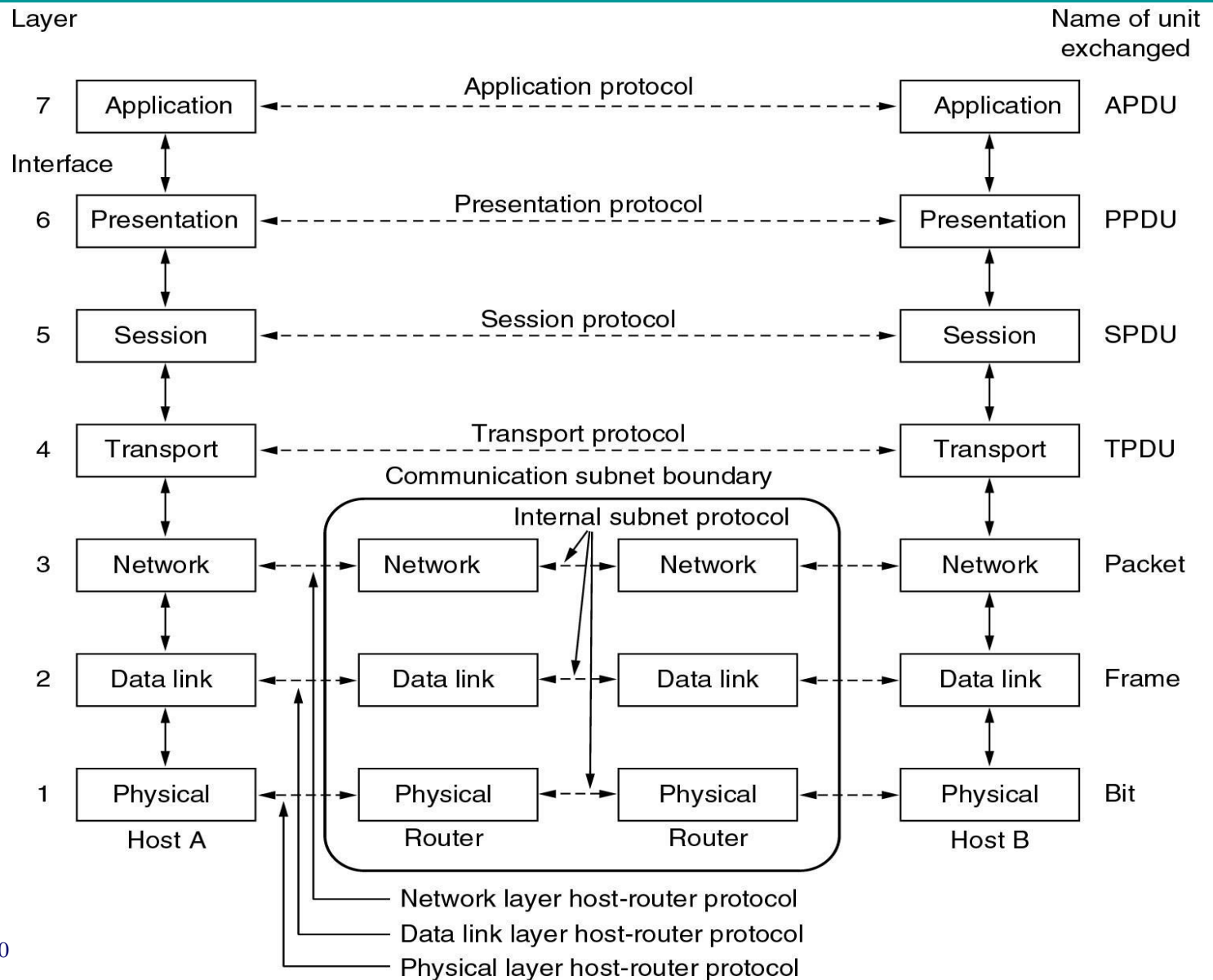


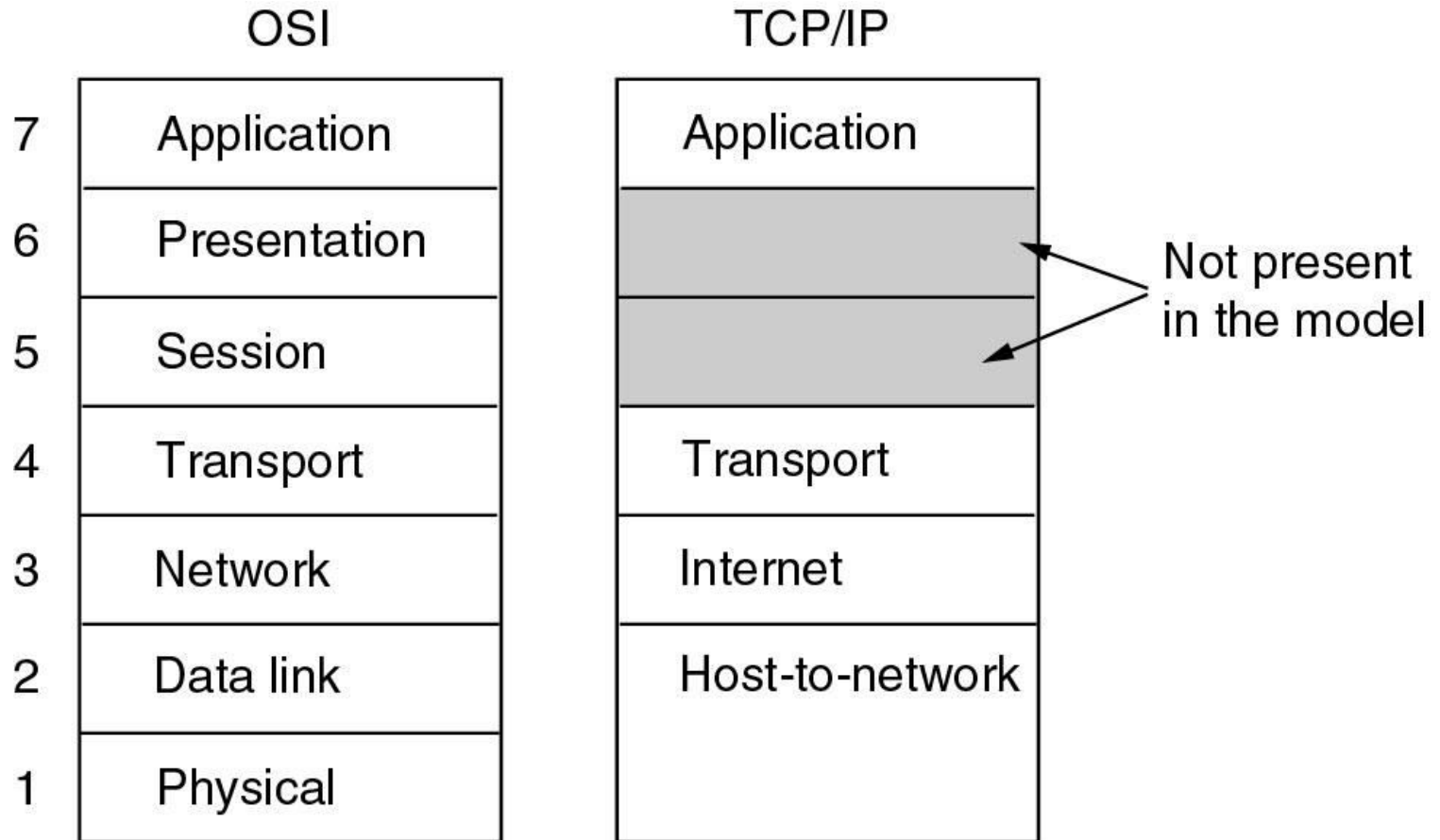
(5) Connection-Oriented vs. Connectionless

| | Service | Example |
|---------------------|-------------------------|----------------------|
| Connection-oriented | Reliable message stream | Sequence of pages |
| | Reliable byte stream | Remote login |
| | Unreliable connection | Digitized voice |
| Connectionless | Unreliable datagram | Electronic junk mail |
| | Acknowledged datagram | Registered mail |
| | Request-reply | Database query |

(8.1) The OSI Reference Model



(8.2) The TCP/IP Reference Model (1)



What is a Topology?

- Network topologies describe the ways in which the elements of a network are mapped. They describe the physical and logical arrangement of the network nodes.
- The physical topology of a network refers to the configuration of cables, computers, and other peripherals

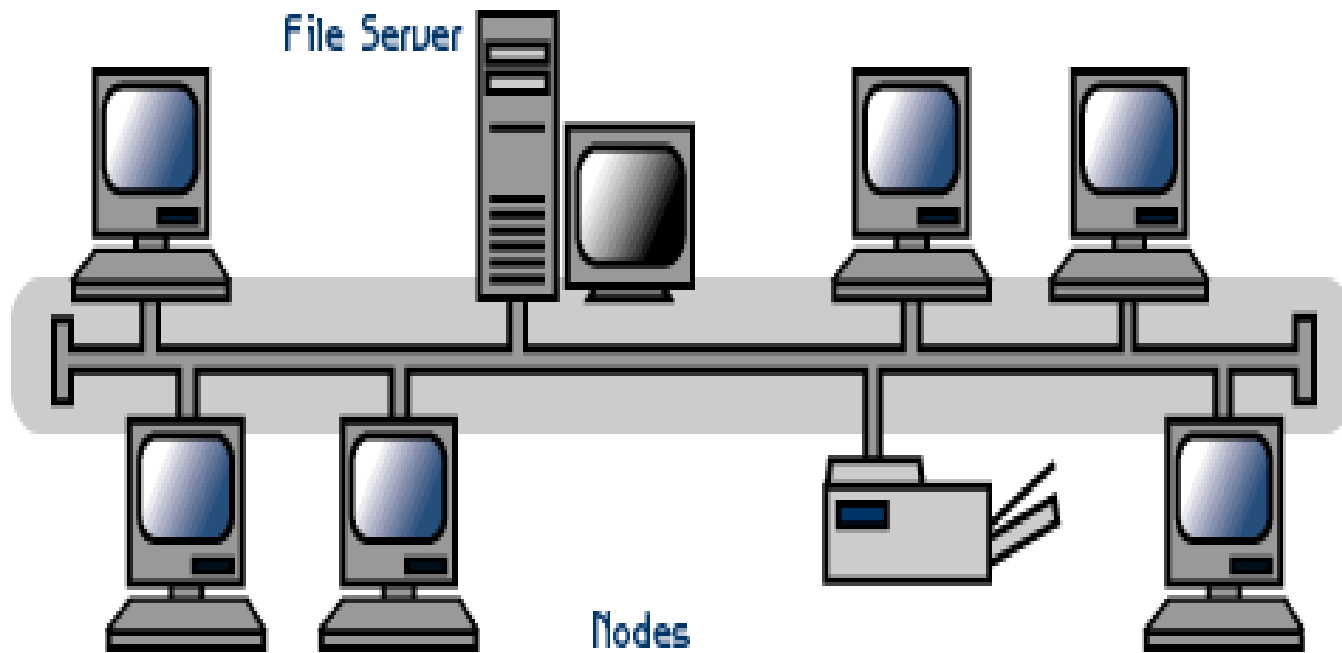
Different Types of Topologies

- Bus Topology
- Star Topology
- Ring Topology
- Mesh Topology
- Tree Topology
- Hybrid Topology

Bus Topology

- All the nodes (file server, workstations, and peripherals) on a bus topology are connected by one single cable.
- A bus topology consists of a main run of cable with a terminator at each end. All nodes (file server, workstations, and peripherals) are connected to the linear cable.
- Popular on LANs because they are inexpensive and easy to install.

Bus Topology



Bus Topology

Advantages of Bus Topology

- It is Cheap, easy to handle and implement.
- Require less cable
- It is best suited for small networks.

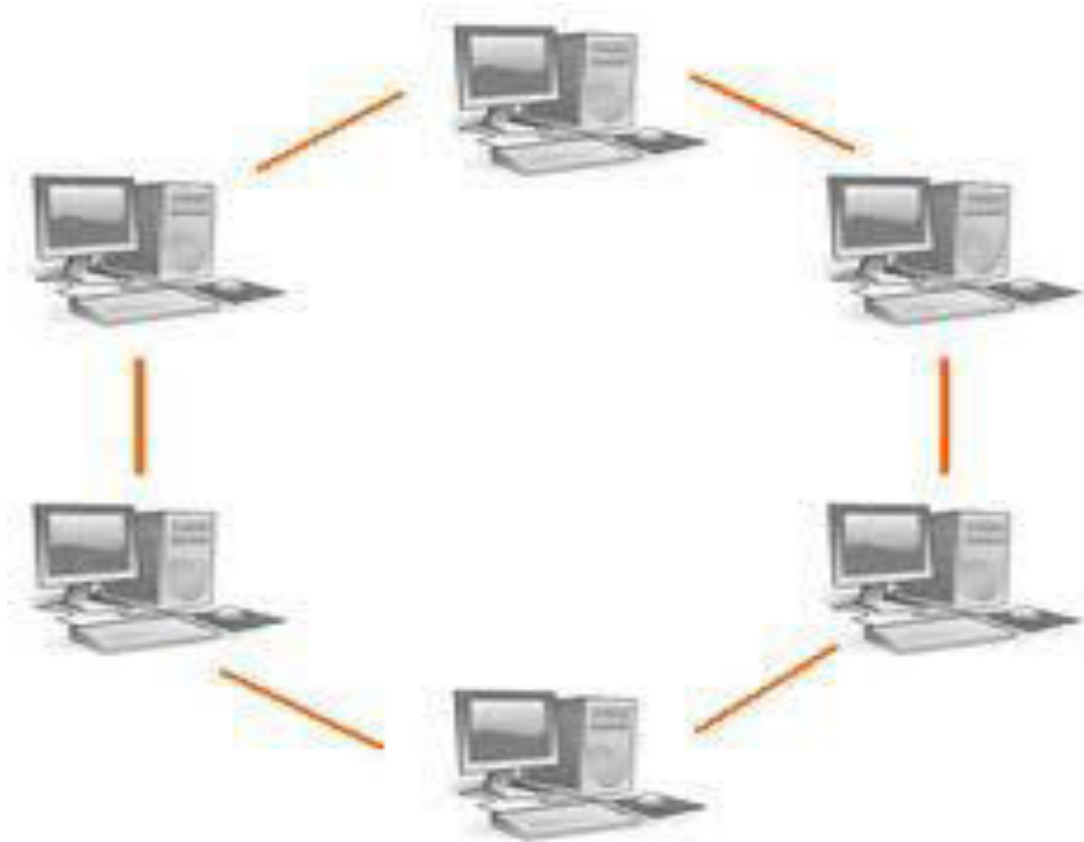
Disadvantages of Bus Topology

- The cable length is limited. This limits the number of stations that can be connected.
- This network topology can perform well only for a limited number of nodes.

Ring Topology

- In a ring network, every device has exactly two neighbours for communication purposes.
- All messages travel through a ring in the same direction.
- A failure in any cable or device breaks the loop and can take down the entire network.
- To implement a ring network we use the Token Ring technology
- A token, or small data packet, is continuously passed around the network. When a device needs to transmit, it reserves the token for the next trip around, then attaches its data packet to it.

Ring Topology



Ring Topology

Advantage of Ring Topology

- Very orderly network where every device has access to the token and the opportunity to transmit.
- Easier to Manage than a Bus Network
- Good Communication over long distances
- Handles high volume of traffic

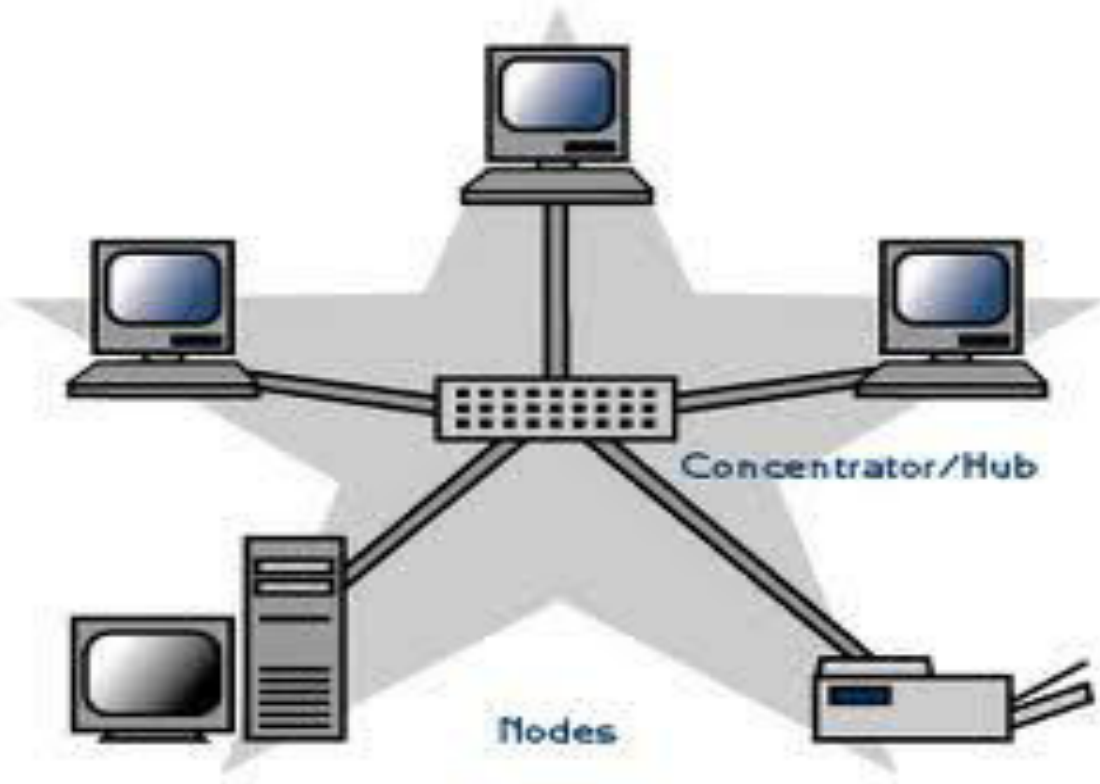
Disadvantages of Ring Topology

- The failure of a single node of the network can cause the entire network to fail.
- The movement or changes made to network nodes affects the performance of the entire network.

Star Topology

- In a star network, each node (file server, workstations, and peripherals) is connected to a central device called a hub.
- The hub takes a signal that comes from any node and passes it along to all the other nodes in the network.
- Data on a star network passes through the hub, switch, or concentrator before continuing to its destination.
- The hub, switch, or concentrator manages and controls all functions of the network.
- The star topology reduces the chance of network failure by connecting all of the systems to a central node.

Star Topology



Star Topology

Advantages of Star Topology

- Easy to manage
- Easy to locate problems (cable/workstations)
- Easier to expand than a bus or ring topology.
- Easy to install and wire.
- Easy to detect faults and to remove parts.

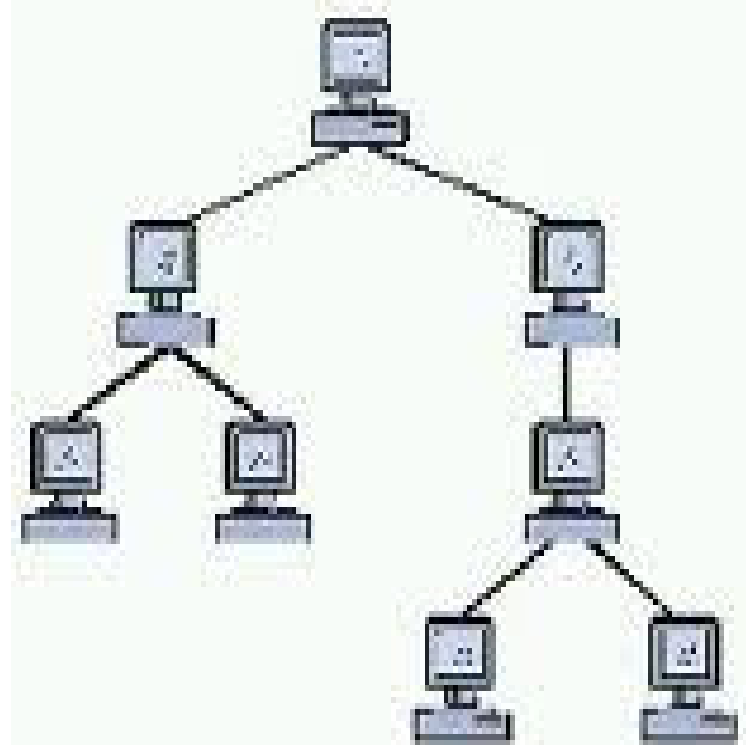
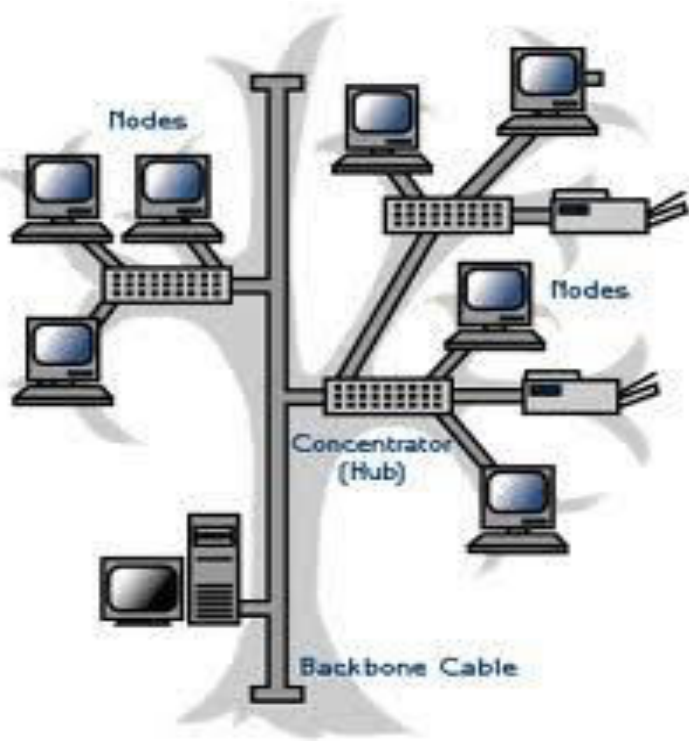
Disadvantages of Star Topology

- Requires more cable length than a linear topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive because of the cost of the concentrators.

Tree Topology

- A tree topology (hierarchical topology) can be viewed as a collection of star networks arranged in a hierarchy.
- This tree has individual peripheral nodes which are required to transmit to and receive from one other only and are not required to act as repeaters or regenerators.
- The tree topology arranges links and nodes into distinct hierarchies in order to allow greater control and easier troubleshooting.
- This is particularly helpful for colleges, universities and schools so that each of the connect to the big network in some way.

Tree Topology



Tree Topology

Advantages of a Tree Topology

- Point-to-point wiring for individual segments.
- Supported by several hardware and software vendors.
- All the computers have access to the larger and their immediate networks.

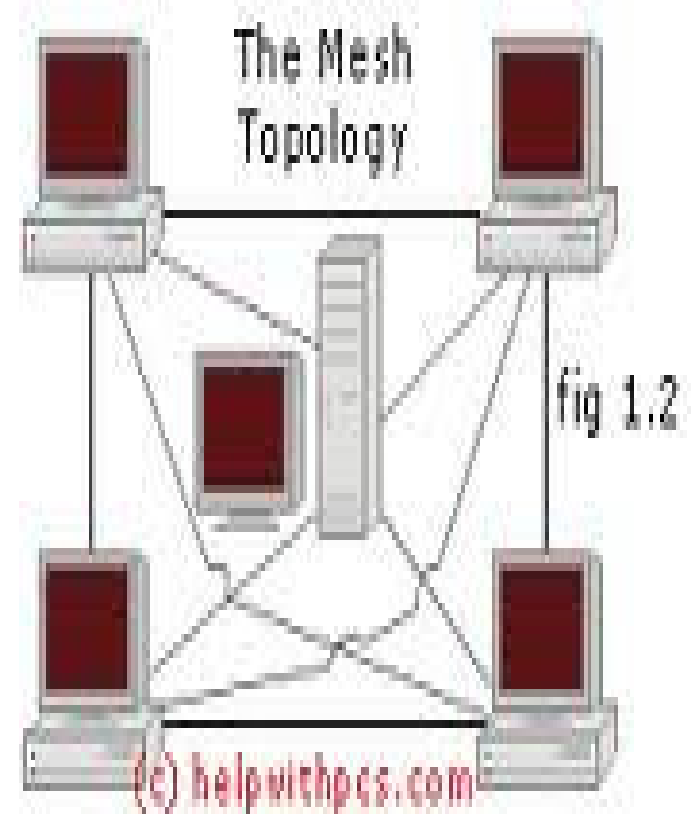
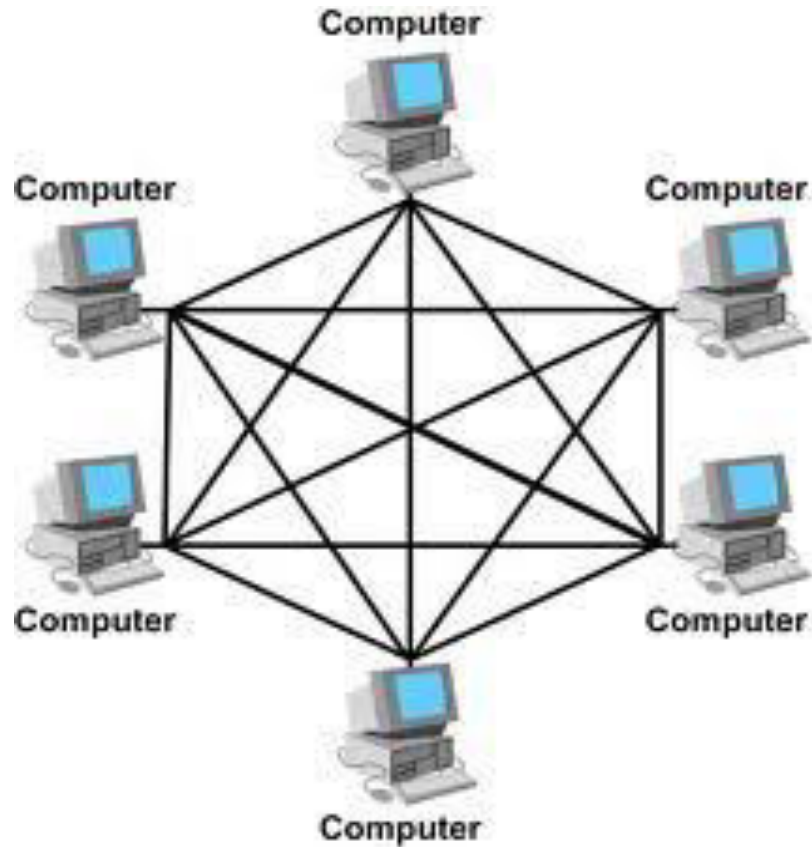
Disadvantages of a Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies.

Mesh Topology

- In this topology, each node is connected to every other node in the network.
- Implementing the mesh topology is expensive and difficult.
- In this type of network, each node may send message to destination through multiple paths.
- While the data is travelling on the Mesh Network it is automatically configured to reach the destination by taking the shortest route which means the least number of hops.

Mesh Topology



Mesh Topology

Advantage of Mesh Topology

- No traffic problem as there are dedicated links.
- It has multiple links, so if one route is blocked then other routes can be used for data communication.
- Points to point links make fault identification easy.

Disadvantage of Mesh Topology

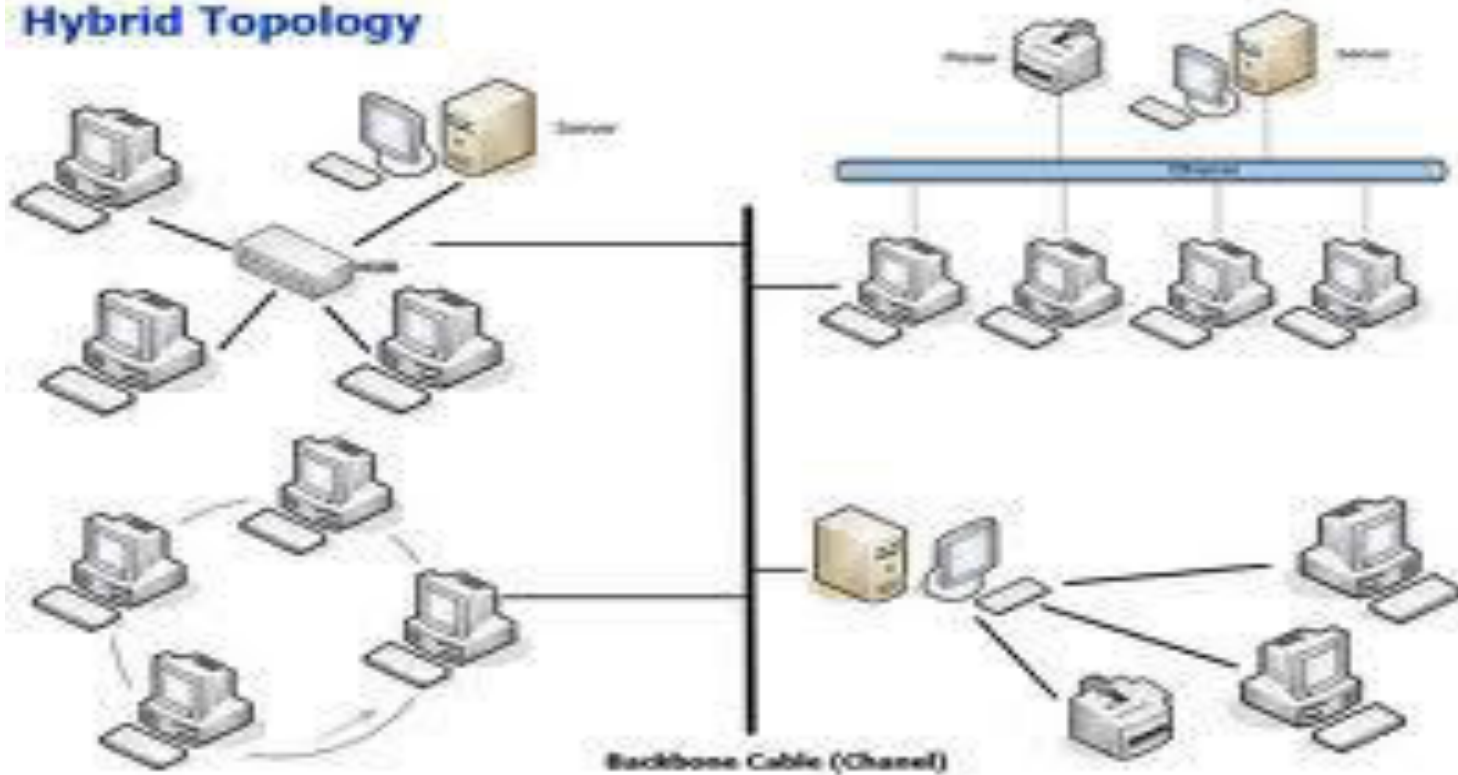
- There is mesh of wiring which can be difficult to manage.
- Installation is complex as each node is connected to every node.
- Cabling cost is high.

Hybrid Topology

- A combination of any two or more network topologies.
- A hybrid topology always accrues when two different basic network topologies are connected.
- It is a mixture of above mentioned topologies. Usually, a central computer is attached with sub-controllers which in turn participate in a variety of topologies

Hybrid Topology

Hybrid Topology



Hybrid Topology

Advantages of a Hybrid Topology

- It is extremely flexible.
- It is very reliable.

Disadvantages of a Hybrid Topology

- Expensive

Introduction to OSI Model

1

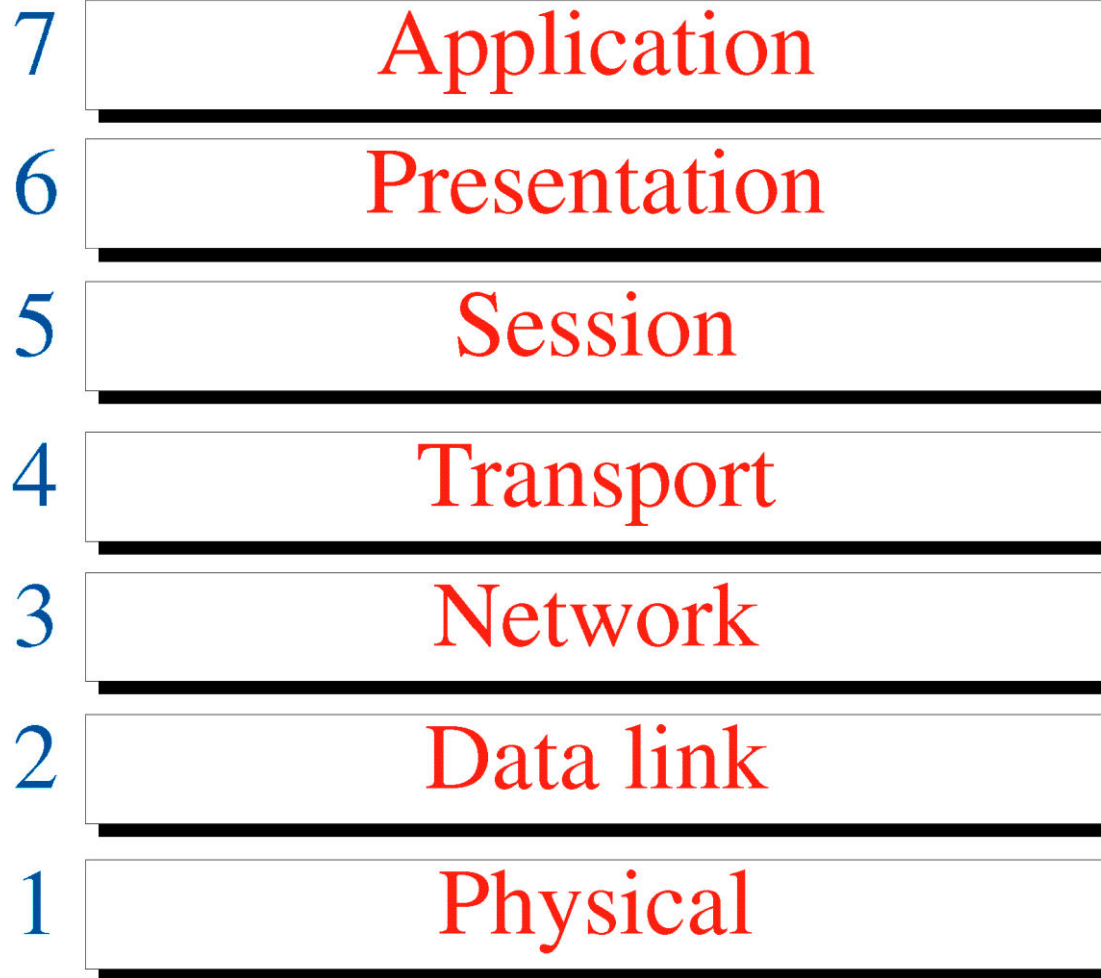
- OSI model is based on the proposal developed by the International Standards Organization (ISO).
- This model is called ISO OSI (Open Systems Interconnection) Reference model because it deals with connecting open systems (systems that are open for communication with other systems)
- We call it as OSI Model.

Principles on which OSI model was designed:

2

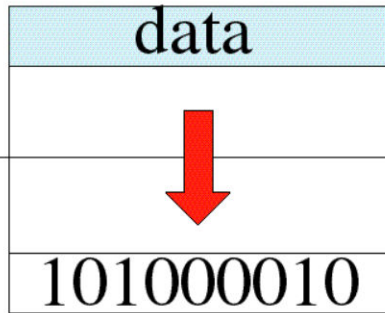
- A layer should be created where different level of abstraction is needed.
- Each layer should perform a well defined function.
- The function of each layer should be chosen according to the internationally standardized protocols.
- The number of layers should be large enough that distinct functions should not be put in the same layer and small enough that the architecture does not become very complex.

OSI Model

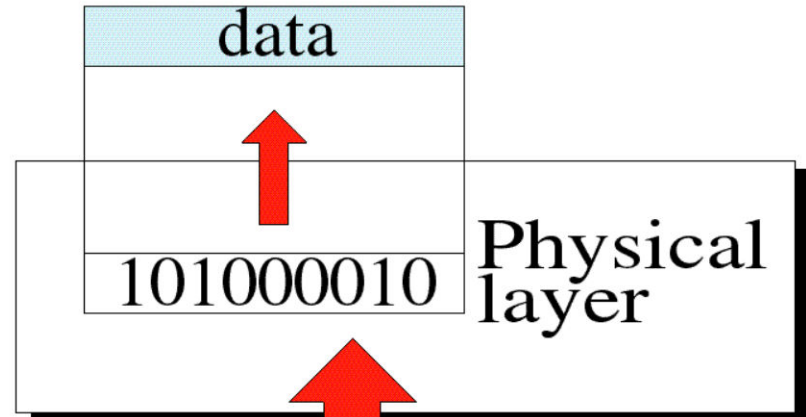


Physical Layer

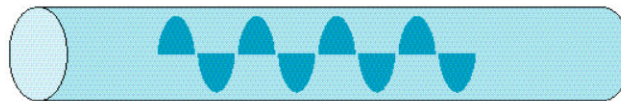
From data link layer



To data link layer



Transmission medium



Physical Layer

5

- It is the bottom layer of OSI Model.
- It is responsible for the actual physical connection between the devices. Such physical connection may be made by using twisted pair cable.
- It is concerned with transmitting bits over a communication channel.

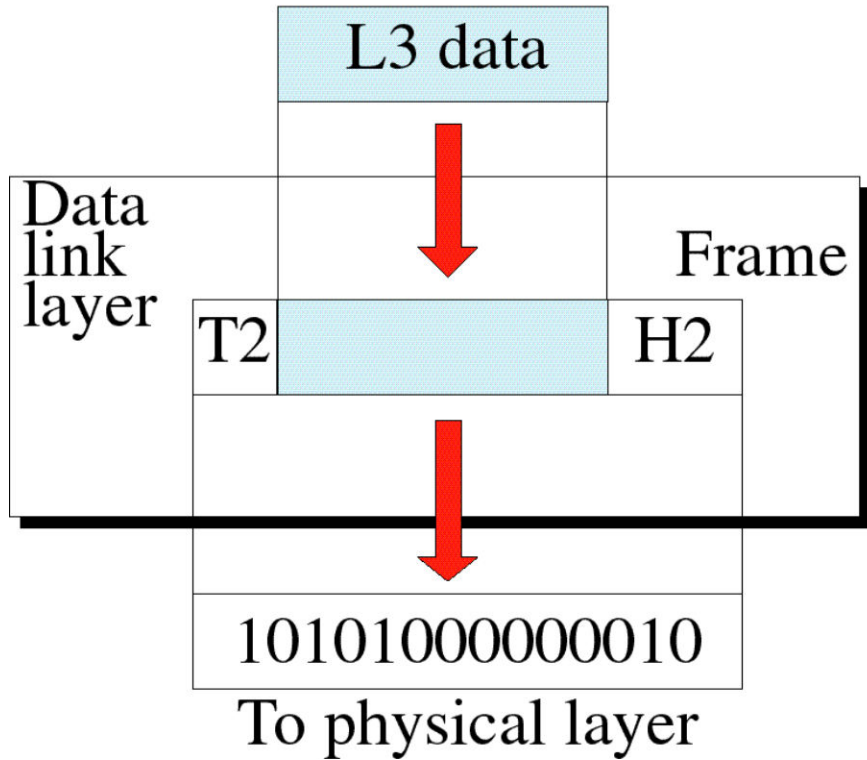
Functions of Physical Layer

6

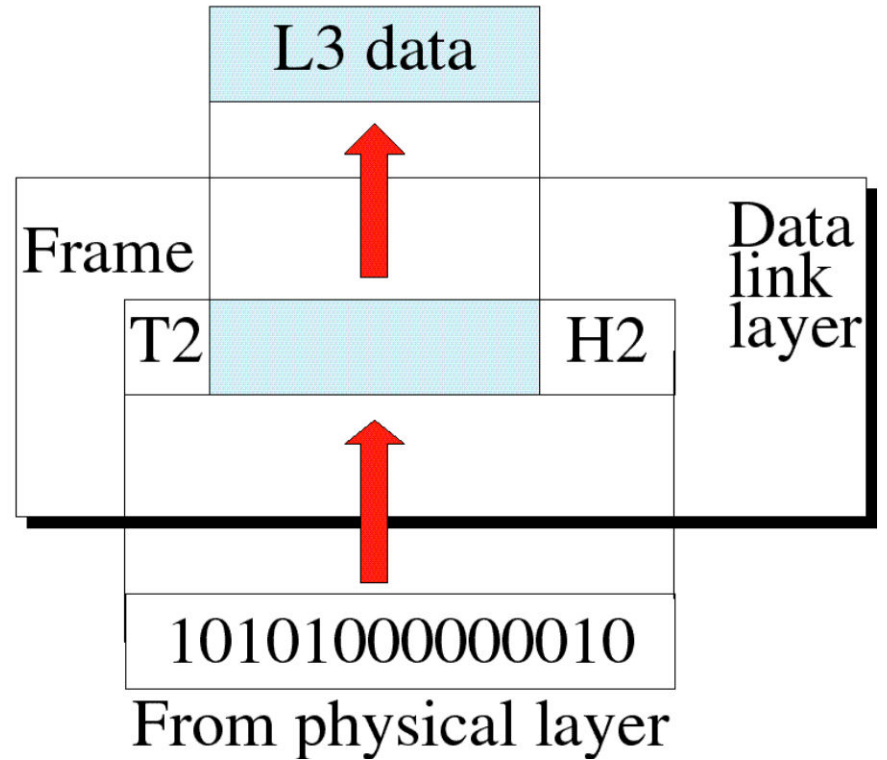
- Transforming bits into signals
- Provides synchronization of bits by a clock.
- Physical layer manages the way a device connects to network media.
- It defines the transmission rate.
- It defines the way in which the devices are connected to the medium.
- It provides physical topologies
- It can use different techniques of multiplexing.

Data Link Layer

From network layer



To network layer



Data Link Layer

8

- It is responsible for node-to-node delivery of data.
- It receives the data from network layer and creates FRAMES , add physical address to these frames & pas them to physical layer
- It consist of 2 layers:

Logical Link Layer (LLC) : Defines the methods and provides addressing information for communication between network devices.

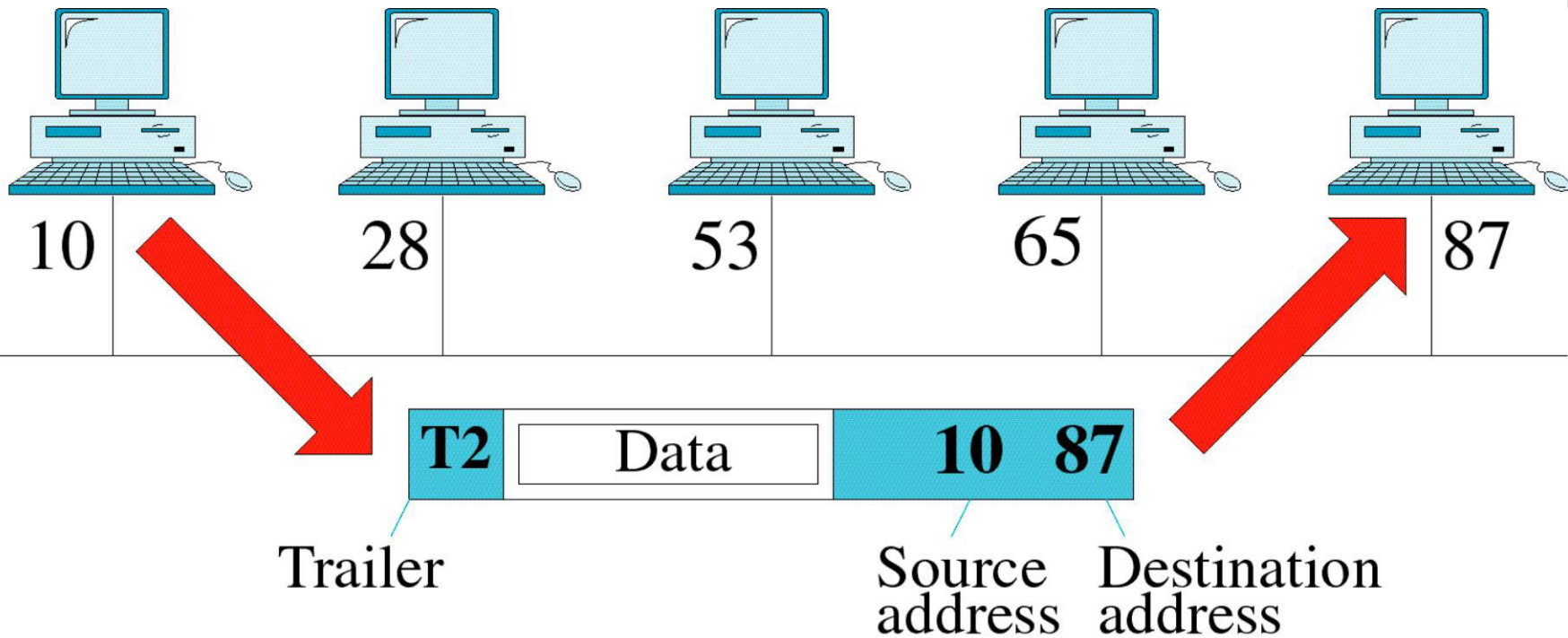
Medium Access Control (MAC): establishes and maintains links between communicating devices.

Functions of Data Link Layer

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- **Framing** : DLL divides the bits received from N/W layer into frames. (Frame contains all the addressing information necessary to travel from S to D).
- **Physical addressing**: After creating frames, DLL adds physical address of sender/receiver (MAC address) in the header of each frame.
- **Flow Control**: DLL prevents the fast sender from drowning the slow receiver.

Data Link Layer Example



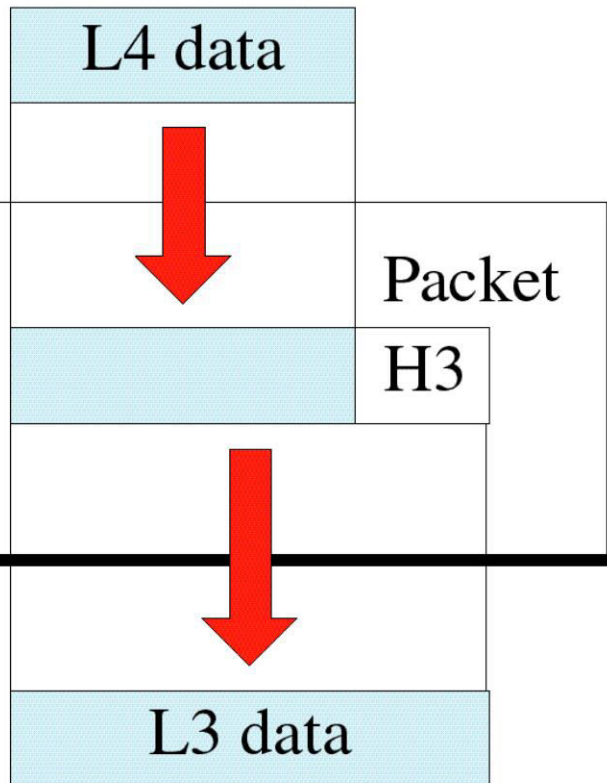
Functions of Data Link Layer

11

- **Error Control:** It provides the mechanism of error control in which it detects & retransmits damaged or lost frames.
- **Access Control:** When single comm. Channel is shared by multiple devices, MAC layer of DLL provides help to determine which device has control over the channel.

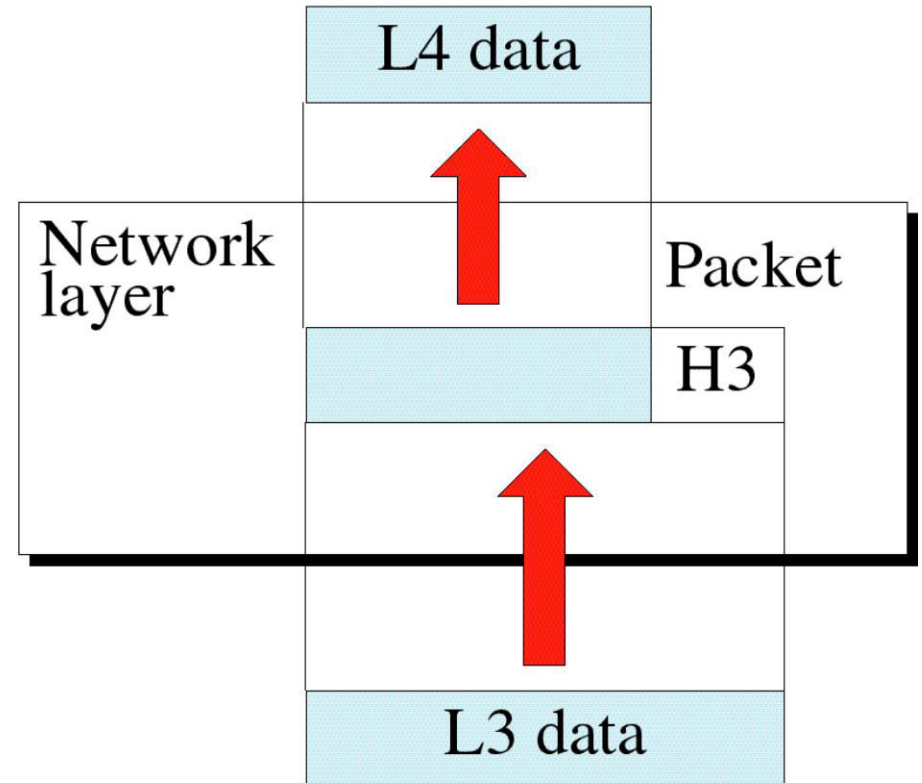
Network Layer

From transport layer



To data link layer

To transport layer



From data link layer

Network Layer

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- It is responsible for the source to destination delivery of a packet across multiple networks.
- If two systems are attached to different networks with devices like routers, then N/W layer is used.
- Thus DLL oversees the delivery of the packet between the two systems on same network and the network layer ensures that the packet gets its point of origin to its final destination.

Functions of Network Layer

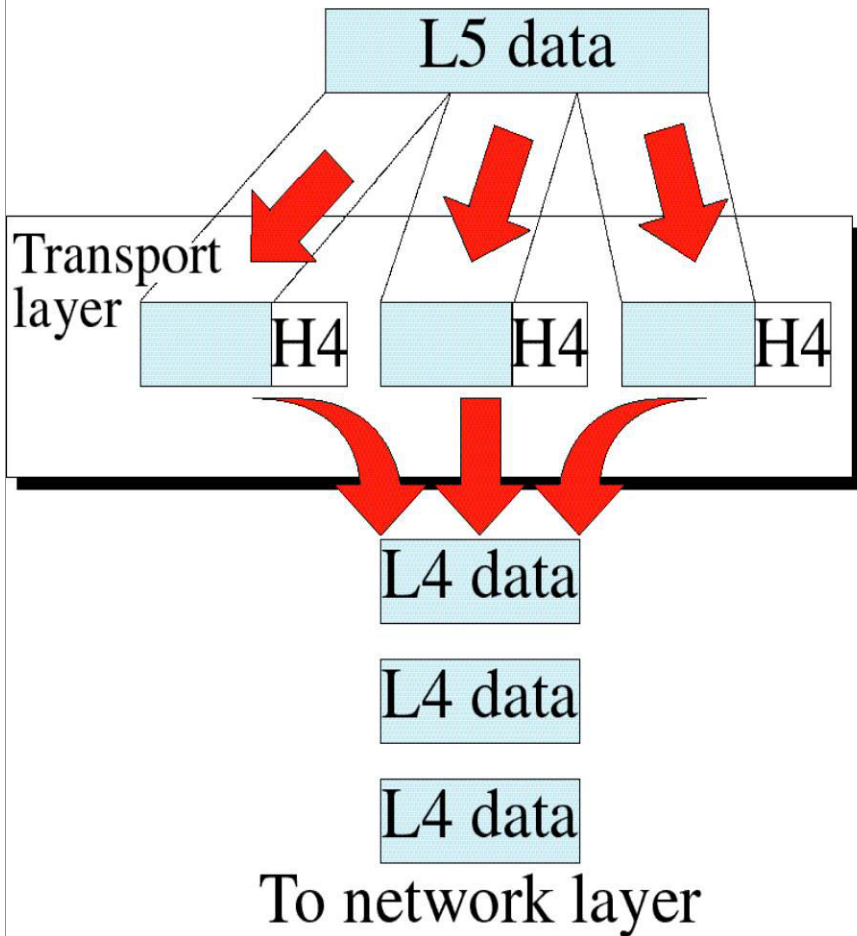
14

- **Internetworking:** It provides Internetworking.
- **Logical Addressing:** When packet is sent outside the network, N/W layer adds Logical (network) address of the sender & receiver to each packet.
- Network addresses are assigned to local devices by n/w administrator and assigned dynamically by special server called DHCP (Dynamic Host Configuration Protocol)
- **Routing:** When independent n/w are connected to create internetwork several routes are available to send the data from S to D. These n/w are interconnected by routers & gateways that route the packet to final destination.

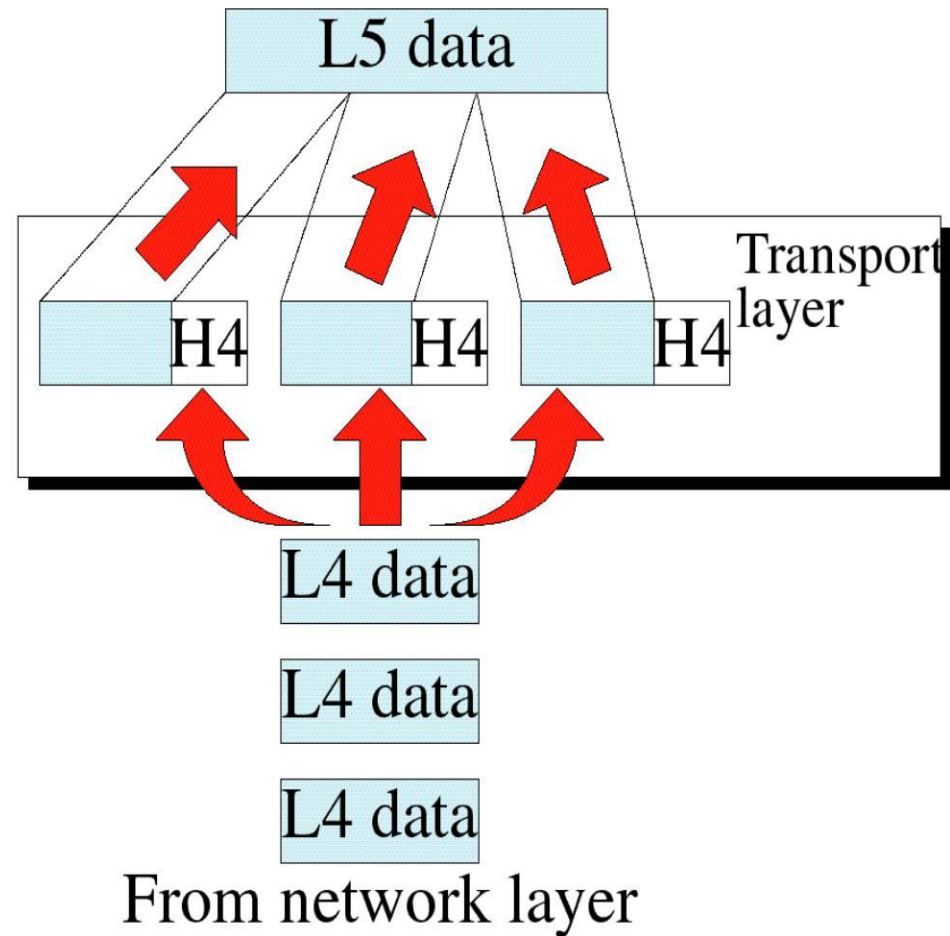
Transport Layer

15

From session layer



To session layer



Transport Layer

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- It is responsible for process-to-process delivery of the entire message.
- TL looks after the delivery of entire message considering all its packets & make sure that all packets are in order. On the other hand n/w layer treated each packet independently.
- At the receiver side, TL provides services to application layer & takes services form n/w layer.
- At the source side, TL receives message from upper layer into packets and reassembles these packets again into message at the destination.

Transport Layer

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- Transport Layer provides two types of services:

Connection Oriented Transmission: In this type of transmission the receiving devices sends an acknowledge back to the source after a packet or group of packet is received. It is slower transmission method.

Connectionless Transmission: In this type of transmission the receiving devices does not sends an acknowledge back to the source. It is faster transmission method.

Functions of Transport Layer

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- **Segmentation of message into packet & reassembly of packets into message.**
- **Port addressing:** Computers run several processes. TL header include a port address with each process.
- **Flow Control:** Flow control facility prevents the source form sending data packets faster than the destination can handle.
- **Error control:** TL ensures that the entire message arrives at the receiving TL without error.

Session Layer

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- Session layer is the fifth layer of OSI Model
- It has the responsibility of beginning, maintaining and ending the communication between two devices, called session.
- It also provides for orderly communication between devices by regulating the flow of data.

Functions of Session Layer

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- **Establishing, Maintaining and ending a session:** When sending device first contact with receiving device, it sends ***syn*** (synchronization) packet to establish a connection & determines the order in which information will be sent. Receiver sends ***ack*** (acknowledgement). So the session can be set & end.
- **Dialog Control:** This function determines that which device will communicate first and the amount of data that will be sent.
- **Dialog separation:** Process of adding checkpoints & markers to the stream of data is called dialog separation.

Presentation Layer

21

- Presentation layer is the sixth layer of OSI Model.
- It is concerned with the syntax & semantics of the information exchanged between the two devices.
- It was designed for data encryption, decryption and compression.

Functions of Presentation Layer

22

- **Data Presentation or Translation:** Because different computers use different encoding systems. It ensures that the data being sent is in the format that the recipient can process.
- **Data Encryption:** PL provides this facility by which hides the information from everyone except the person who originally sent the information & the intended recipient. When encrypted data arrives at destination, PL decrypts the message.
- **Data Compression:** PL shrinks large amount of data into smaller pieces i.e. it reduces the size of data.

Application Layer

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- It is the topmost i.e. seventh layer of OSI Model.
- It enables the user to access the network.
- It provides user interface & supports for services such as e-mail, file transfer, access to the world wide web.
- So it provides services to different user applications.

Functions of Application Layer

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- **Mail Services:** This application provides various e-mail services.
- **File transfer & Access:** It allows users to access files in a remote host, to retrieve files from remote computer for use etc.
- **Remote log-in:** A user can log into a remote computer and access the resources of that computer.
- **Accessing the World Wide Web:** Most common application today is the access of the World Wide Web.

What is Network?

- A network consists of two or more computers that are linked in order to share resources (such as printers and CDs), exchange files, or allow electronic communications.
- The computers on a network may be linked through cables, telephone lines, radio waves, satellites, or infrared light beams.

Different Types of Networks

- Depending upon the geographical area covered by a network, it is classified as:
 - Local Area Network (LAN)
 - Metropolitan Area Network (MAN)
 - Wide Area Network (WAN)
 - Personal Area Network (PAN)

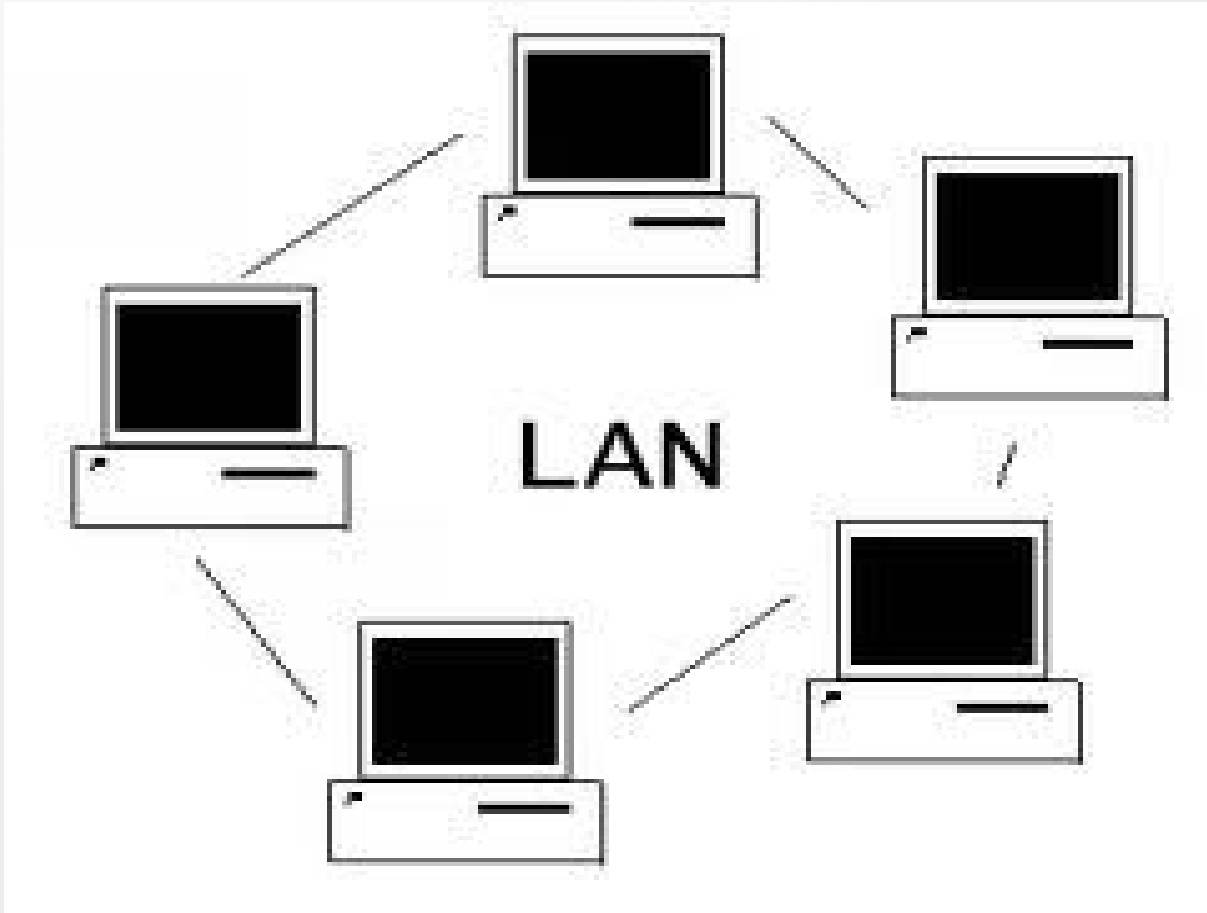
Local Area Network (LAN)

- *A LAN is a network that is used for communicating among computer devices, usually within an office building or home.*
- LAN's enable the sharing of resources such as files or hardware devices that may be needed by multiple users
-
- Is limited in size, typically spanning a few hundred meters, and no more than a mile
- Is fast, with speeds from 10 Mbps to 10 Gbps
- Requires little wiring, typically a single cable connecting to each device
- Has lower cost compared to MAN's or WAN's

Local Area Network (LAN)

- LAN's can be either wired or wireless. Twisted pair, coax or fibre optic cable can be used in wired LAN's.
- Every LAN uses a protocol – a set of rules that governs how packets are configured and transmitted.
- Nodes in a LAN are linked together with a certain topology. These topologies include:
 - Bus
 - Ring
 - Star
- LANs are capable of very high transmission rates (100s Mb/s to G b/s).

Local Area Network (LAN)



Advantages of LAN

- Speed
- Cost
- Security
- E-mail
- Resource Sharing

Disadvantages of LAN

- Expensive To Install
- Requires Administrative Time
- File Server May Fail
- Cables May Break

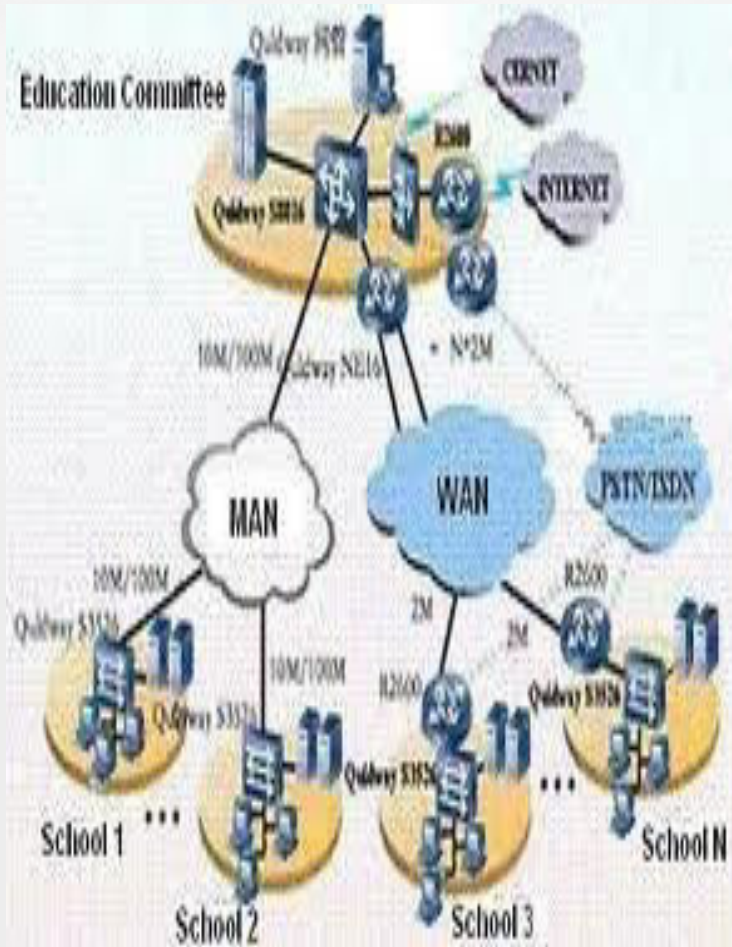
Metropolitan Area Network (MAN)

- A **metropolitan area network (MAN)** is a large computer network that usually spans a city or a large campus.
- A MAN is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities.
- A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations.

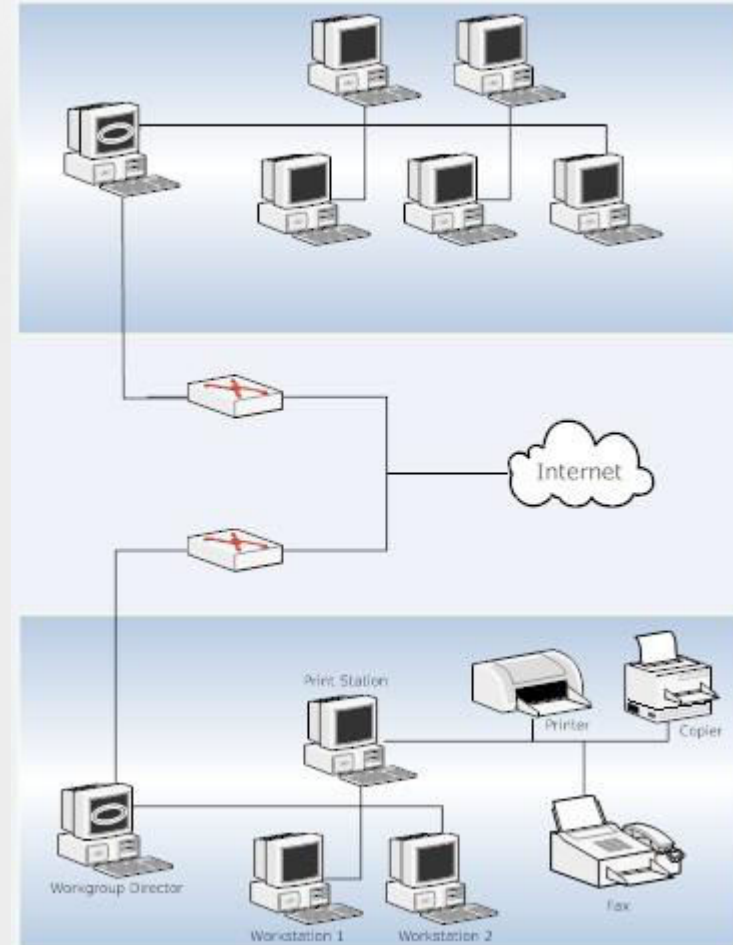
Metropolitan Area Network (MAN)

- A MAN often acts as a high speed network to allow sharing of regional resources.
- A MAN typically covers an area of between 5 and 50 km diameter.
- Examples of MAN: Telephone company network that provides a high speed DSL to customers and cable TV network.

Metropolitan Area Network (MAN)



General WAN Diagram



Wide Area Network (WAN)

- WAN covers a large geographic area such as country, continent or even whole of the world.
- A WAN is two or more LANs connected together. The LANs can be many miles apart.
- To cover great distances, WANs may transmit data over leased high-speed phone lines or wireless links such as satellites.

Wide Area Network (WAN)

- Multiple LANs can be connected together using devices such as bridges, routers, or gateways, which enable them to share data.
- The world's most popular WAN is the Internet.

Personal Area Network (PAN)

- A **PAN** is a network that is used for communicating among computers and computer devices (including telephones) in close proximity of around a few meters within a room
- It can be used for communicating between the devices themselves, or for connecting to a larger network such as the internet.
- PAN's can be wired or wireless

Personal Area Network (PAN)

- A **personal area network (PAN)** is a computer network used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body.
- The devices may or may not belong to the person in question. The reach of a PAN is typically a few meters.