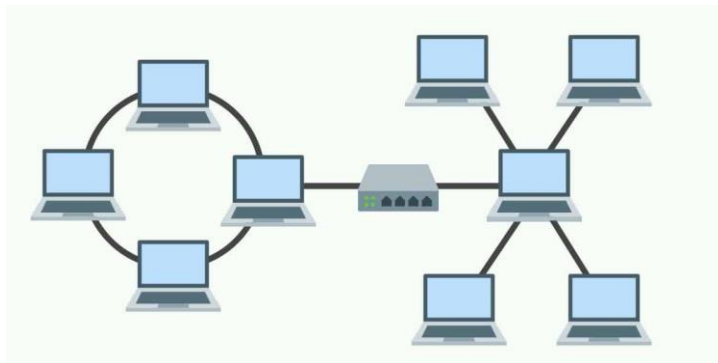
✅ Flexibility

❌ Quite complex

❌ Can be quite costly

THANKS!

Any questions?

You can find me at:

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Open System Interconnection (OSI) Specifications

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▶ What is OSI Reference Model?

▶ Layers of OSI Model

▶ Data Encapsulation

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1 What is OSI Reference Model?

What is OSI Reference Model?

The **OSI** provides a standard for different computer systems to be able to communicate with each other

Developed by ISO in 1984

What is OSI Reference Model?

Upper Layers (OS)

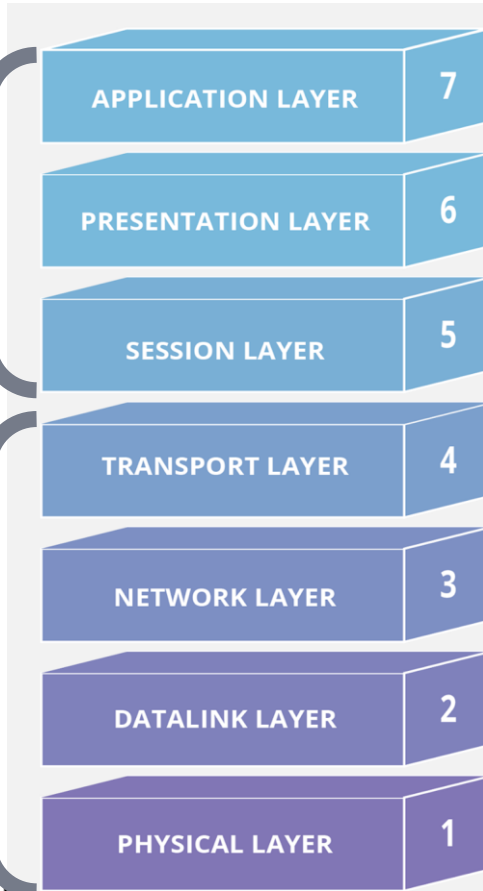|		
APPLICATION LAYER	7	- Human-computer interaction layer, where applications can access the network services
PRESENTATION LAYER	6	- Ensures that data is in a usable format and is where data encryption occurs
SESSION LAYER	5	- Maintains connections and is responsible for controlling ports and sessions

Lower Layers (Network)

TRANSPORT LAYER	4	- Transmits data using transmission protocols including TCP and UDP
NETWORK LAYER	3	- Decides which physical path the data will take
DATALINK LAYER	2	- Defines the format of the data on the network
PHYSICAL LAYER	1	- Transmits raw bit stream over the physical medium

Layers of the OSI Model

- Physical Layer
- Data Link Layer
- Network Layer
- Transport Layer
- Session Layer
- Presentation Layer
- Application Layer

2

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Application Layer (Layer 7)

- Directly interacts with data from the user

- Software applications (web browsers, email clients, etc.) rely on the application layer to initiate communications
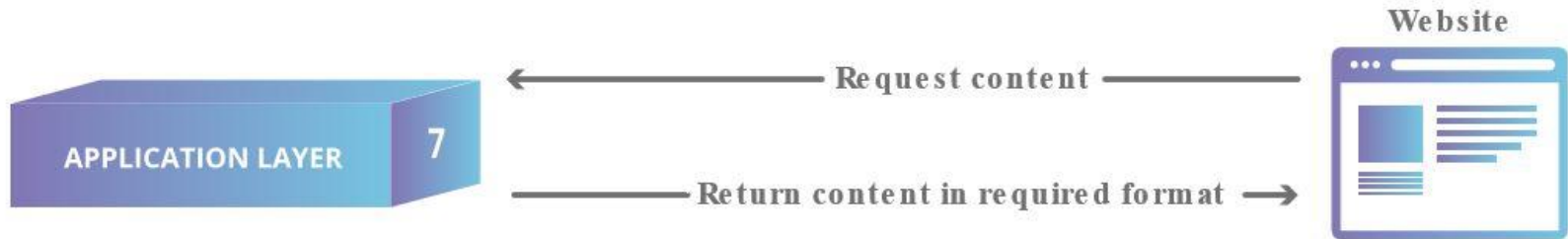
Presentation Layer (Layer 6)

- Primarily responsible for preparing data

- Translates, encrypts, and compresses data

Encryption   Compression   Translation

Session Layer (Layer 5)

- Responsible for opening and closing communication between the two devices

- The time between when the communication is opened and closed is known as the <u>session</u>

- Synchronizes data transfer

Session of communication

Transport Layer (Layer 4)

- Responsible for end-to-end communication between the two devices

- Takes data (from upper layer) and breaks into <u>segments</u>

- Responsible for flow control and error control

Segmentation　　　　　Transport　　　　　Reassembly

Network Layer (Layer 3)

- Facilitates data transfer between two different networks

- Takes data segments (from upper layer) and breaks into <u>packets</u>

Packets Creation → Transport → Packets Assembly

Data Link Layer (Layer 2)

- Facilitates data transfer between two devices on the same network

- Takes data packets (from upper layer) and breaks into <u>frames</u>

- Responsible for flow control and error control

Frame Creation → **Transport** → **Transfer frames between network nodes**

Physical Layer (Layer 1)

- Includes physical equipment
  - cables   repeaters
                    modems
  - transceivers   media converters   hubs
  - etc.

- Data is converted into bit streams

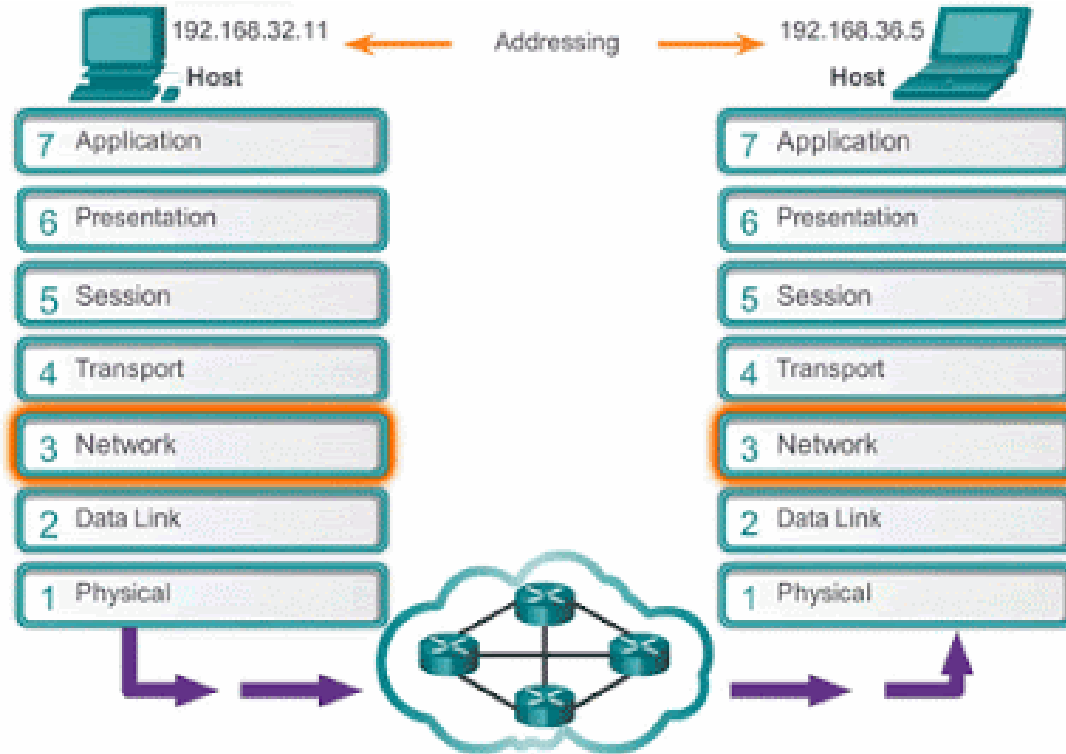Sending cable   Bitstream   Receiving cable
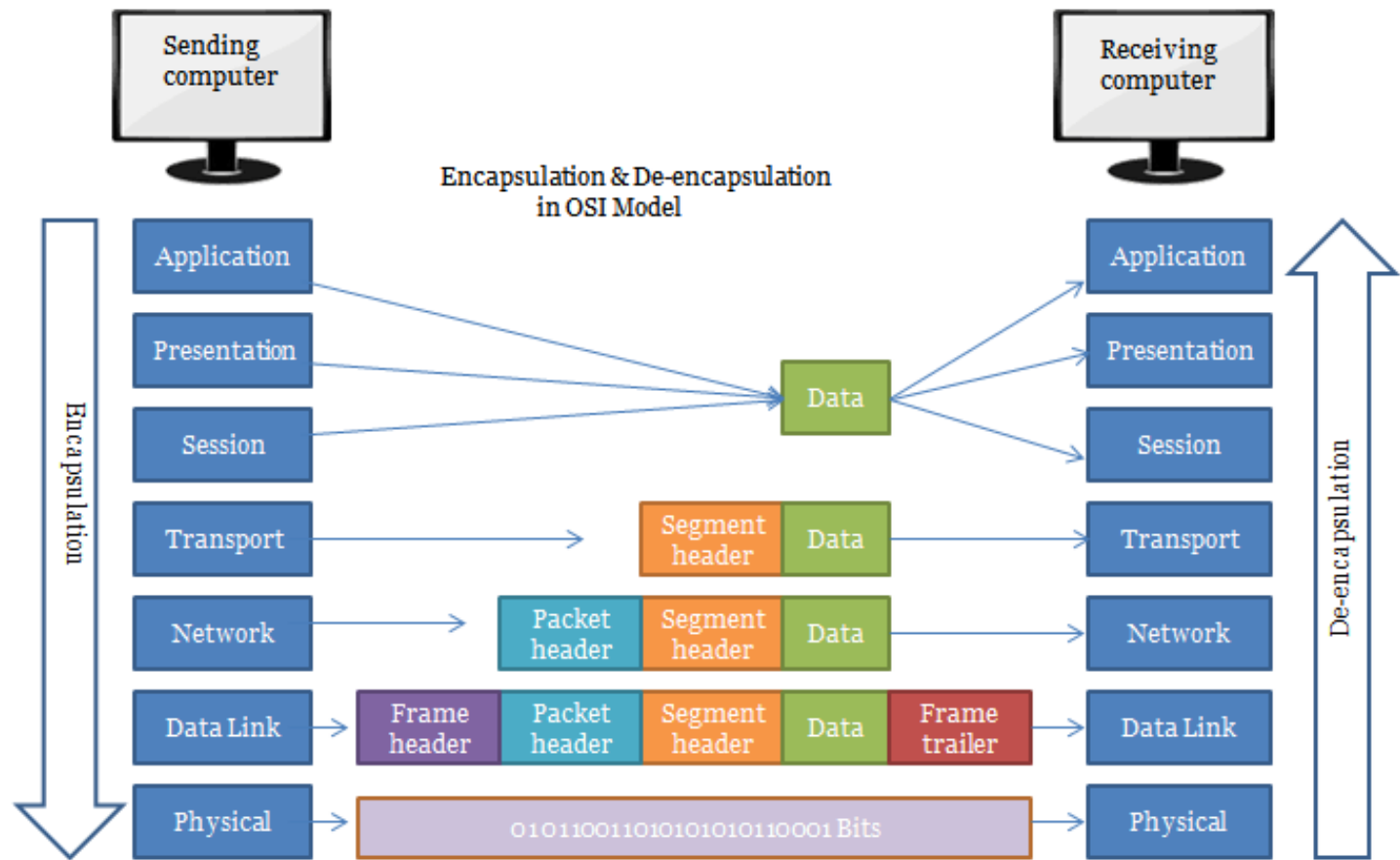
3 Data Encapsulation

Data Encapsulation

- For two nodes communicate they must use the same protocol

- Each layer *(OSI or DoD)* communicates with its equivalent layer on the other node via the lower layers of the model

- Each layer provides services for the layer above and uses the services of the layer below

Data Encapsulation

Data Encapsulation

Encapsulation & De-encapsulation in OSI Model

THANKS!

Any questions?

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