Fundamentals of Computer Networks and Data Communication

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Presentation Outline

- Computer Network
- Data Communication
- Transmission Mode
- Type of Connection
- Network Topology
- The OSI model

Computer Network

A computer network is a set of devices (nodes) connected via a transmission medium (Figure 1).

- Nodes: computers, printers, mobile phones, etc.
- Transmission Medium: wired (cables) or wireless (Wi-Fi) connections

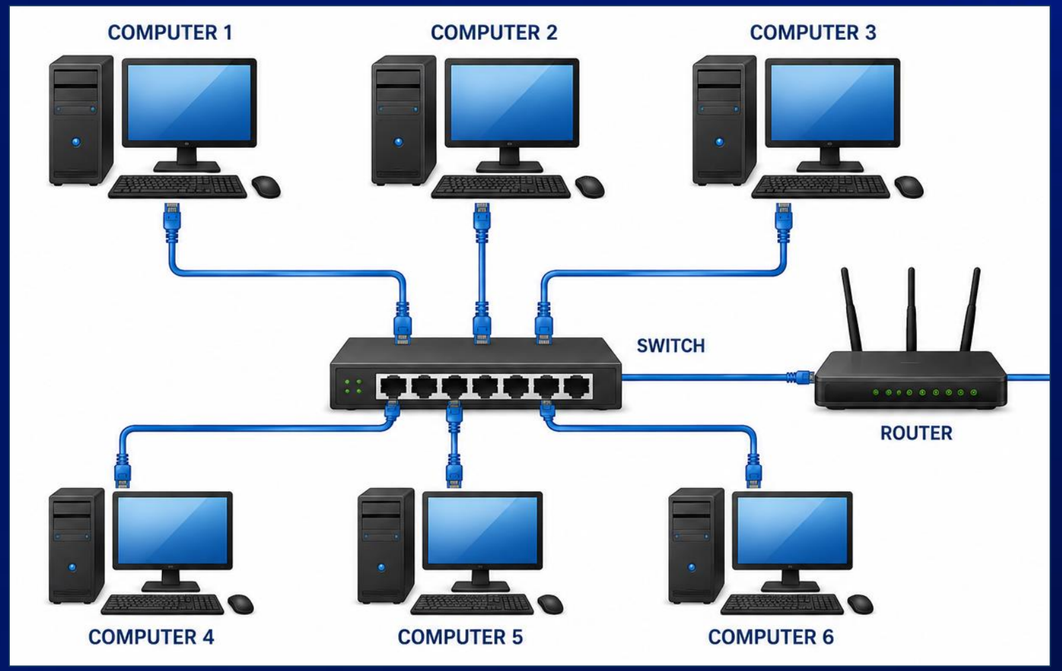


Figure 1: Devices Connected to Form a Network

Data Communication

Data communication is the exchange of data between two devices via some form of transmission medium such as a wire cable (Figure 2**).**

Components of Data Communication -

A data communication system has five components:

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

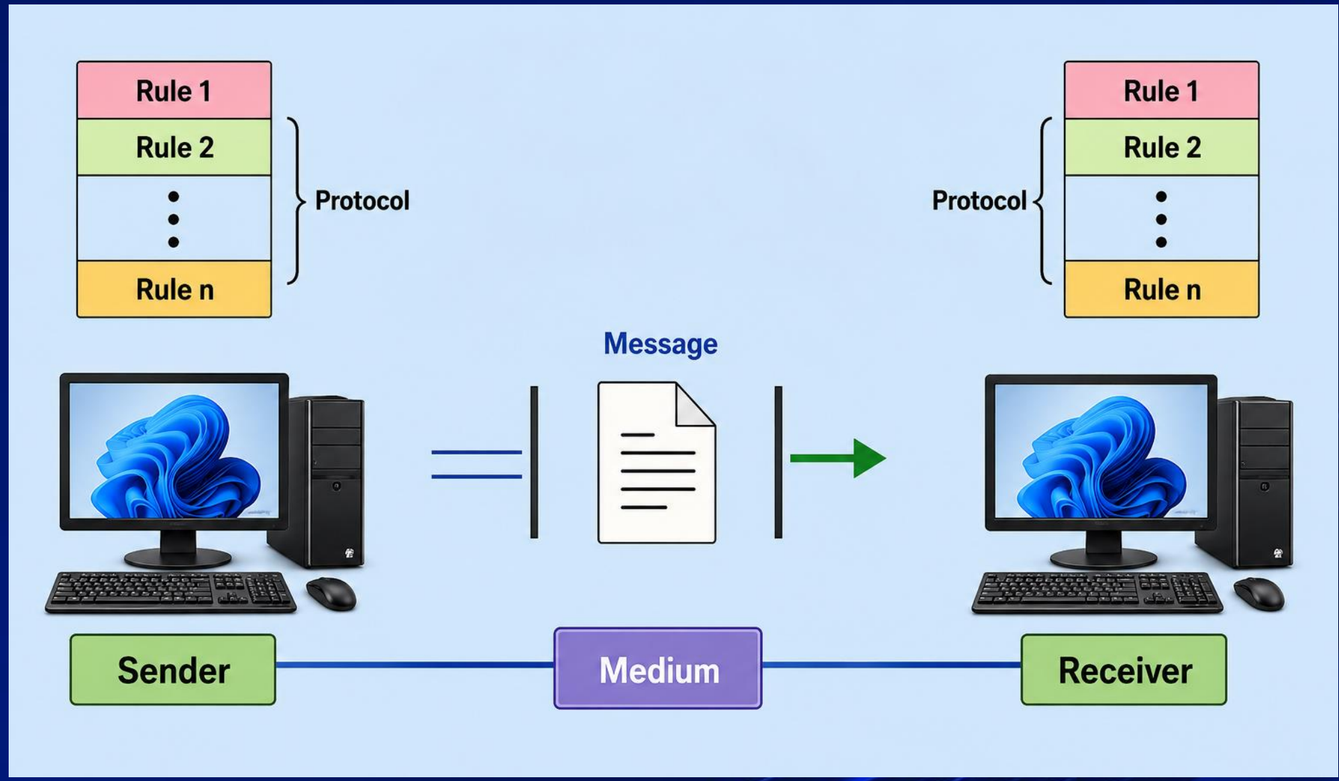


Figure 2: Components of a Data Communication System

Transmission Mode

It shows the direction in which data moves between devices (Figure 3).

Type of Transmission Mode

1. Simplex → One-way communication only
2. Half-Duplex → Two-way, but one direction at a time
3. Full-Duplex → Two-way simultaneously

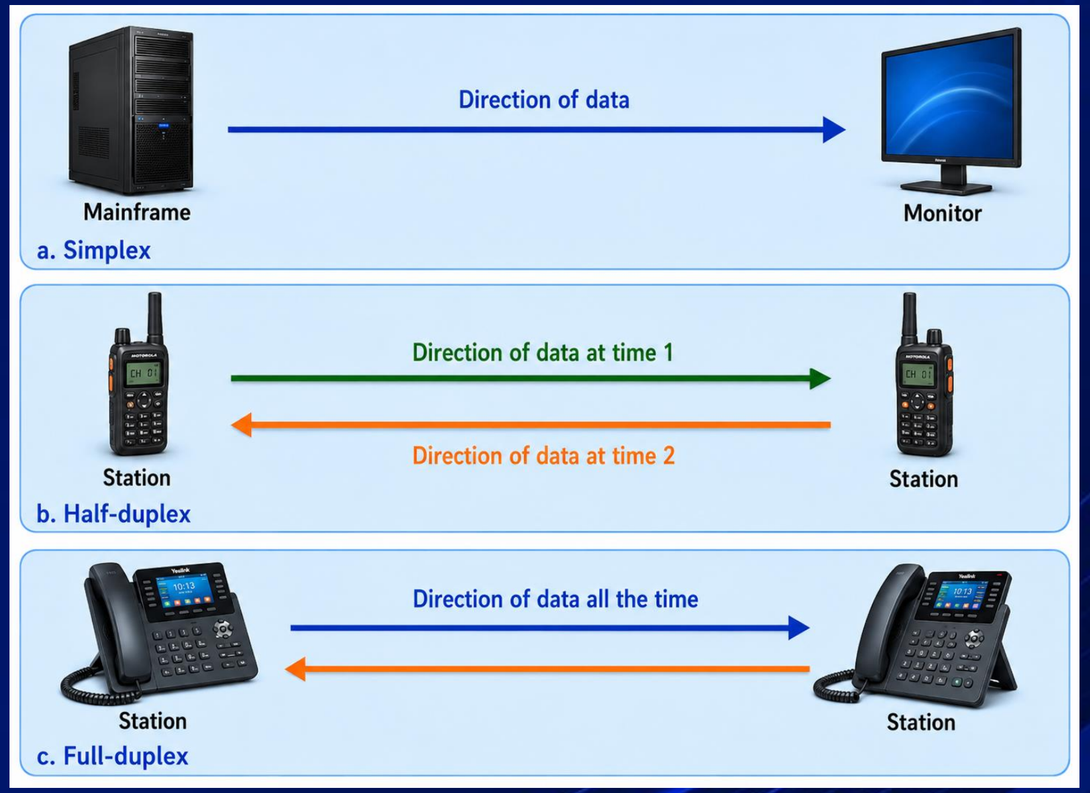


Figure 3: Types of Transmission Modes

Types of Connections

1. Point-to-Point connection
2. Multipoint connection

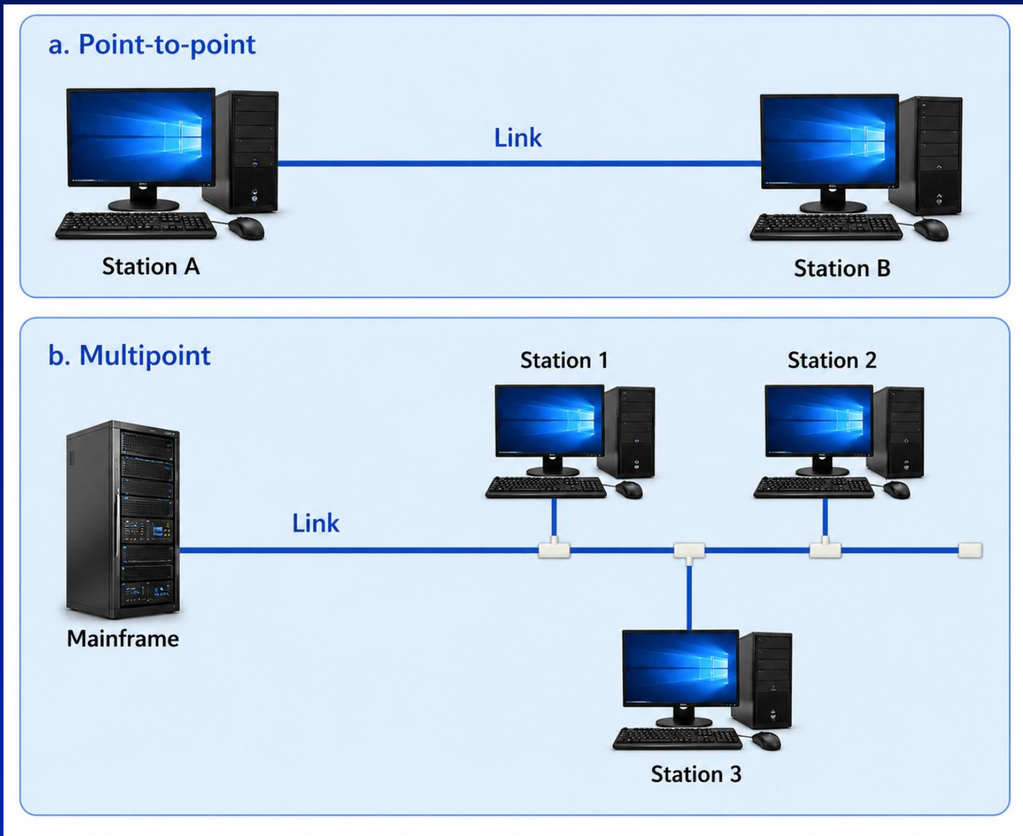


Figure 4: Types of Connection

Network Topology

The topology of a network is the geometric representation of links and connecting devices

Examples of Physical Topologies

There are four basic topologies possible:

1. Bus Topology
2. Star Topology
3. Ring Topology
4. Mesh Topology
5. Hybrid Topology

Mesh Topology

Mesh topology is a network topology in which every device is directly connected to every other device through dedicated links (Figure 5).

In a Mesh Topology:

- Every device has a dedicated point-to-point link.
- Each device must be connected to all other devices.
- If n number of nodes are there, then each device must be connected to n – 1 devices.
- Link is full duplex transmission mode used, hence: $\frac{n(n-1)}{2}$ links required.
- Every device must have n – 1 number of i/o ports

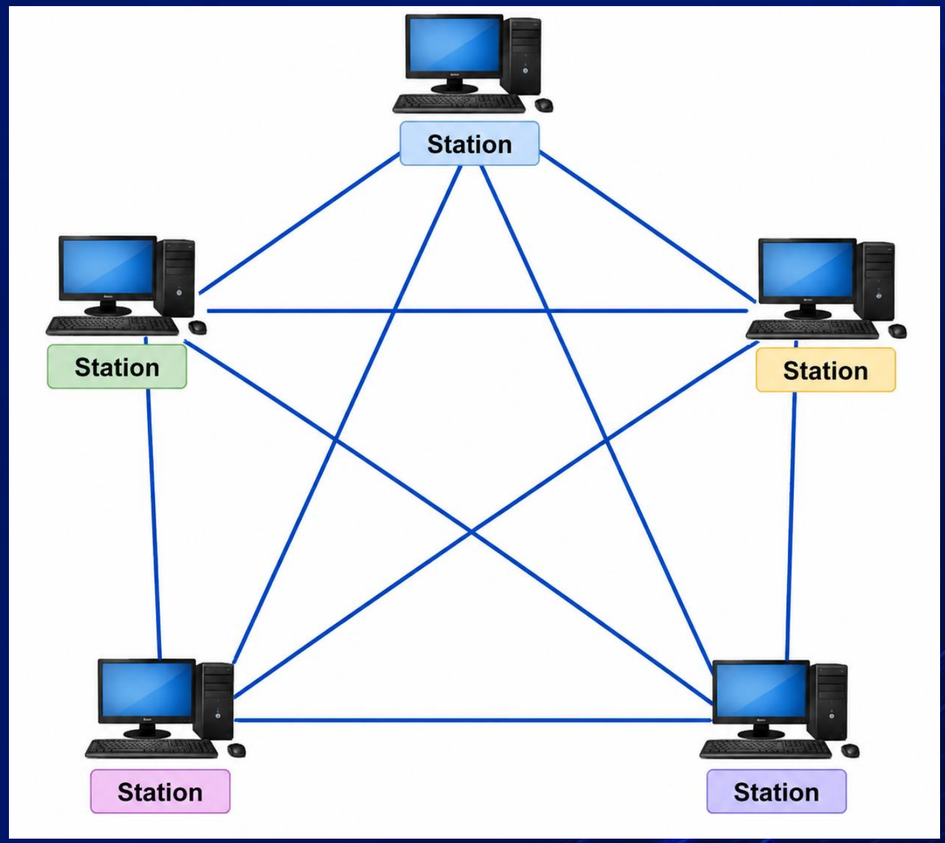


Figure 5: Mesh Topology

Star Topology

Each device has a dedicated point-to-point link only to a central controller, usually called a hub. Unlike a mesh topology, a star topology does not allow direct traffic between devices. If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device (Figure 6).

In a star topology :

- Each device needs only one link and one I/O port to connect it to any number of others.
- It is easy to install and configure.
- If one link fails, only that link is affected. All other links remain active.
- If the hub goes down, the whole system is dead.

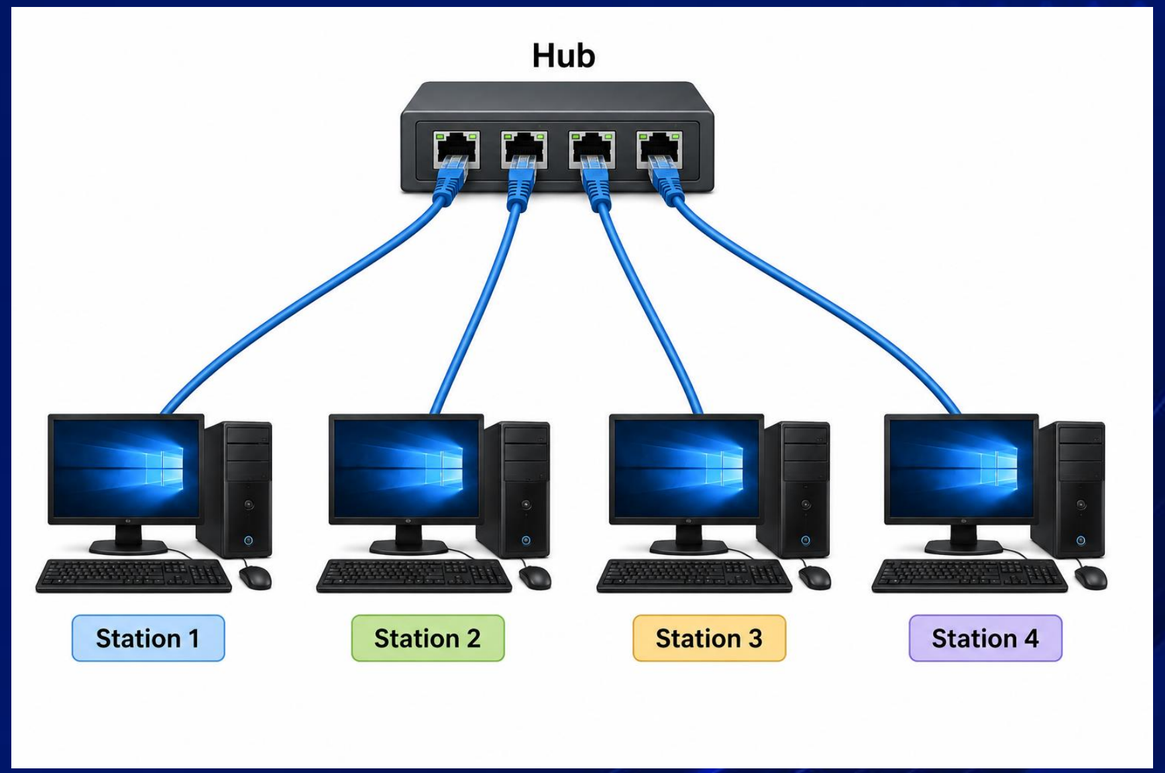


Figure 6: Star Topology

Bus Topology

In a Bus, all devices are connected to a single central cable called the backbone. A drop line is a connection running between the device and the main cable (Figure 7).

In a Bus Topology :

- Signal travels in the backbone cable.
- Some part of the signal energy is converted into heat.
- Signal strength decreases with distance due to energy loss.
- When the backbone cable breaks, the entire system will crash down.

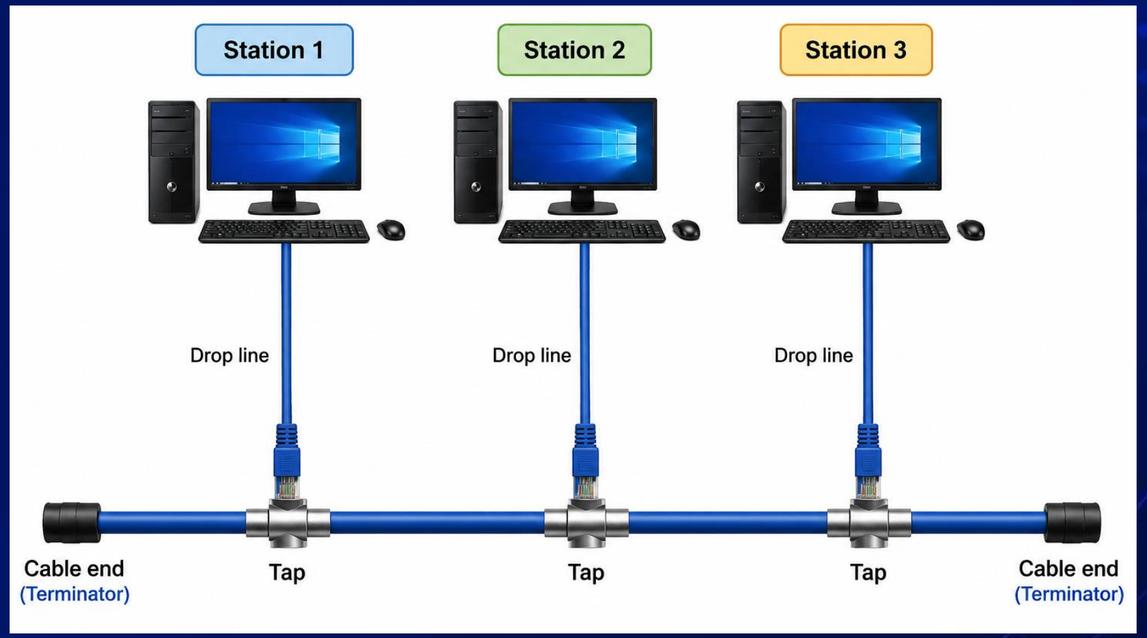


Figure 7: Star Topology

Ring Topology

Ring topology is a network topology in which each device is connected to two neighboring devices (Figure 8).

In a Ring Topology :

- Each device acts as a repeater, regenerating and forwarding the signal to the next device. Signal strength decreases with distance due to energy loss.
- Unidirectional traffic can be a disadvantage.
- In a simple ring, a break in the ring (such as a disabled station) can disable the entire network. This weakness can be solved by using a dual ring or a switch capable of closing off the break (Figure 9).

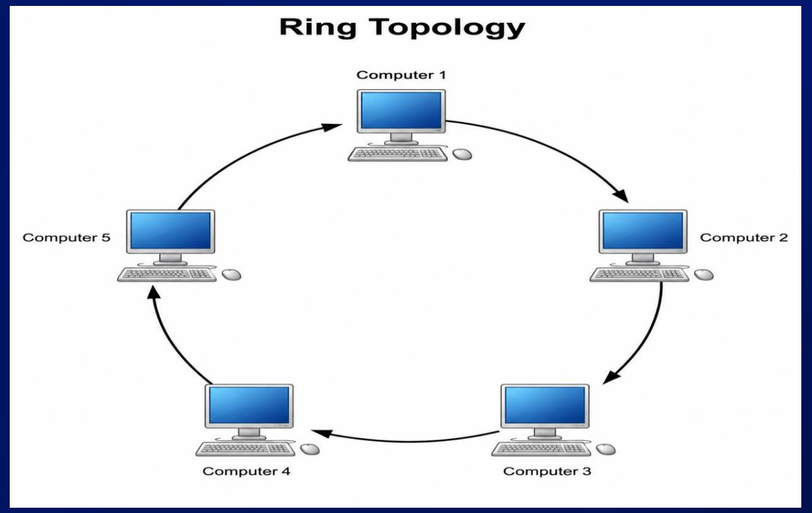


Figure 8: Traditional Ring Topology

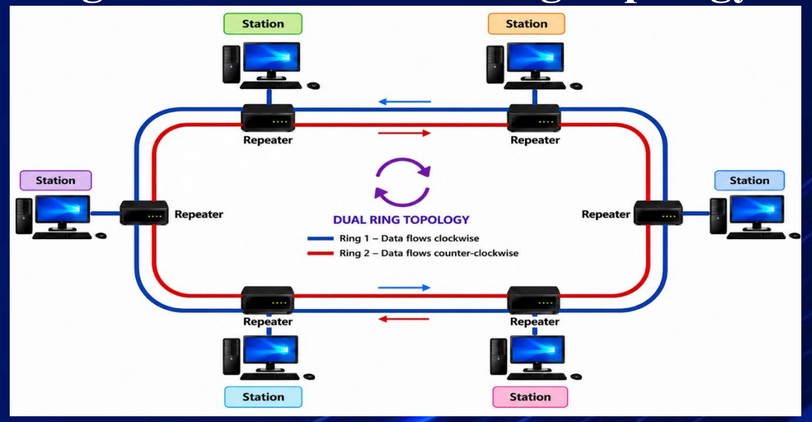


Figure 9: Modern Ring Topology

Hybrid Topology

A Hybrid Topology is a combination of two or more different network topologies connected in a single network (Figure 10).

For example:

- **A main Star Topology may connect several branches.**
- **Each branch may internally use a Bus Topology**
- Example: A company may use: Star topology inside departments, Bus topology between floors,

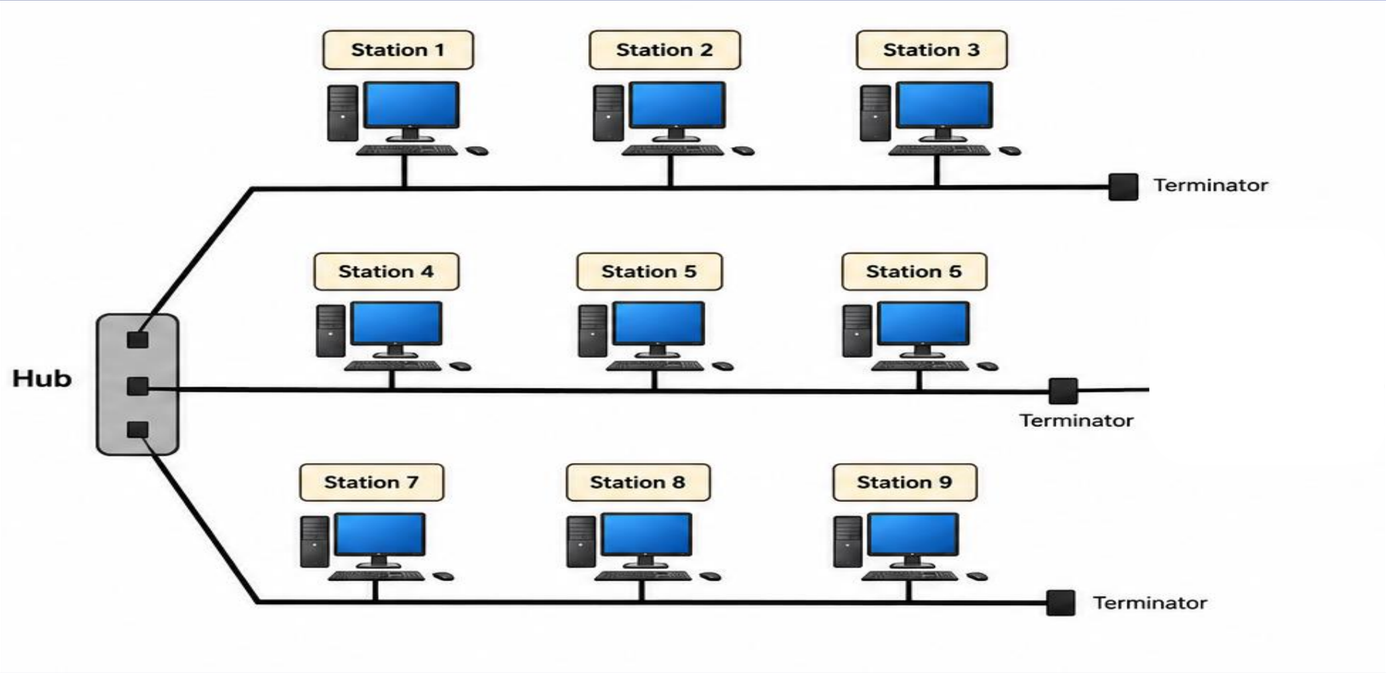


Figure 10: Hybrid Topology

THE OSI MODEL

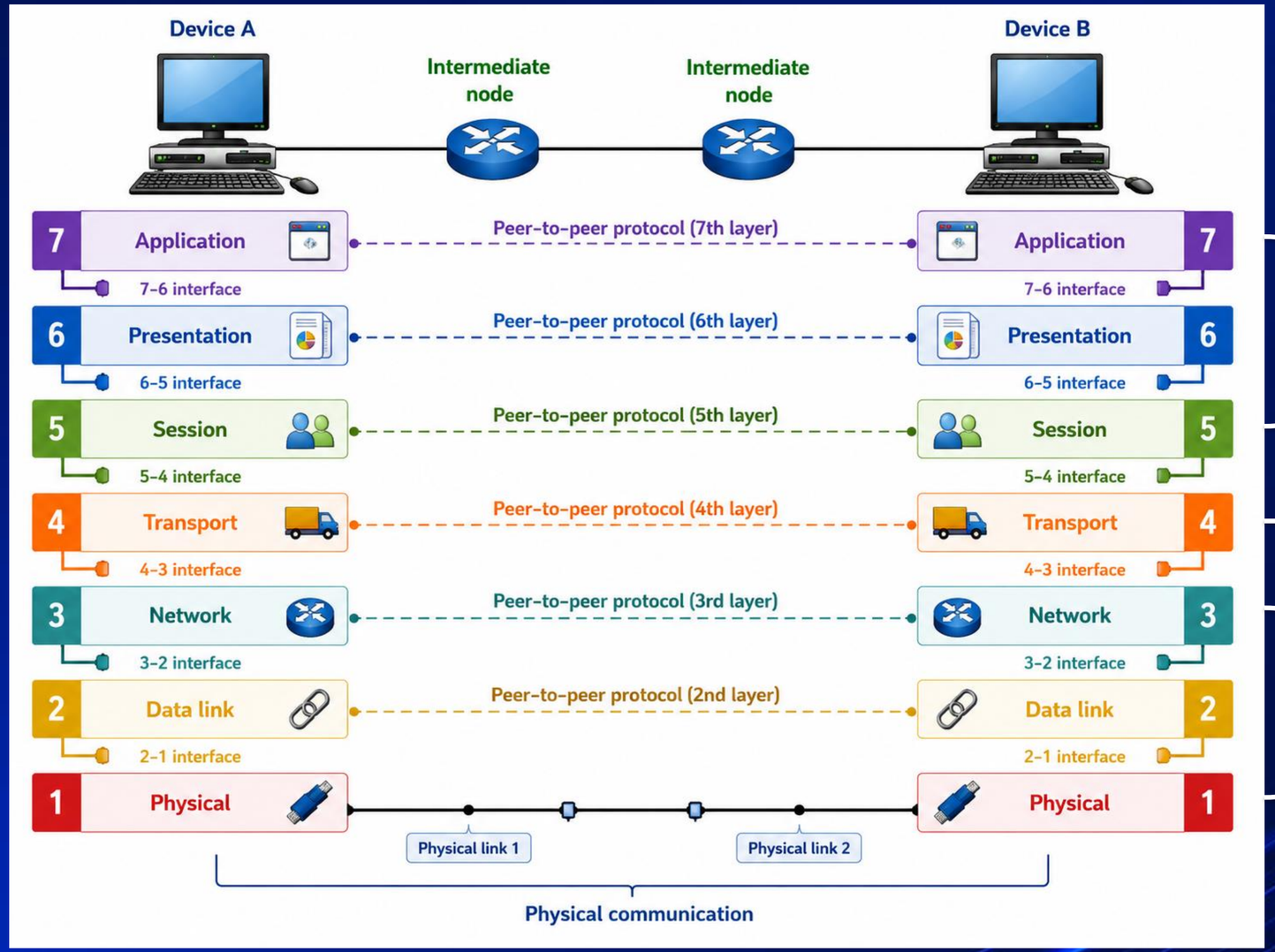
The International Standards Organization (ISO) (established in 1947) is a multinational body dedicated to develop worldwide standards for technology, industry and communication systems. The Open Systems Interconnection is the ISO standard that covers all aspects of a computer network.

- It was first introduced in the late 1970s.
- An open system allows different computer systems to communicate using standard protocols. even if they use different hardware, software or architectures.
- The main purpose of OSI model is to show how two different systems can communicate without changing their hardware and software.
- OSI is a model for understanding and designing a network architecture.

THE OSI MODEL

- The OSI model has 7 separate ordered layers

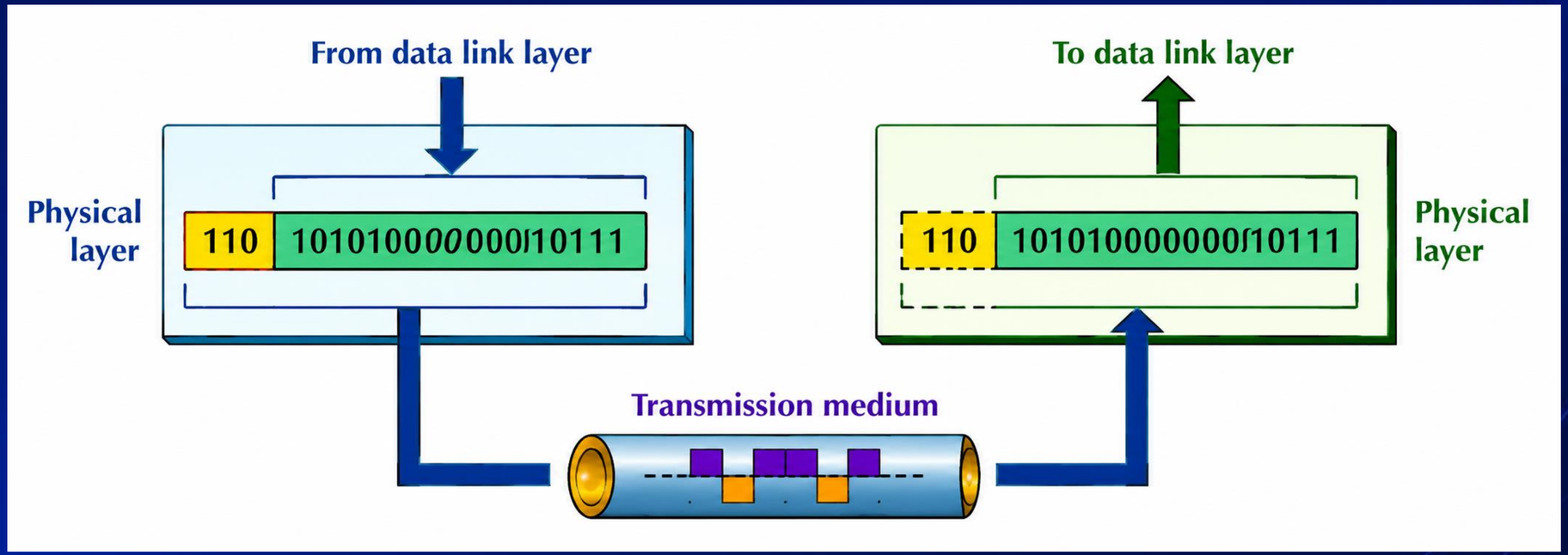
- Peer-to-Peer Process
- Interface
- Modularity
- Encapsulation
- Decapsulation



Physical Layer

The physical layer is responsible for the movement of individual bits from one hop (node) to the next.

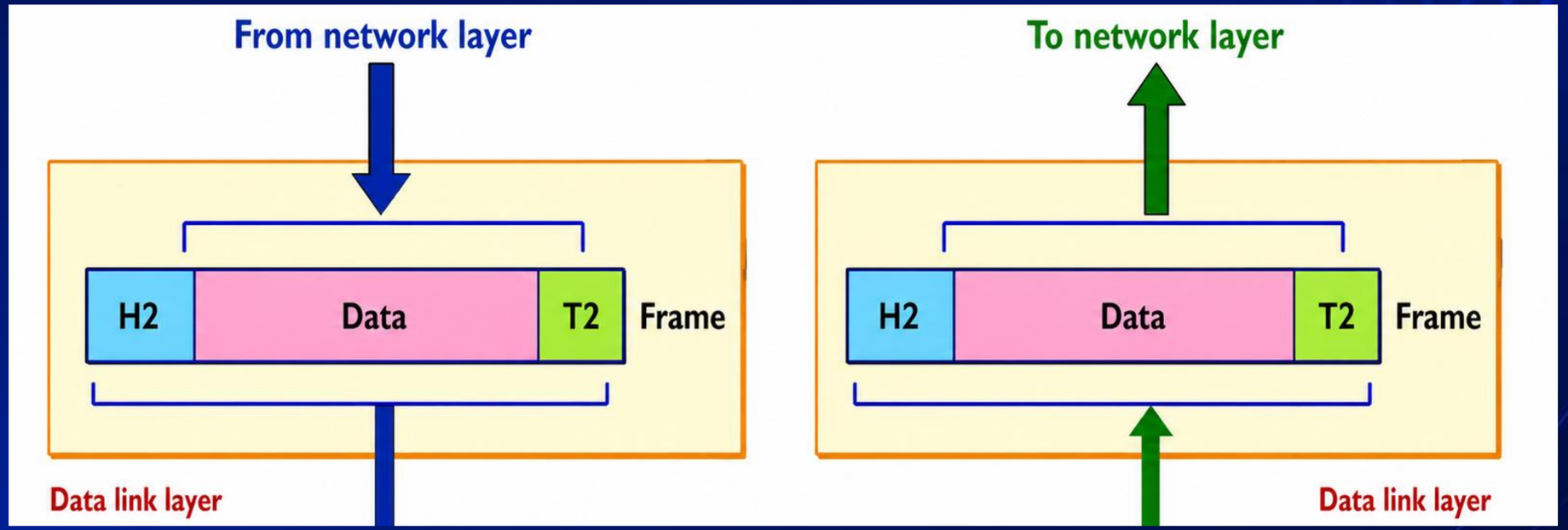
- Representation of Bits
- Data rate
- Synchronization of bits
- Line Configuration.
- Topology
- Transmission Mode



Data Link Layer

The data link layer is responsible for the node-to-node delivery of frames.

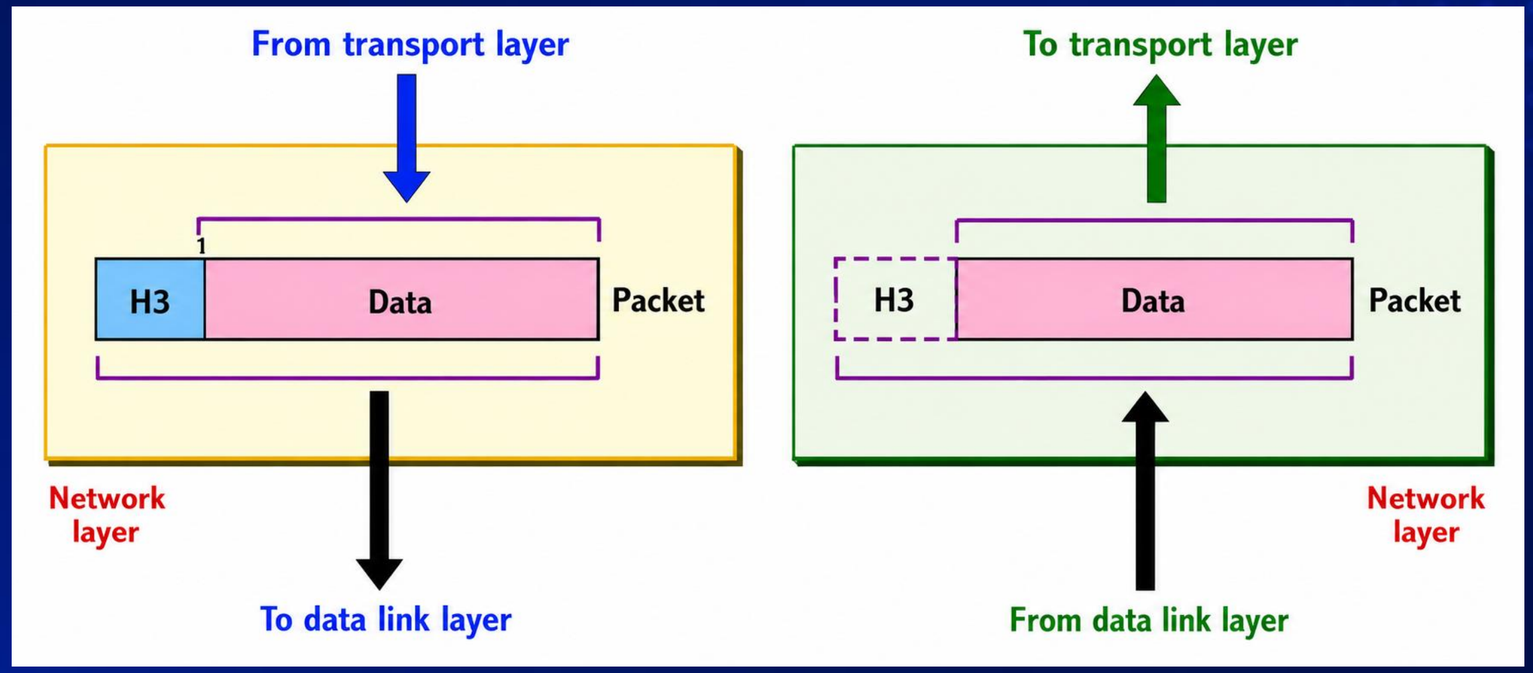
- Framing
- Physical addressing
- Flow Control
- Error control



Network Layer

The network layer is responsible for the source-to-destination delivery of a packet

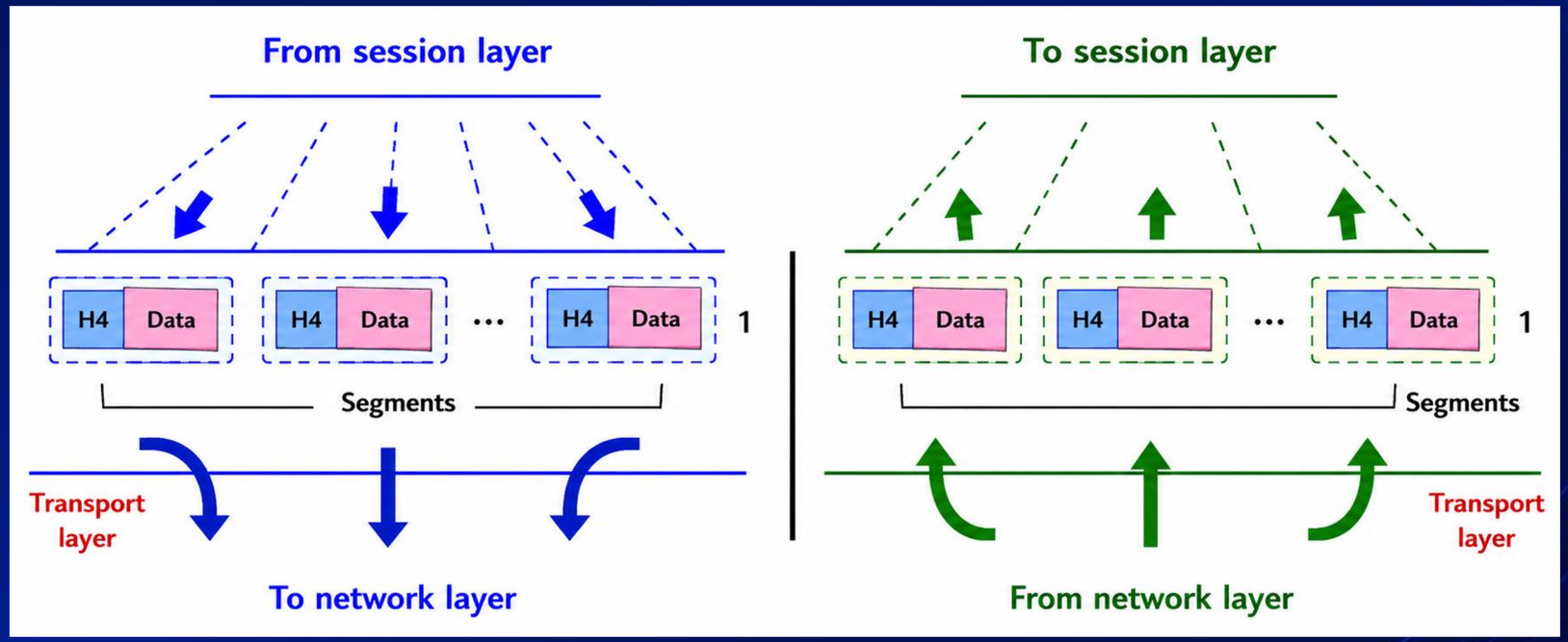
- Logical addressing
- Routing



Transport Layer

The transport layer is responsible for process-to-process delivery of the entire message.

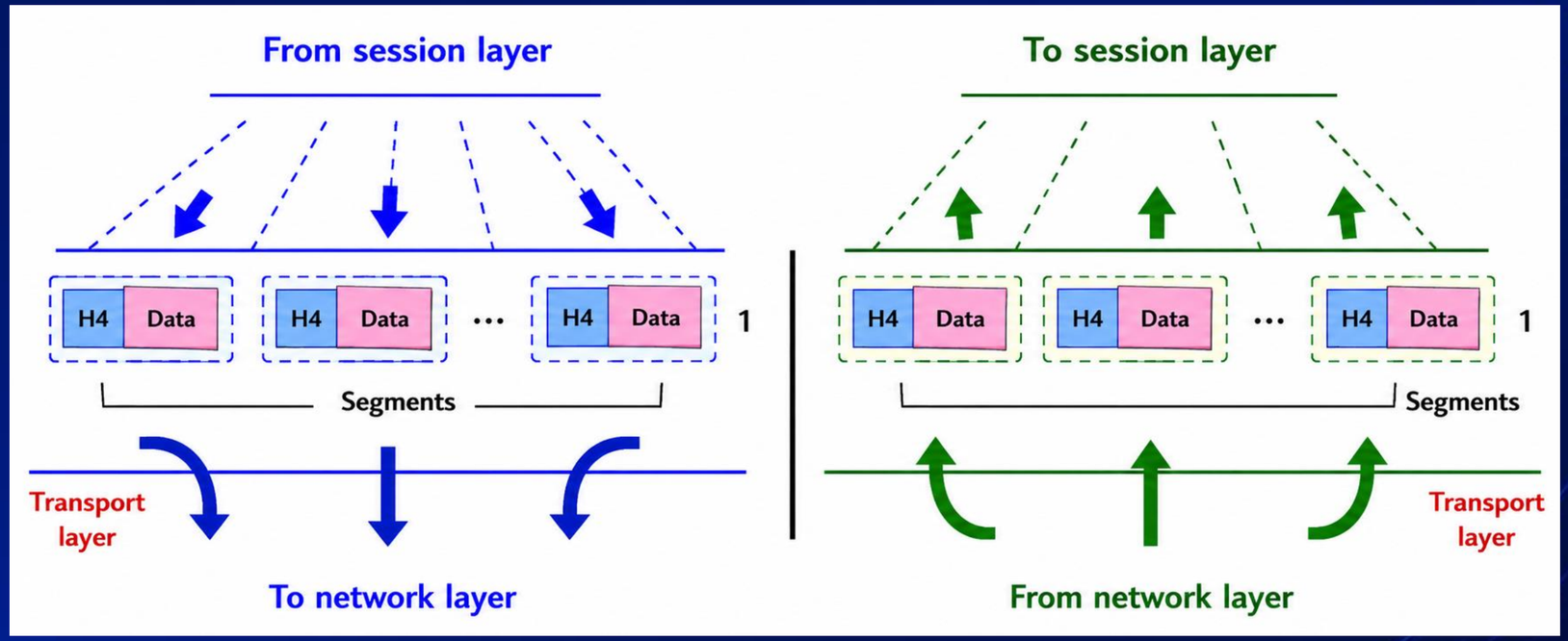
- Service-point addressing
- Segmentation and reassembly
- Connection control
- Error control



Session Layer

The session layer is responsible for dialog control and synchronization.

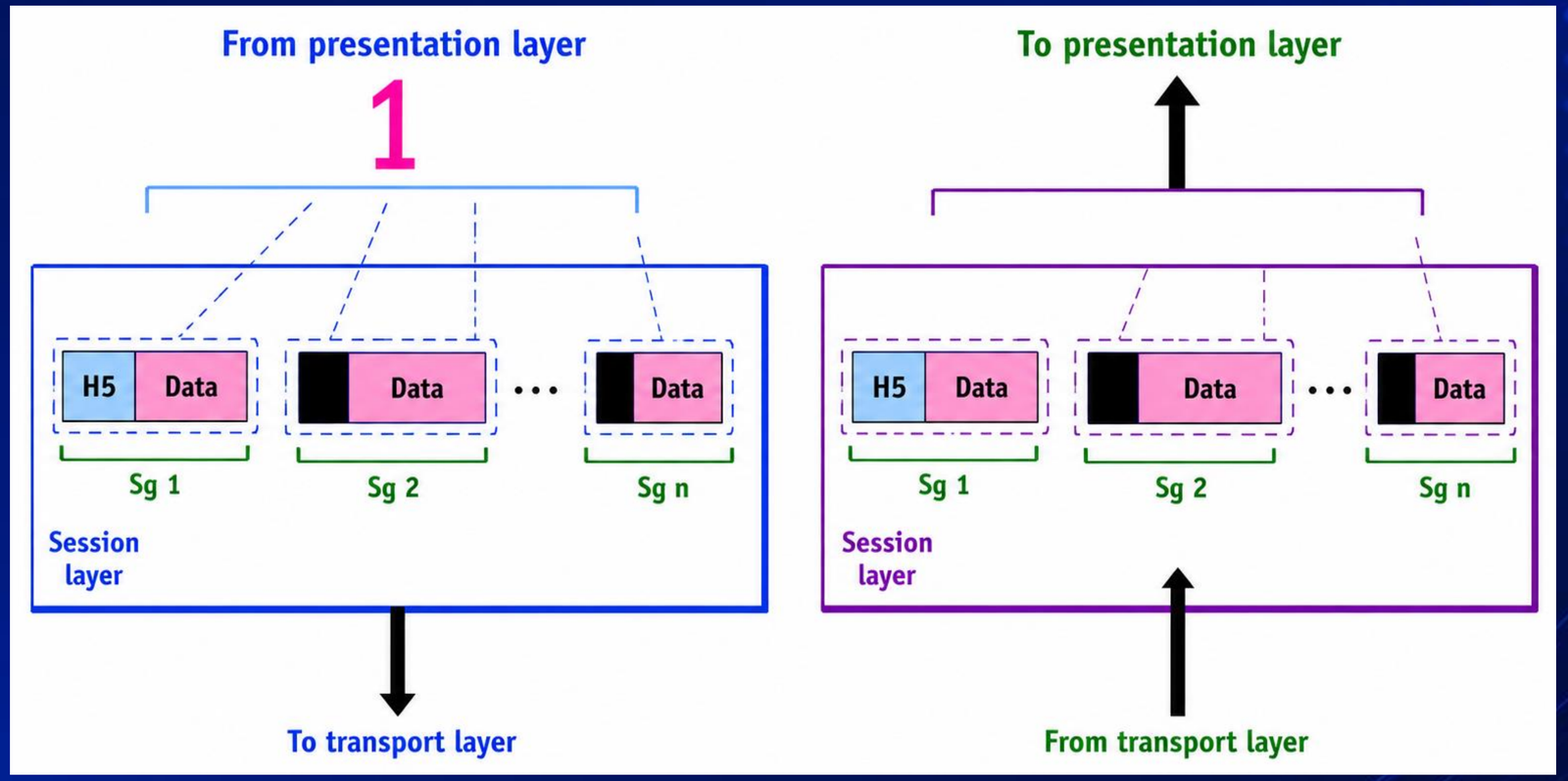
- Dialog control
- Synchronization



Presentation Layer

The session layer is responsible for dialog control and synchronization.

- Translation
- Encryption
- Compression

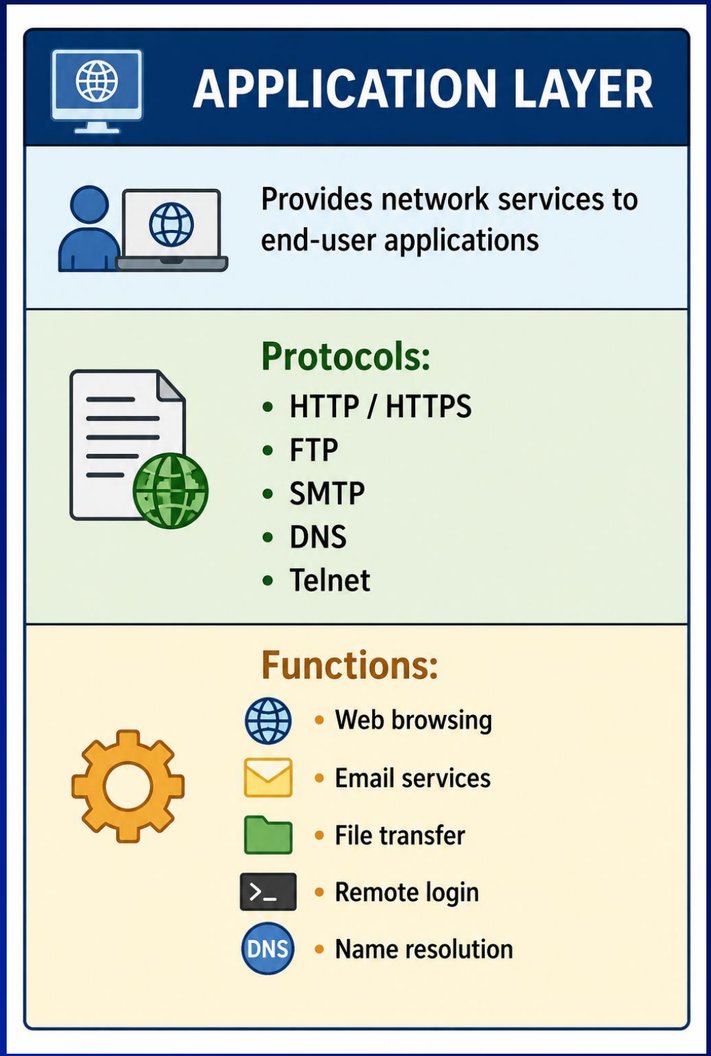


Application Layer

The application layer is responsible for providing services to the user

Functions

- Web Browsing
- Email Services
- File Transfer
- Remote Login
- Name Resolution



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