

Chapter-1

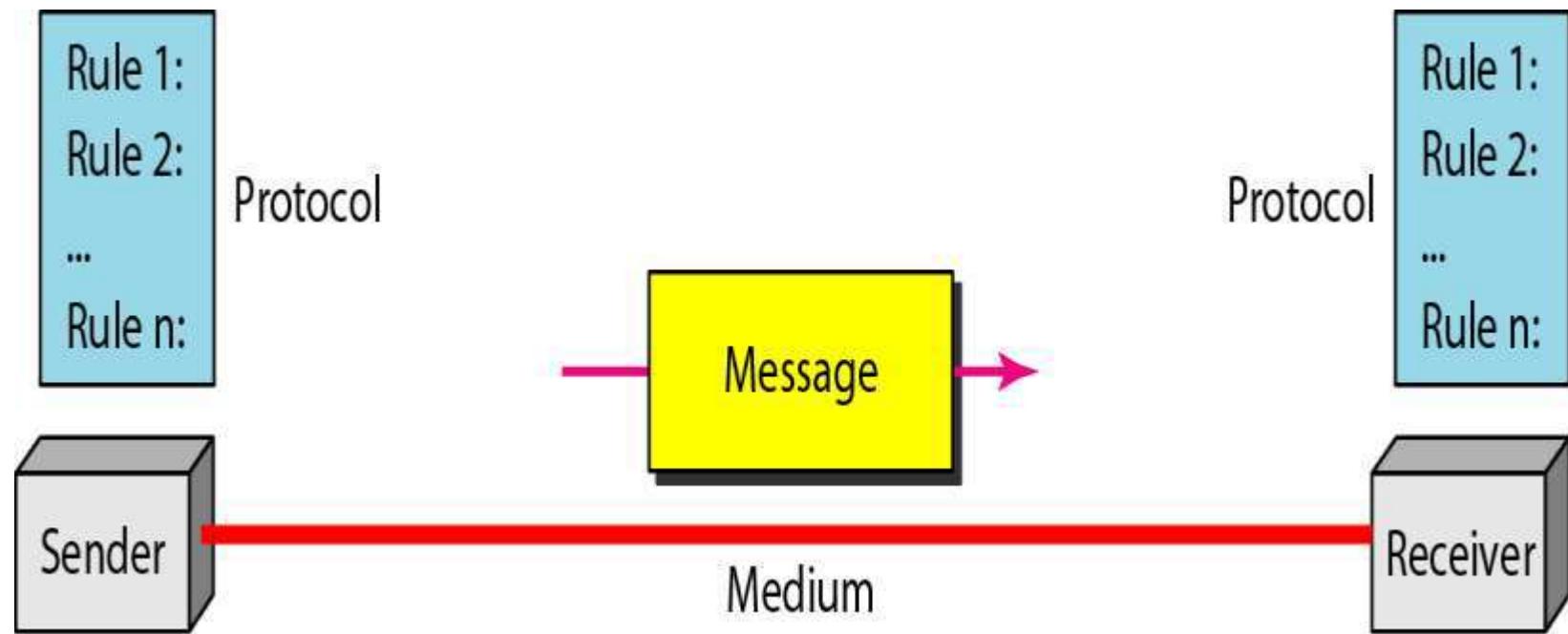
Data communication

- In computer information systems, data are represented by binary information units 0s and 1s
- Delivery → Correct destination
- Accuracy → Deliver data accurately
- Timeliness → Deliver data in a timely manner

Components of a data communication system

The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.

Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable.



1. Message. The message is the information (data) to be communicated.

---Popular forms of information include text, numbers, pictures, audio, and video.

2. Sender. The sender is the device that sends the data message.

--- It can be a computer, telephone handset, video camera, and so on.

3. Receiver. The receiver is the device that receives the message.

---It can be a computer, telephone handset, television, and so on.

4. Transmission medium. The transmission medium is the physical path by which a message travels from sender to receiver.

---Some examples of transmission media include twistedpair wire, coaxial cable, fiber-optic cable, and radio waves

5. Protocol. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

---just as a person speaking French cannot be understood by a person who speaks only Japanese.

- **PROTOCOLS**

A protocol is a set of rules that govern data communications. It determines **what** is communicated, **how** it is communicated and **when** it is communicated. The key elements of a protocol are syntax, semantics and timing

Networks

- A network is set of devices (often referred as nodes) connected by a media links. A node can be any devices capable of sending and receiving data generated. by other nodes

Distributed process

- Security /encapsulation
- Distributed data base
- Faster problem solving
- Security through redundancy
- Collaborative processing

Network criteria

Performance



- Number of users.
- Type of transmission medium
- Hardware
- software

RELIABILITY

- Frequency of failure
- Recover time of network after failure
- Catastrophe

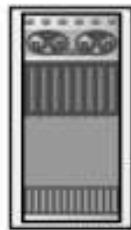
SECURITY

- Unauthorized users
- Viruses

APPLICATIONS

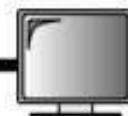
- Marketing and sales
- Financial services
- Manufacturing
- Electronic messaging
- Directory services
- Information services
- EDI
- Teleconferencing
- Cellular telephone
- Cable television etc...

Data flow (simplex, half-duplex, and full-duplex)



Mainframe

Direction of data



Monitor

a. Simplex



Direction of data at time 1



Direction of data at time 2

b. Half-duplex



Direction of data all the time

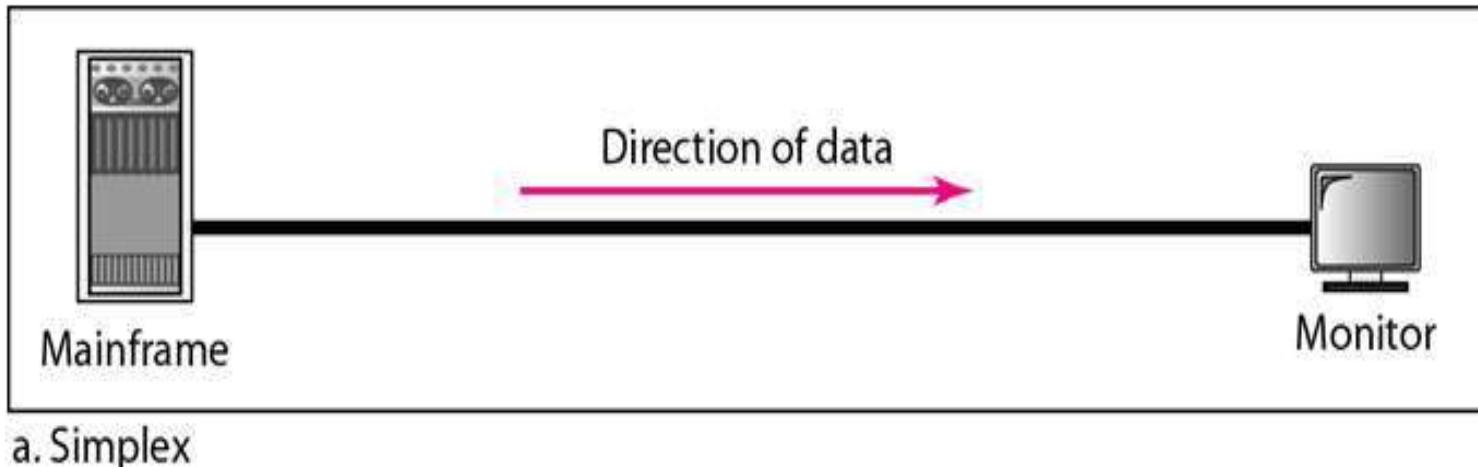


c. Full-duplex

Simplex:

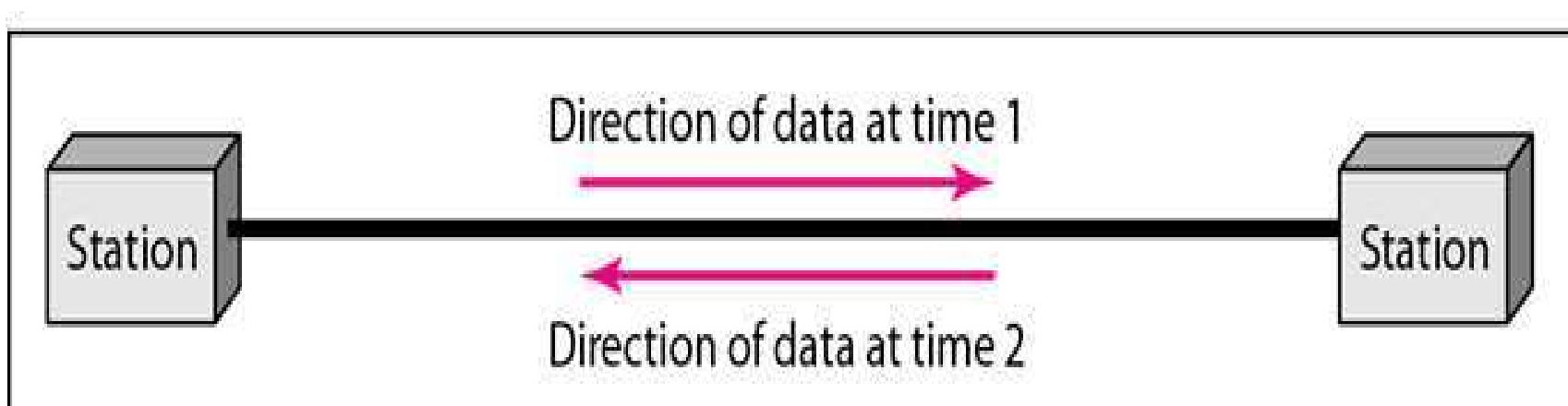
In simplex mode, the communication is unidirectional, as on a one way street. Only one of the two devices on a link can transmit; the other can only receive.

- **Examples:-** Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output. The simplex mode can use the entire capacity of the channel to send data in one direction.



Half-Duplex: In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.

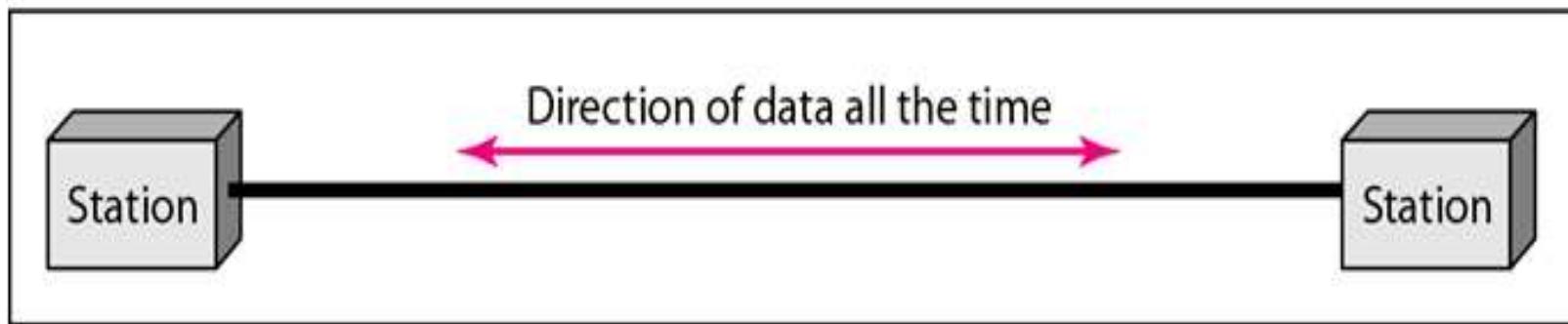
- **Examples:-**When cars are traveling in one direction, cars going the other way must wait. In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time. Walkie-talkies is half-duplex systems.



b. Half-duplex

Full-Duplex: In full-duplex both stations can transmit and receive simultaneously. The full-duplex mode is like a two-way street with traffic flowing in both directions at the same time. In full-duplex mode, signals going in one direction share the capacity of the link: with signals going in the other direction.

- **Example:-** full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time. The full-duplex mode is used when communication in both directions is required all the time. The capacity of the channel, however, must be divided between the two directions.



c. Full-duplex

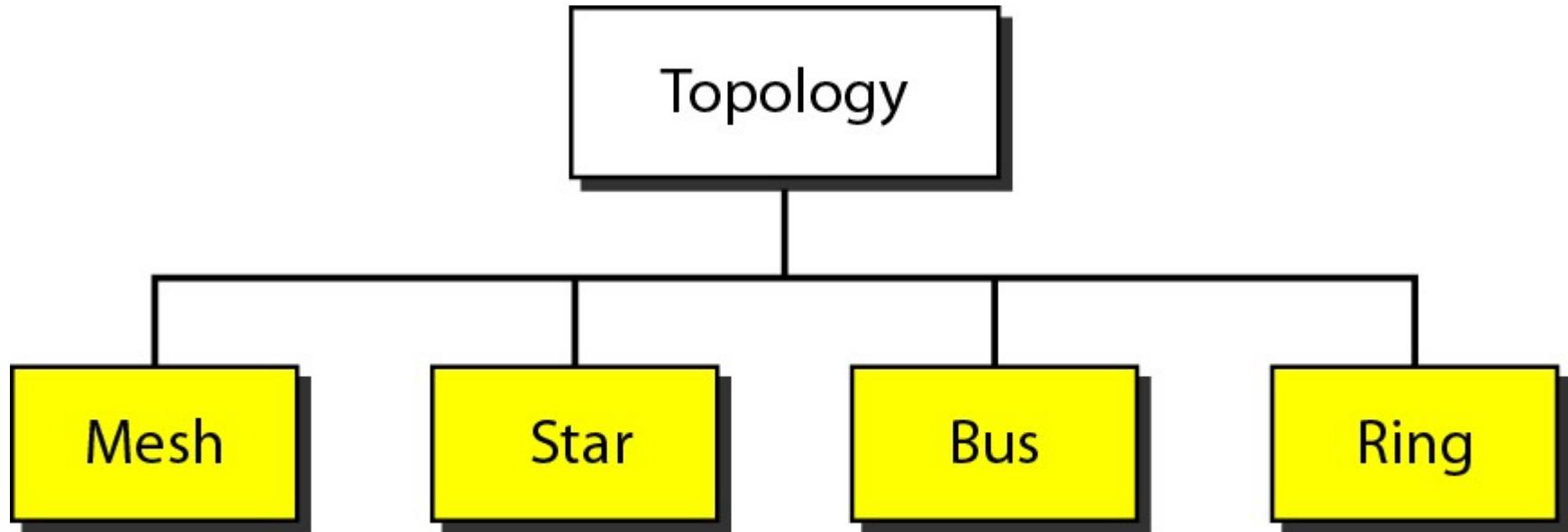
Computer networks

Computer network : consists of two or more computers that are linked in order to share resources, exchange data files or to allow electronic communication. The computers on a network may be linked through cables, telephone lines, radio waves, satellites or infrared light beams.

There are two aspects of computer networks – **hardware** and **software**.

- **Hardware** includes physical connection between two machines by using adaptors, cables, routers, bridges etc.
- **software** includes a set of protocols. Protocols define a formal language among various components. It makes hardware usable by applications.

Categories of topologies



- The term **physical topology** refers to the way in which a network is laid out physically. One or more devices connect to a **link**; two or more links form a **topology**.
- The **topology** of a network is the geometric representation of the relationship of all the links and linking devices (usually called nodes) to one another.
- There are four basic topologies possible: mesh, star, bus, and ring.

A fully connected mesh topology (five devices)

- In mesh topology every device has a dedicated point-to-point link to every other device.

- The link carries traffic only between the two devices it connects.

- Duplex-mode

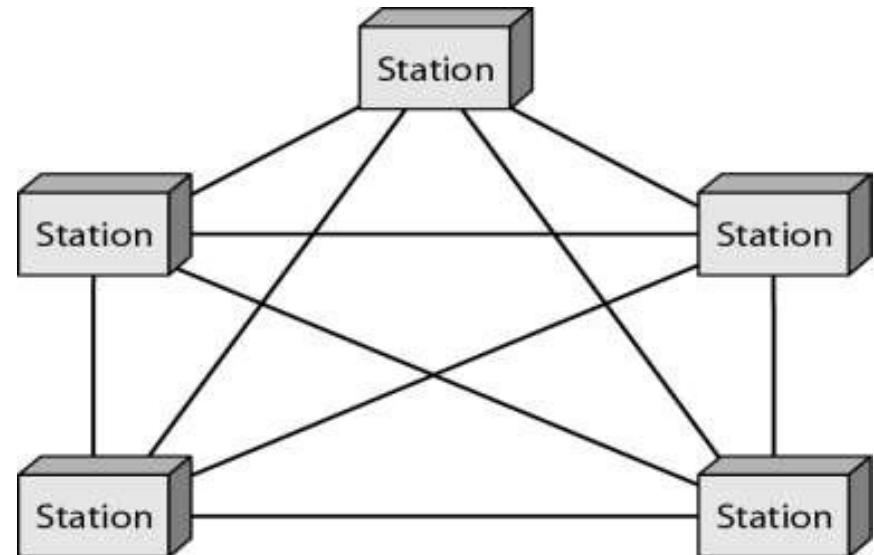
- **Advantages:**

- guaranteed dedicated links

- eliminates traffic problems

- privacy and security

- this makes fault identification easy



- **Disadvantages:**

- cabling and number of IO ports required

- wiring is greater than available space

- hardware is required for each link – expensive

A star topology connecting four stations

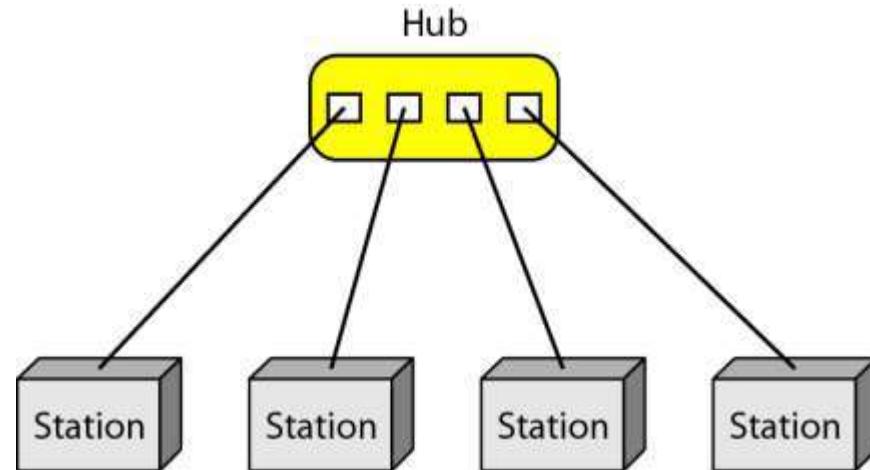
- In star topology, each device has a dedicated point-to-point link only to a central controller called hub.
- The controller acts as an exchange: if one device wants to send data to another , it sends the data to controller, which then relays the data to the another connected device.

- **Advantages:**

- less expensive
- robustness – if one link fails, only that link is affected, other links remain active.

- **Disadvantages:**

- dependency of the whole topology on one single point.
- star requires less than mesh, each node is linked to the hub. So more cabling is required .



A bus topology connecting three stations

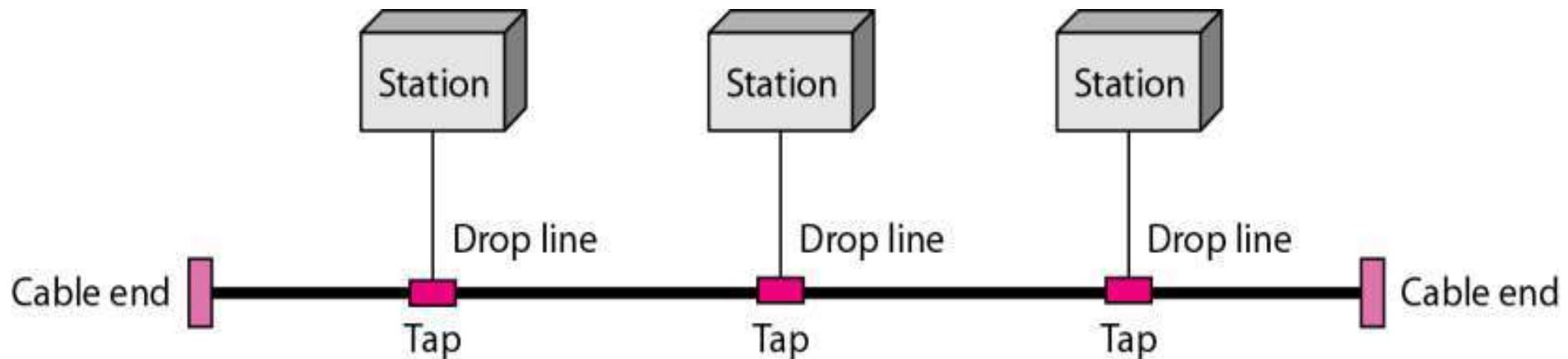
- A bus topology is a multipoint .
- One long cable acts as a backbone to link all the devices in the network.
- Nodes are connected by bus cable by drop line and taps. a drop line is a connection running between the device and the main cable a tap is a connector that either splices or punctures.

- **Advantages:**

- easy of installation

- **Disadvantages:**

- difficult reconnection
 - addition of new devices require modification or replacement
 - of the backbone



A ring topology connecting six stations

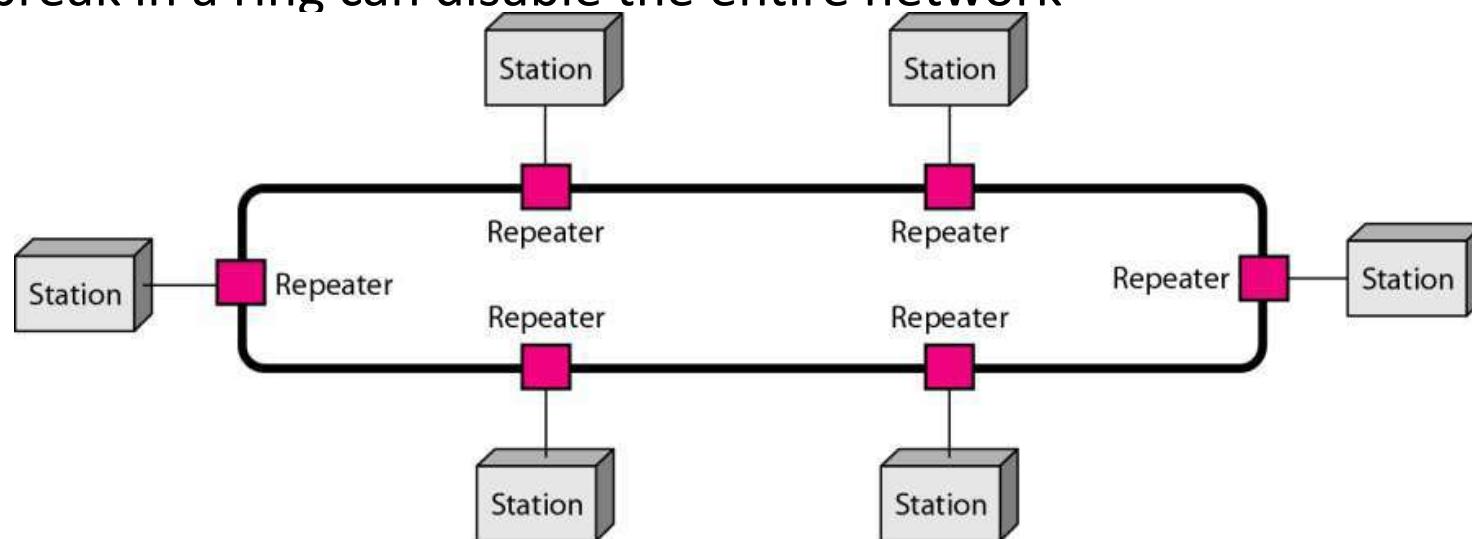
- In ring topology each device has a point-to-point connection with only the two devices on either side of it.
- A signal is passed along a ring in one direction, from device to device until it reaches its destination.

• Advantages:

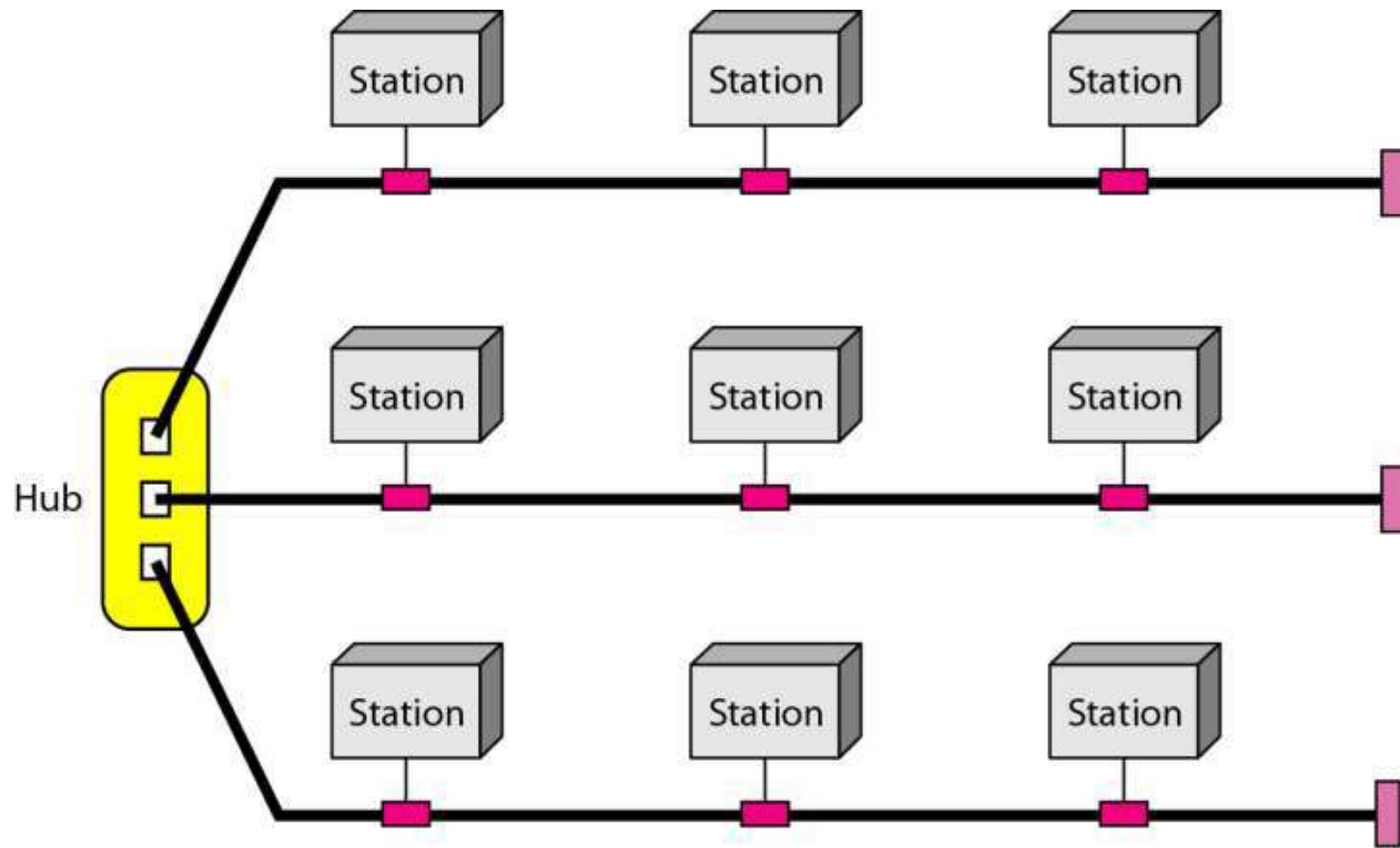
- easy to install and reconfigure
- to add or delete a device requires changing only two connections.
The only
- constraints are media and traffic.

• Disadvantages:

- unidirectional
- a break in a ring can disable the entire network



A hybrid topology: a star backbone with three bus networks

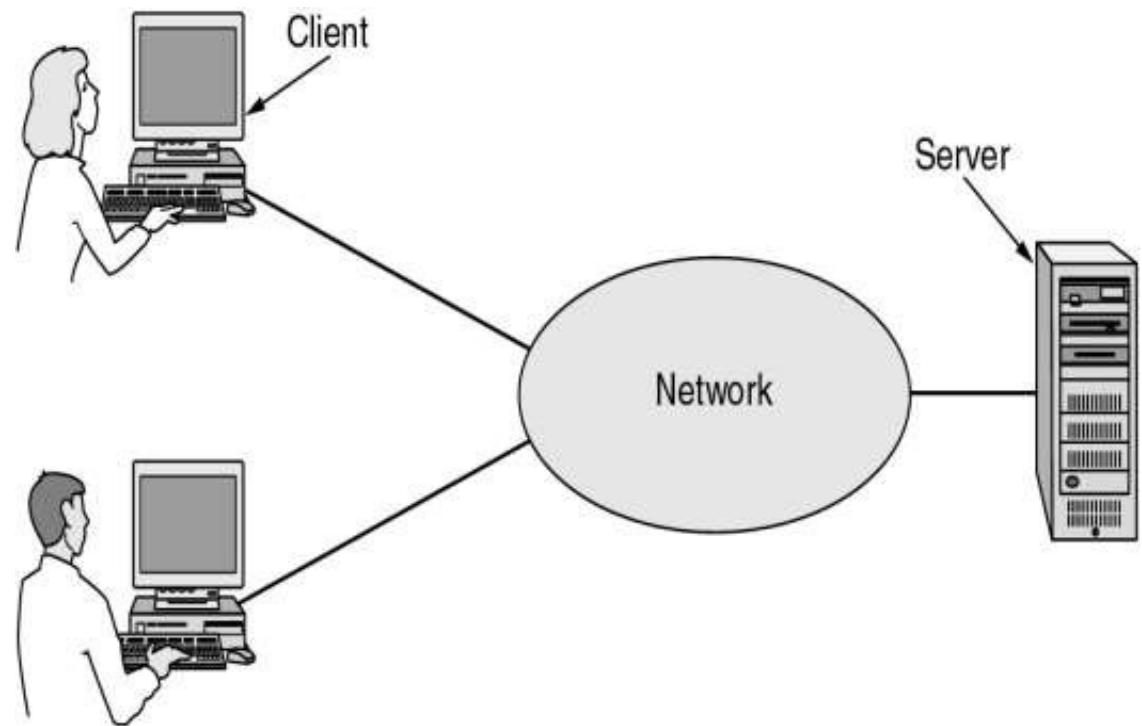


Uses of Computer Networks

- Business Applications
- Home Applications
- Mobile Users

Business Applications of Networks

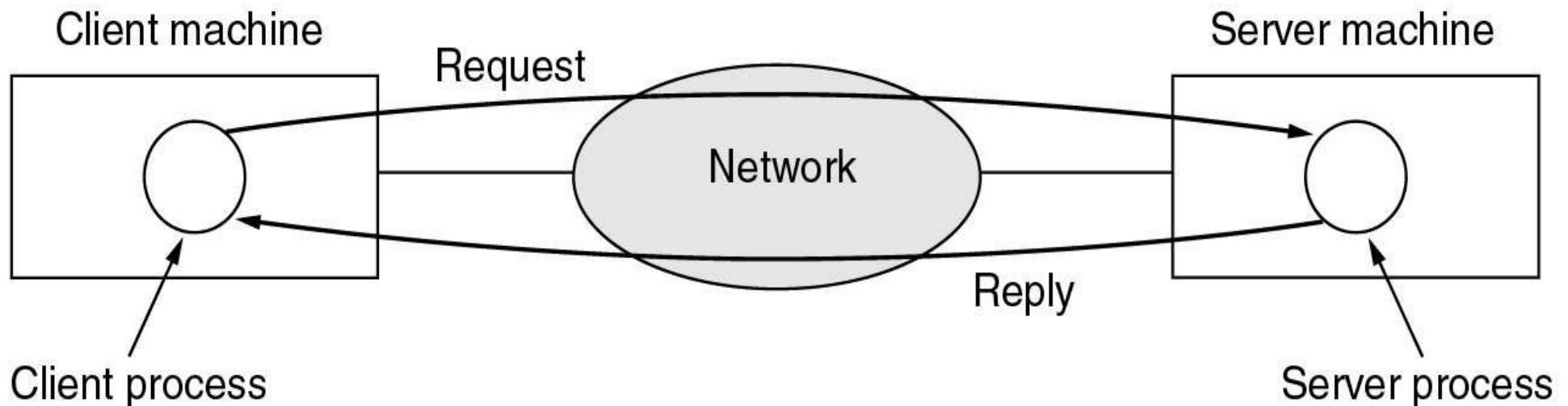
- Resource sharing
- High reliability
- Saving money
- scalability



Client-server model

Business Applications of Networks (2)

- The client-server model involves requests and replies.



Home Network Applications

1. Access to remote information

- Many people pay their bills, manage bank accounts, handle their investments electronically.
- Home shopping.
- On-line newspaper which can be personalized.
- Access to information system like world wide web, which contains information about arts,business,cooking,government,health,history,science,sports,travel,.....
- All the above applications involve in interactions between a person and remote database.

2. Person-to-person communication

- Electronic mail or email which allow users to communicate with no delay
- Videoconference- which makes possible

3. Interactive entertainment

- Huge and growing industry.
- Video
- Game playing

4. Electronic commerce

Cont.

- **Electronic Commerce**, commonly known as **Ecommerce** or **e Commerce**, is trading in products or services using computer networks, such as the Internet
- **E-commerce** facilitates home shopping, catalogue of company products.

It is also popularly employed for bill payments , banking, investments,

Tag	Full name	Example
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on-line
P2P	Peer-to-peer	File sharing

Some forms of e-commerce

- **Mobile Network Users** Many professionals uses desktop computers at office and want to be connected to the office network while travelling and at home also. This is possible by wireless networks, hence use of laptop, notebook computers and personal digital assistants(PDAs) is increased.
- Wireless networks are used in:- taxis, military applications, airports, banking, weather reporting
- Combinations of wireless networks and mobile computing.

Wireless	Mobile	Applications
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

Network Hardware

- Local Area Networks
- Metropolitan Area Networks
- Wide Area Networks

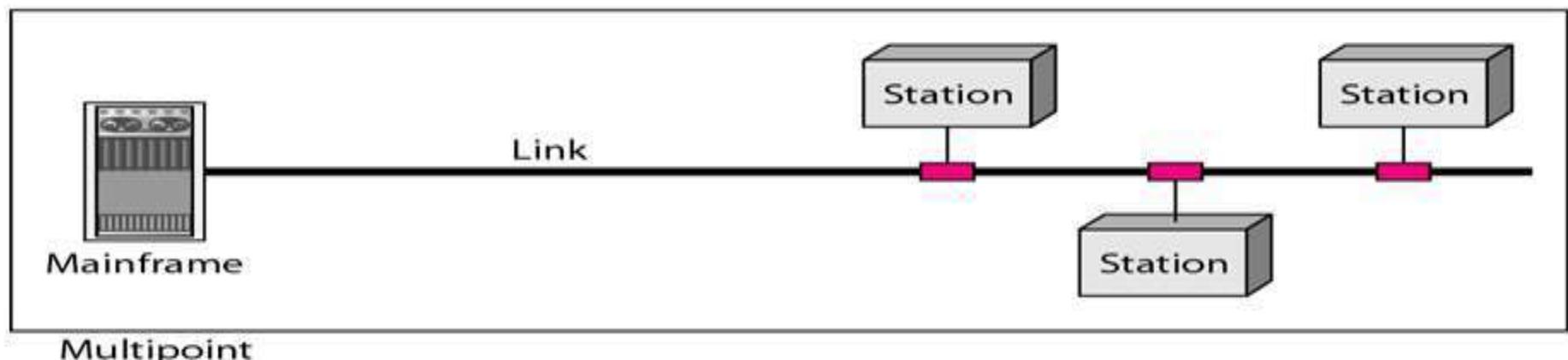
There are two types of transmission technology:

- 1. Broadcast Networks

This has a single communication channel that is shared by all the machines on the network.

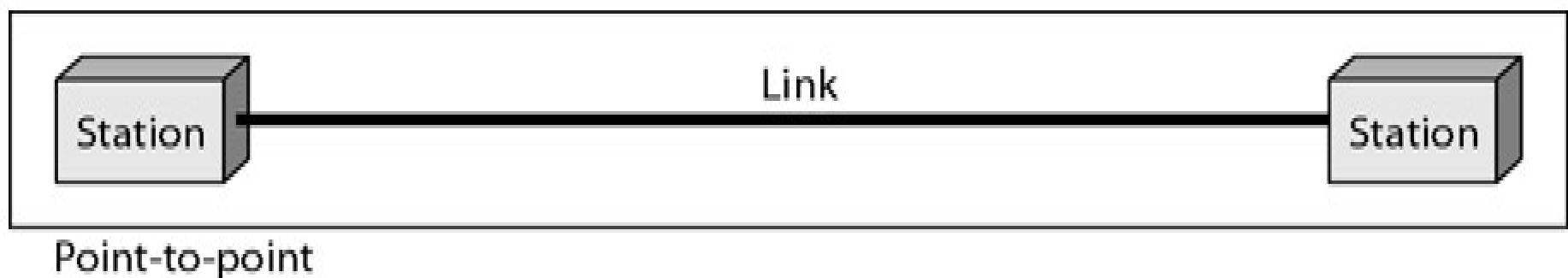
The data transmitted is converted in small packets form. Each packet contains address field of the destination station.

- Ex:- a person standing at corridor “watson, come here. I want you” sending same packets to all the stations within a network is called as **broadcasting**.
- When data packets are sent to a specific group of stations it is called as **multicasting**. This is a selective process



Point-to-point Network : Point-to-point connections use an actual length of wire or cable to connect the two ends, but other options, such as microwave or satellite links, are also possible. When you change television channels by infrared remote control, you are establishing a point-to point connection between the remote control and the television's control system.

This network provides a dedicated link between any two stations . Such a transmission is called **unicasting**.



Classification of interconnected processors by scale.

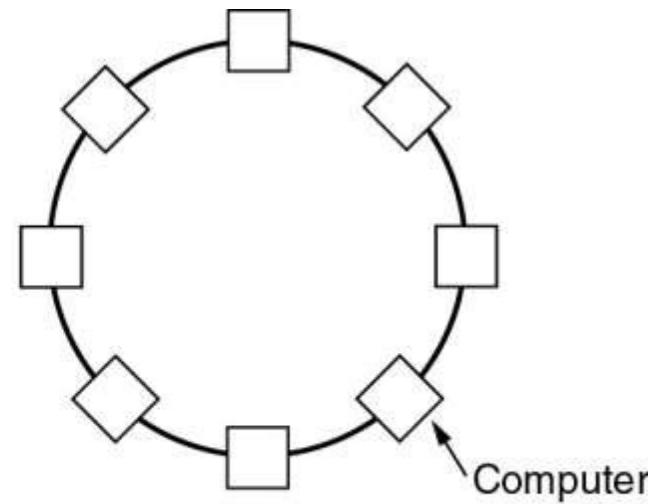
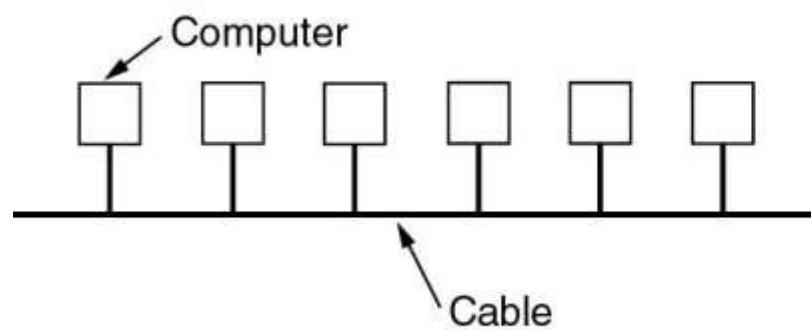
Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	
100 m	Building	
1 km	Campus	
10 km	City	
100 km	Country	
1000 km	Continent	
10,000 km	Planet	

- Personal area network is sending a message over a very short distance
- Computers that communicate by exchanging messages over longer cables. LAN MAN WAN
- The connection of two or more networks is called an internetwork.

Local Area Networks(LANs)

- LANS are privately-owned networks within a single building or campus of up to few kilometers in size.
- LANS are distinguished based on
 - Their size
 - Their transmission technology
 - Their topology
- LANS are restricted in size
- LANS use a transmission technology consisting of a single cable to which all machines are attached like telephone company lines once used in rural areas.
- LANS run at speeds of 10 to 100 Mbps, have low delay and make very few errors.

Local Area Networks



(a)

Two broadcast networks

- (a) Bus
- (b) Ring

(b)

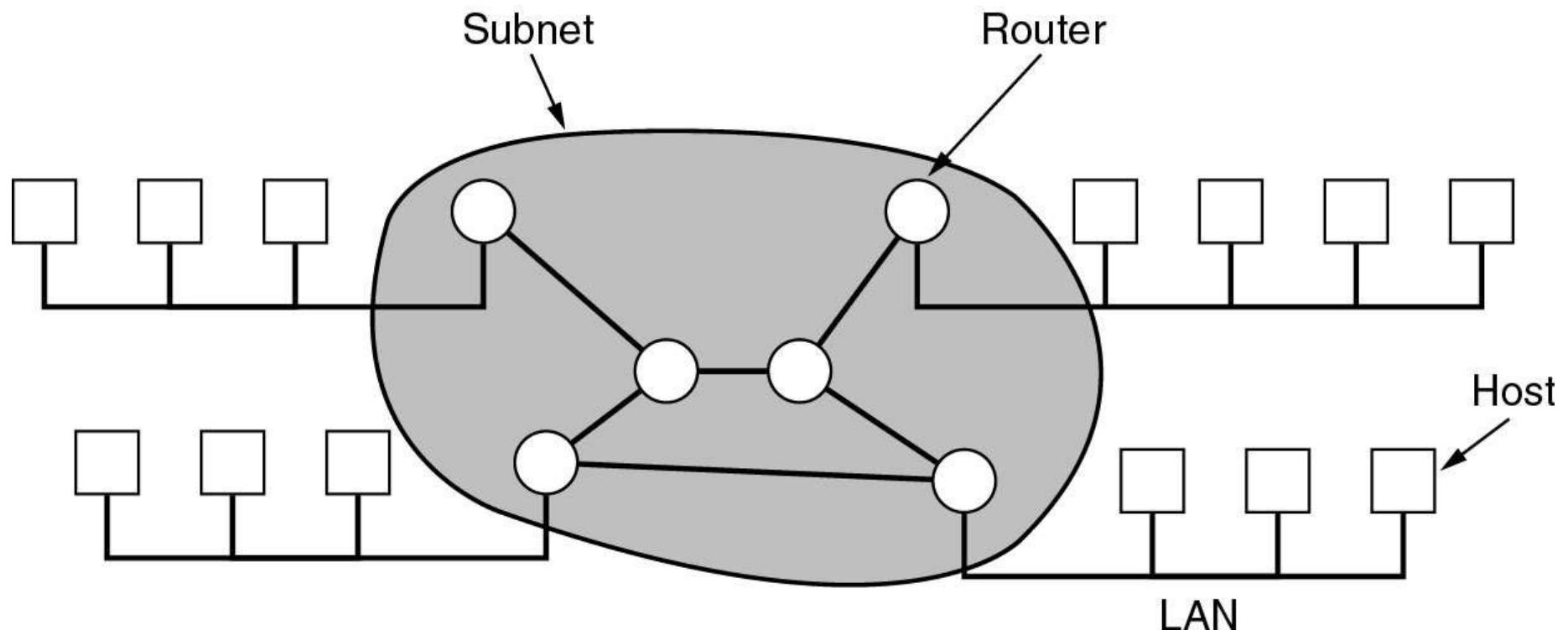
Metropolitan Area Networks

MAN is basically a bigger version of a LAN and normally uses similar technology.

- It might cover a group of near by offices, may be either private or public
- A MAN just has one or two cables and does mot have any switching elements
- The main reason for even distinguishing MAN's is that a standard has been adopted and this standard is now being implemented
- It is called DQDB (distributed queue dual bus, 802.6)

Wide Area Networks

- Relation between hosts on LANs and the subnet.



Wide Area Networks

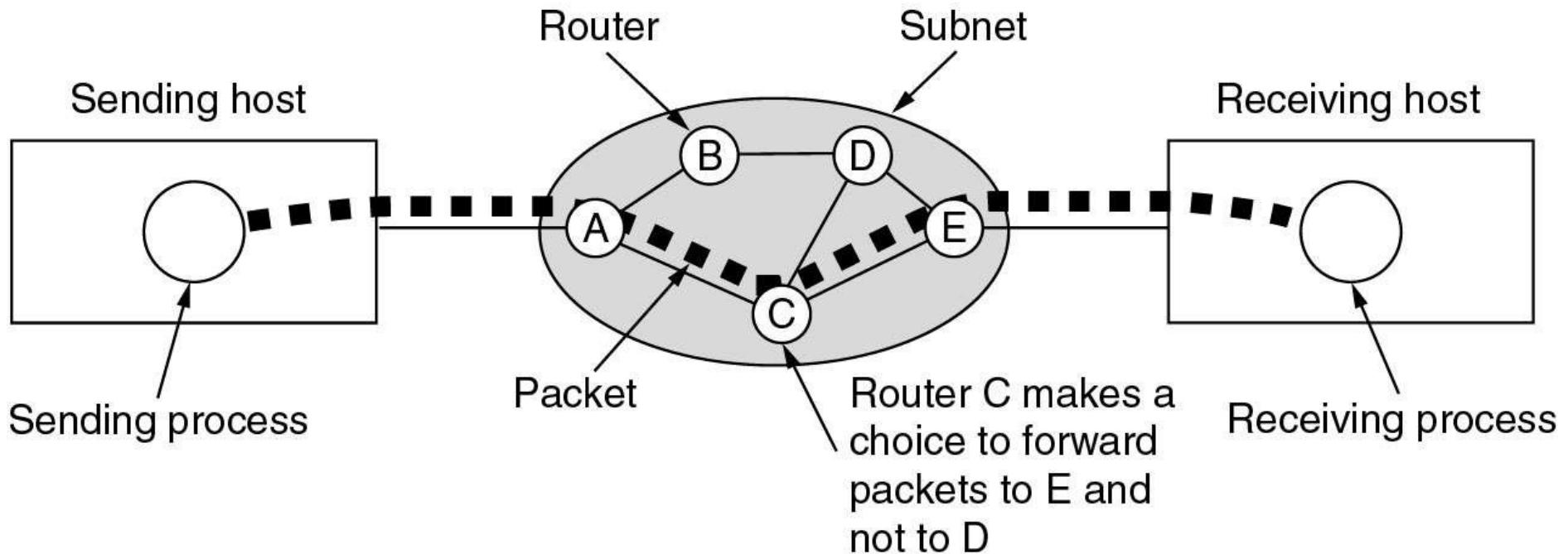
WANs spans a large geographical area, often a country or continent.

- It contains collection of machines for running user applications, called **hosts** or **end user**.
- The hosts are connected by communication subnet or **subnet**. The subnet carries message from host to host.
- For communication aspect – subnet
application aspect - hosts

In WAN the subnets consists of two distinct components: transmission lines and switching elements.

- Transmission lines are circuits or channels
- Switching elements are specialized computers used to connect two or more transmission lines. These are called **routers**
- Each host is connected to LAN on which a router is present, or in some cases host can be connected directly connected to router.
- The collection of communication lines and routers form the subnet.

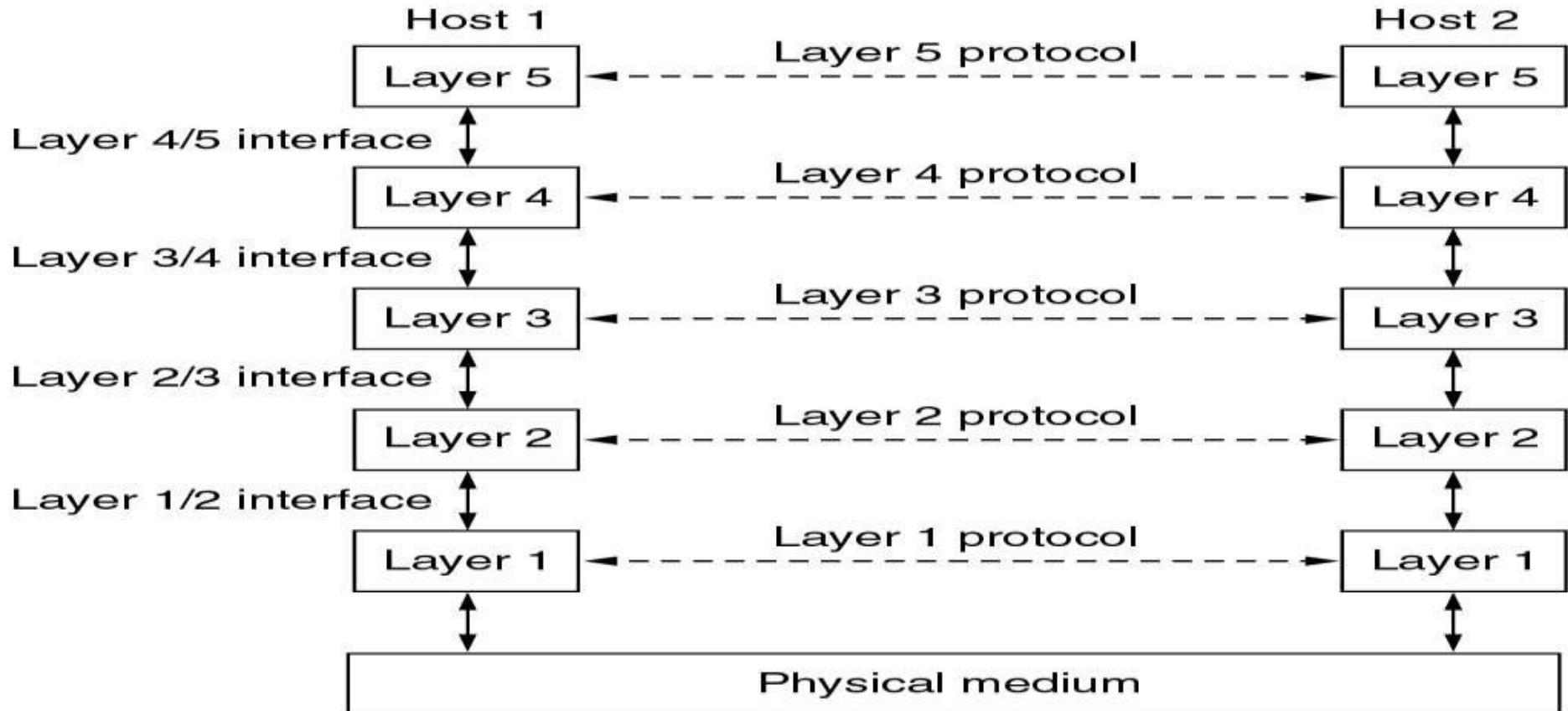
- If two routers do not share a cable or not wish to communicate , they must do this indirectly ie., via other router.
- When the packet is send from one router to another via one or more intermediate routers , the packet is received at each router and stores until required output line is free and then forward.
- A subnet using this principle is called point-to-point , storeand-forward, or packet-switching subnet.



Protocol Hierarchies

- To reduce the design complexity, most networks are organized as a series of layers or levels. Each one built upon the one below it.
- The number of layers, name of each layer, contents of each layer and the function of each layer differ from network to network.
- Layer n on one machine carries on a conversation with layer n on another machine. The rules and conventions used in this conversation are collectively known as the layer n **protocol**.

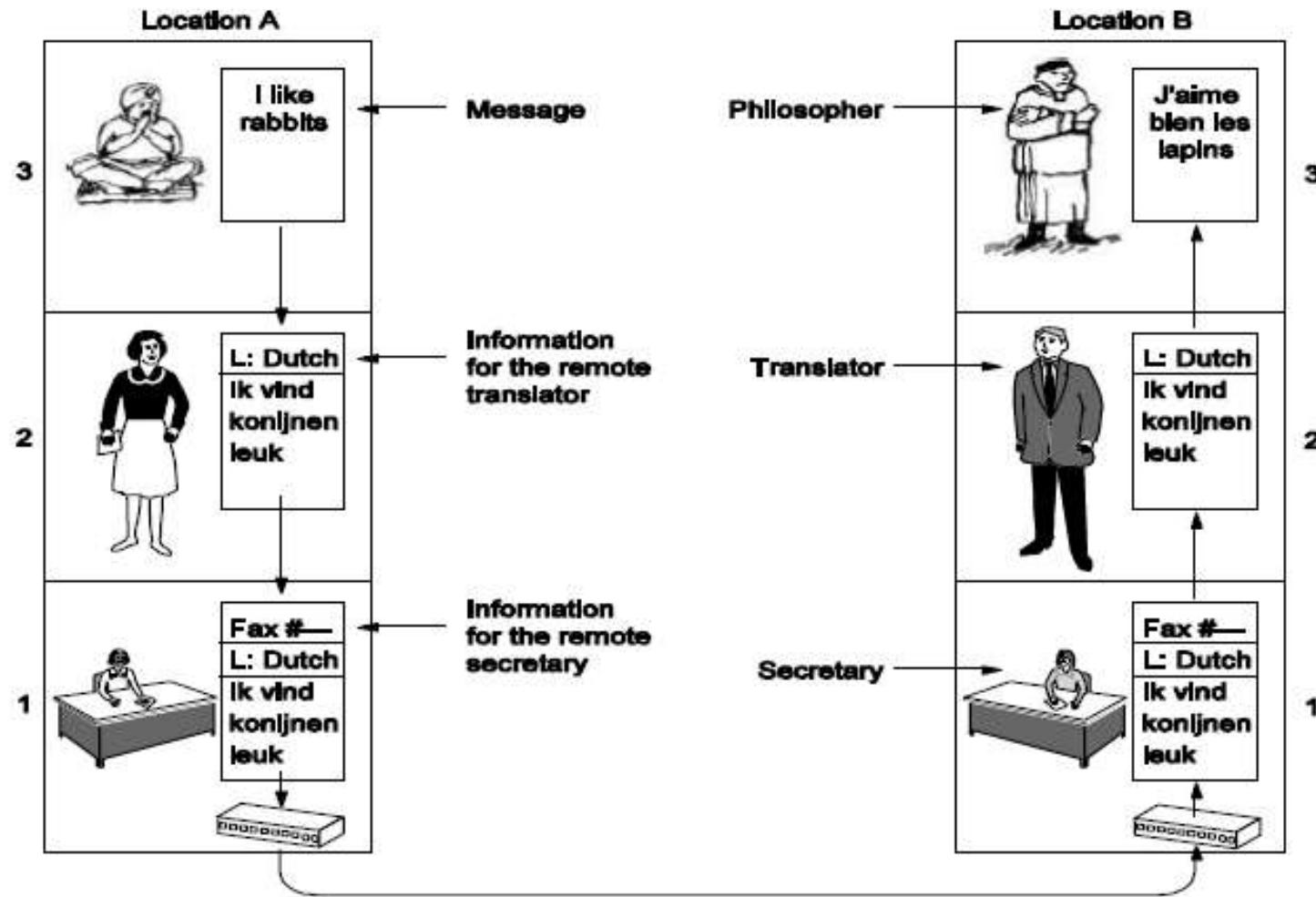
Protocol Hierarchies



Between each pair of adjacent layers there is an **interface**.

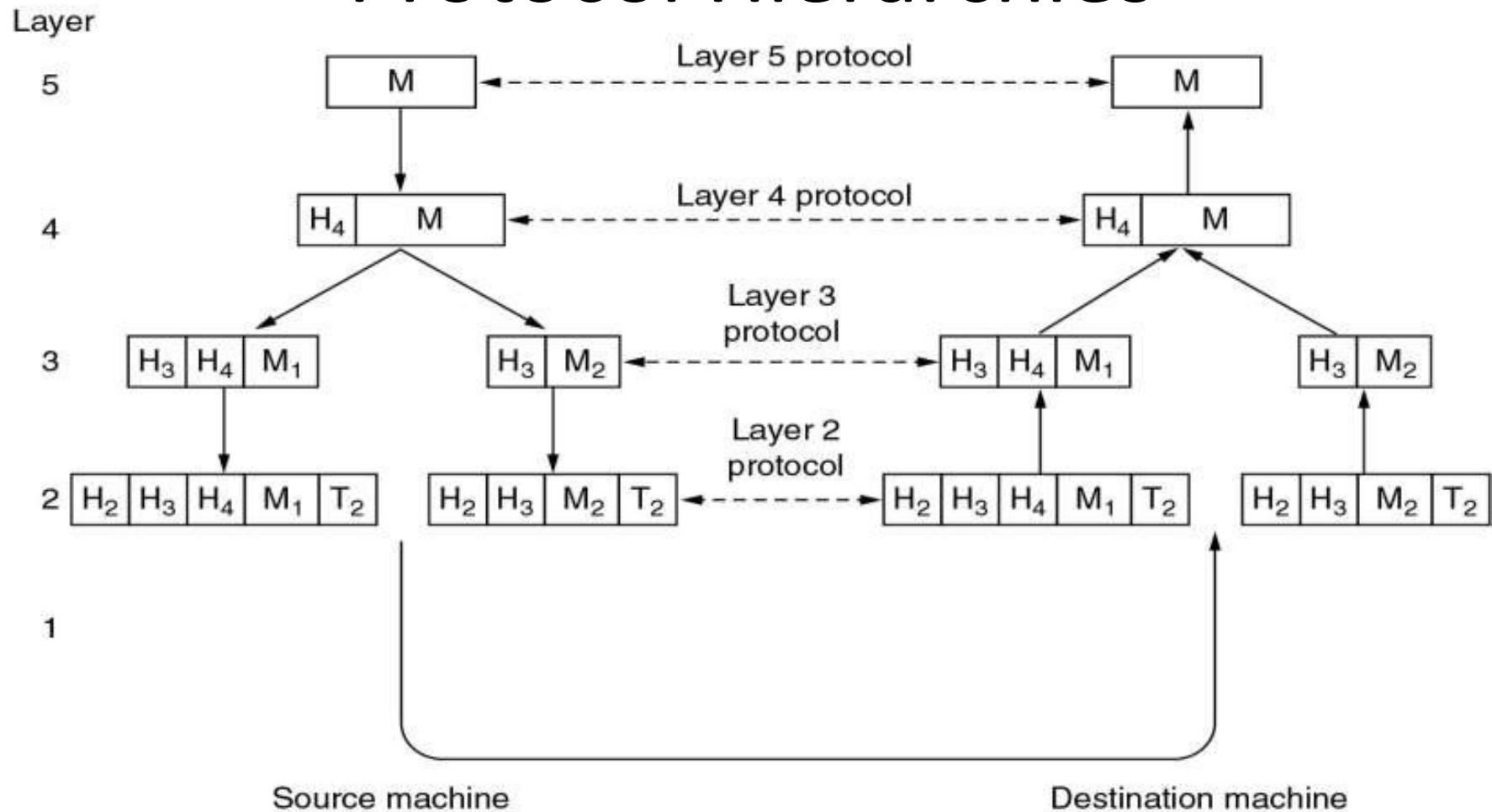
- A set of layers and protocols is called a **network architecture**.
- A list of protocols used by a certain system , one protocol per layer, is called a **protocol stack**.

Protocol Hierarchies



The philosopher-translator-secretary architecture.

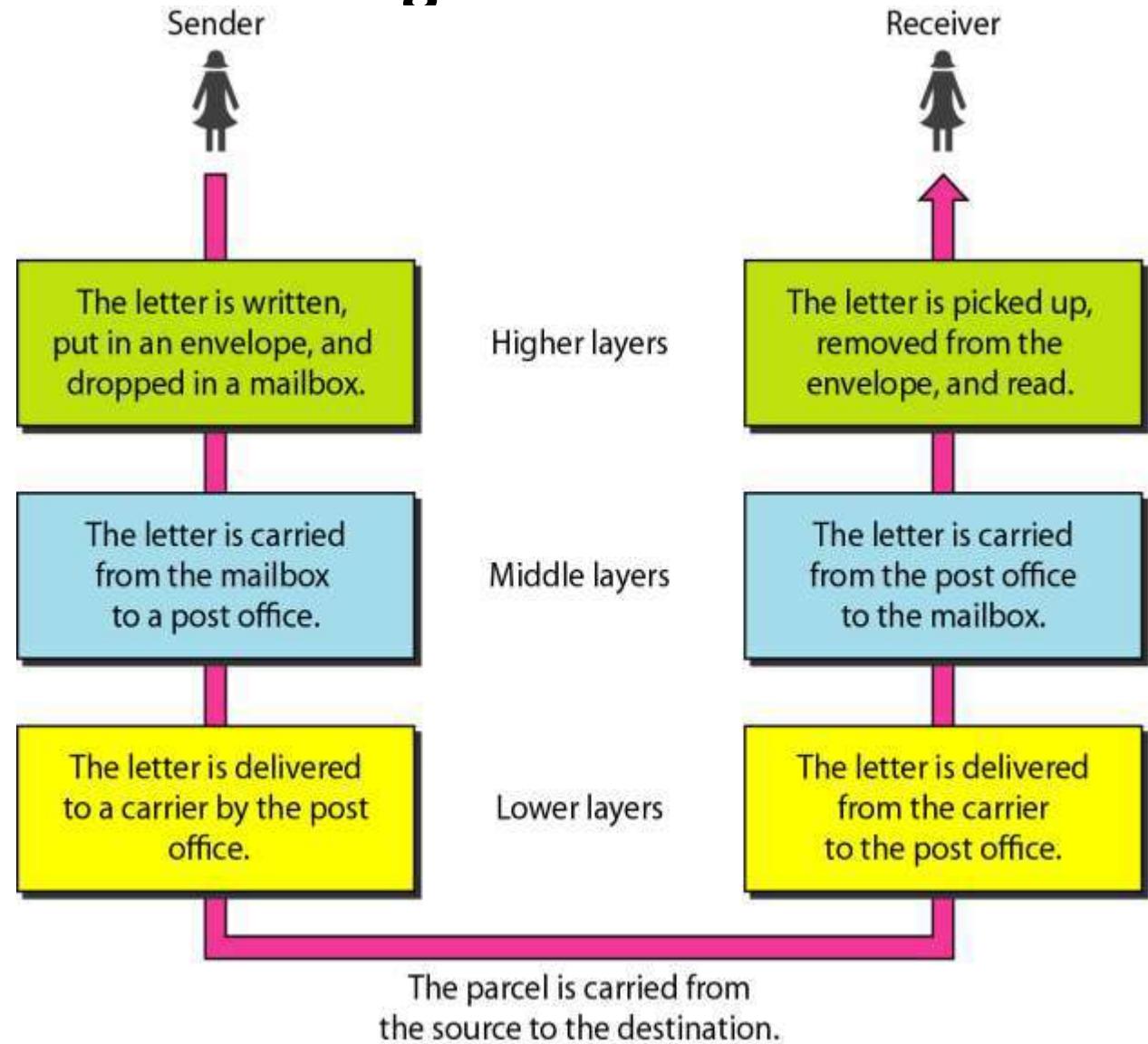
Protocol Hierarchies



- Example information flow supporting virtual communication in layer 5.

- **Tasks involved in sending a letter**

We use the concept of layers in our daily life. As an example, let us consider two friends who communicate through postal mail.



Design Issues for the Layers

- Addressing – each layer needs a mechanism for identifying senders and receivers.
- The rules of data transfer – simplex, half-duplex, full duplex
- Error Control – error-correction and error-detection
- Flow Control - The communication channels must preserve the order of messages sent on them – disassembling, transmitting, and then reassembling.
- Multiplexing – inconvenient or expensive to set up a connection for each pair of communication process.
- Routing – multiple paths between source and destination , a route must be chosen

Connection-Oriented and Connectionless Services

- **Connection-oriented** is modeled after the **telephone system**.
 - To talk to someone, you pick up the phone, dial the number, talk, and then hang up.
 - To use a connection-oriented network service, the service user first establishes a connection, uses the connection, and then releases the connection.
- **Connectionless** service is modeled after **postal system**.
 - Each message carries the full destination address, and each one is routed through the system independent of all the routers.
 - When two messages sent to the same destination, the first one sent will be the first one to arrive. If the first one is delayed, the second one arrives first.
 - With connection-oriented service this is not possible.

Service Primitives

Primitive	Meaning
LISTEN	Block waiting for an incoming connection
CONNECT	Establish a connection with a waiting peer
RECEIVE	Block waiting for an incoming message
SEND	Send a message to the peer
DISCONNECT	Terminate a connection

Five service primitives for implementing a simple connection-oriented service.

Services to Protocols Relationship

The relationship between a service and a protocol.

- A service is a set of primitives(operations)that a layer provides to the layer above it
- A protocol is a set of rules governing the format and meaning of the frames, packets, or messages that are exchanged by the peer entities within the layer

