

Computer Networking Lecture 1 Hassan Alamri

Agenda:

- What is a network?
- Data communication overview .
- Data communication components.
- Data Representations.
- Data Flow.
- Network Criteria
- Type of network connections
- Network topology
- Categories of Networks.
- Conclusion

What is a Network?

A network consists of 2 or more computers **connected** together, and they can **communicate** and **share** resources (e.g. information)



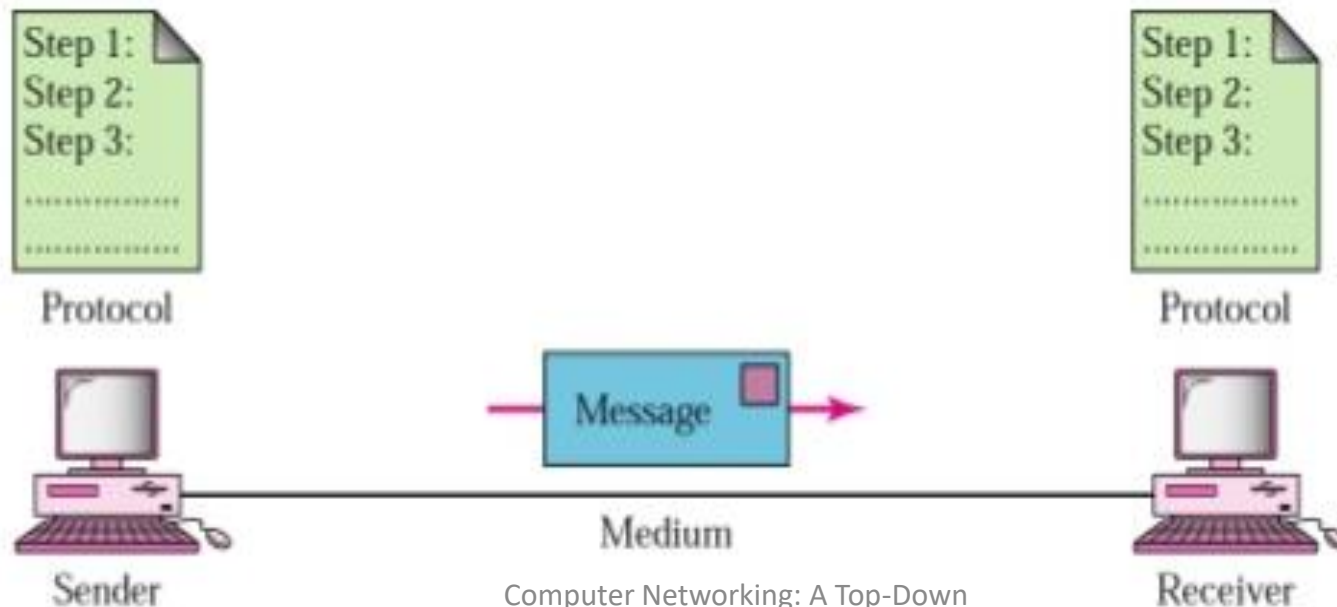
DATA COMMUNICATIONS

- **Data communications** are the exchange of data between two devices via some form of transmission medium such as wire cable or radio waves.

Major components of Data communications (1)

A data communications system has five components:

- 1- message
- 2- Sender
- 3- Receiver
- 4- Transmission medium
- 5- protocol



Major components of Data communications (2)

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, workstation, telephone handset, video camera, and so on.

3. Receiver:

The receiver is the device that receives the message. It can be a computer, workstation, 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 twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves.

Major components of Data communications (3)

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

Data Representation

Information today comes in different forms such as:

Text, Numbers, Images, Audio, Video:

Text

In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s). Different **sets of bit patterns** have been designed to represent text symbols.

Numbers

Numbers are also represented **by bit patterns**. However, a code such as ASCII is not used to represent numbers; **the number is directly converted to a binary number** to simplify mathematical operations.

Images

Images are also represented by **bit patterns**. In its simplest form, **an image is composed of a matrix of pixels** (picture elements), where each pixel is a small dot. The size of the pixel depends on the **resolution**.

Data Representation (2)

Audio

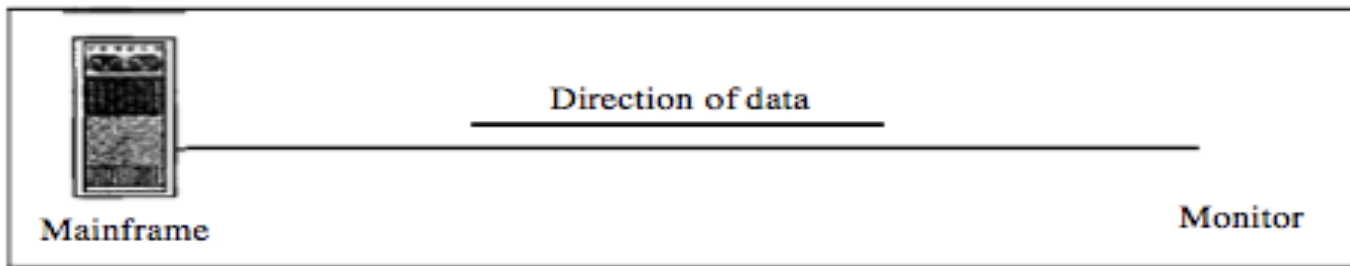
Audio refers to the recording or broadcasting of **sound or music**. **Audio is by nature different from text, numbers, or images. It is continuous, not discrete.**

Video

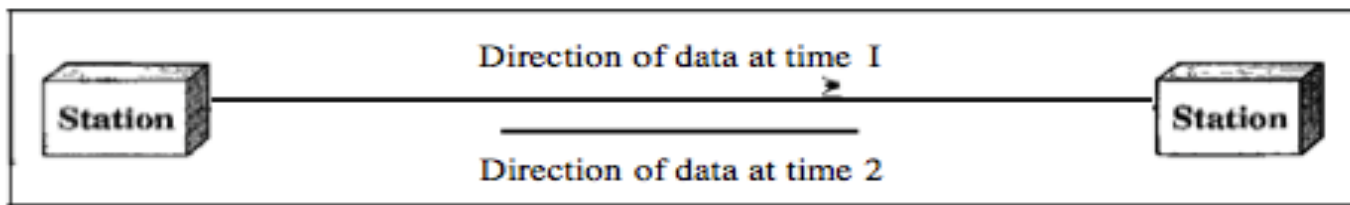
Video refers to the recording or broadcasting of **a picture or movie**. Video can either be produced as a continuous entity (e.g., by a TV camera), or **it can be a combination of images**, each a discrete entity, arranged to convey the idea of motion.

Data Flow

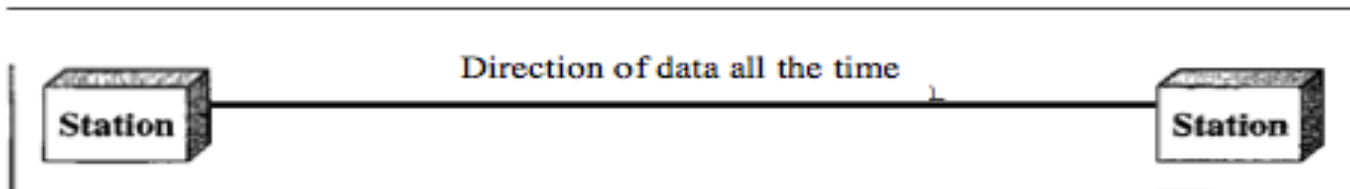
- Communication between two devices can be:
Simplex, Half-duplex, Or Full-duplex as shown in below



a. Simplex



b. Half-duplex

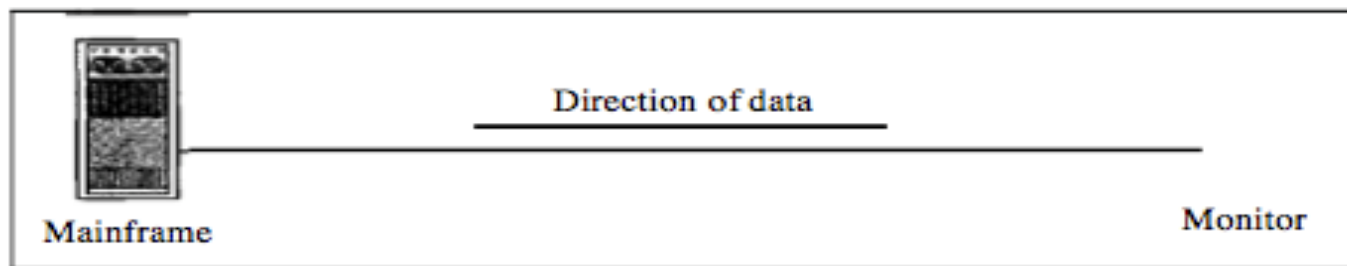


c. Full-duplex

Data Flow - Simplex

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 .
- **Keyboards** and **traditional monitors** are examples of simplex devices.
- The key- board 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.



a. Simplex

Data Flow – Half-Duplex

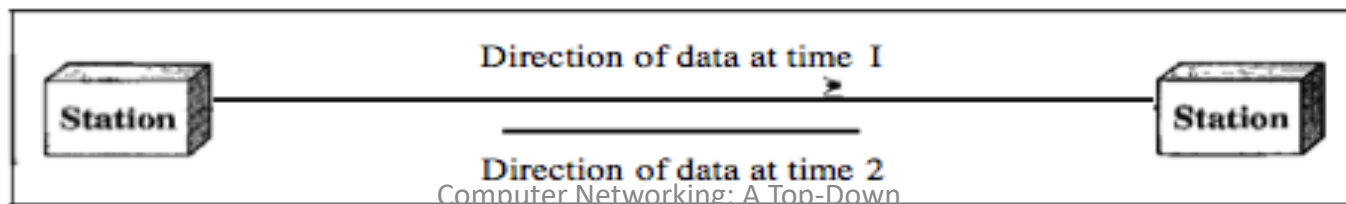
Half-Duplex

- 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.

-The half-duplex mode is like a one-lane road with traffic allowed in both directions. 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.

-The entire capacity of the channel can be utilized for each direction.



b. Half-duplex

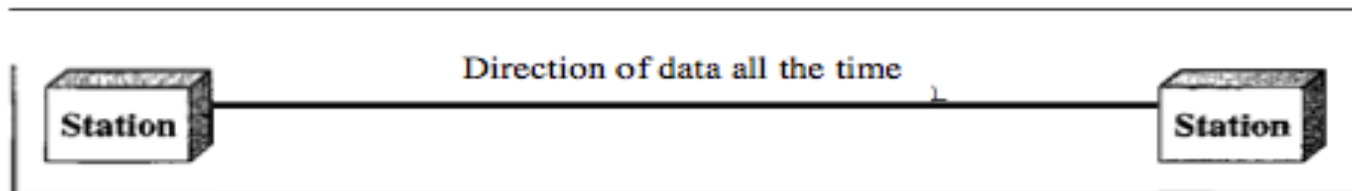
Data Flow – Full-Duplex (1)

Full-Duplex:

In full-duplex (also called 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 .



c. Full-duplex

Networks

A **network** is a set of devices (often referred to as **nodes**) connected by communication **links**.

A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network.

Network Criteria

A network must be able to meet a certain number of criteria. The most important of these are performance, reliability, and security.

Performance

The performance of a network **depends on a number of factors: the number of users, the type of transmission medium, the capabilities of the connected hardware, and the efficiency of the software.**

Performance is often evaluated by two networking metrics: throughput and delay.

Reliability

network reliability is **measured by the frequency of failure**, the time it takes a link to recover from a failure, and the network's robustness in a catastrophe.

Security

Data protection against corruption/loss of data due to:

Errors

Malicious users

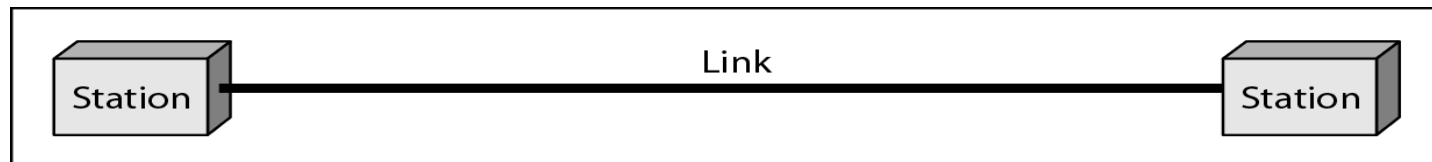
Type of Connection

A network is two or more devices connected through links.

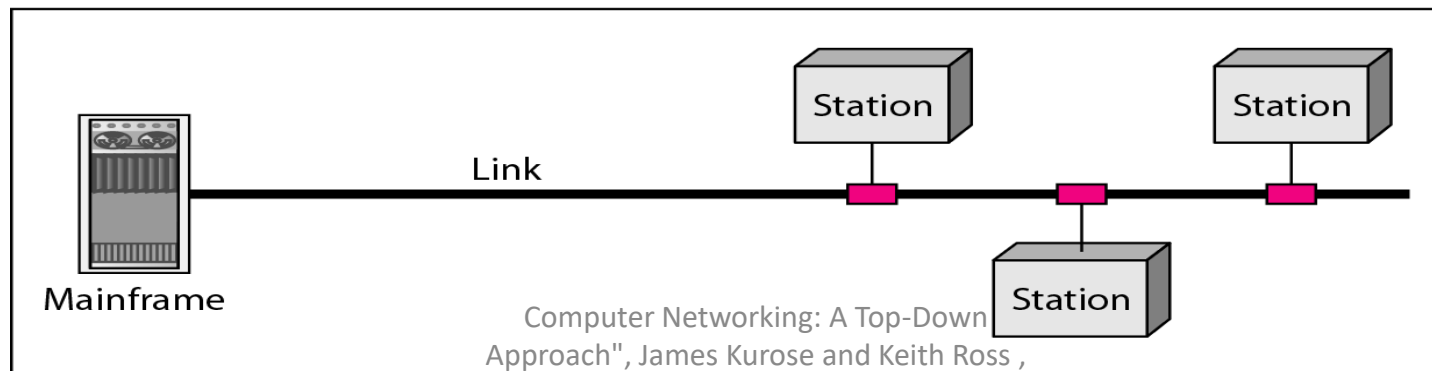
A **link** is a communications pathway that transfers data from one device to another.

There are two possible types of connections:

point-to-point and **multipoint**.



a. Point-to-point



b. Multipoint

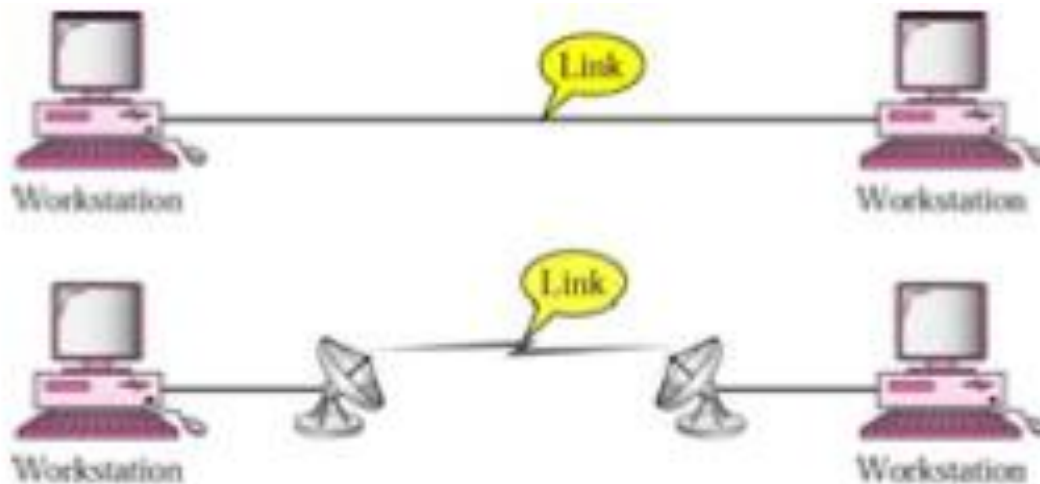
Computer Networking: A Top-Down Approach", James Kurose and Keith Ross ,

5th edition

Type of Connection – point to point

Point-to-point

- Provide a dedicated link between two devices.
- The entire capacity of the link is reserved for transmission between those two devices



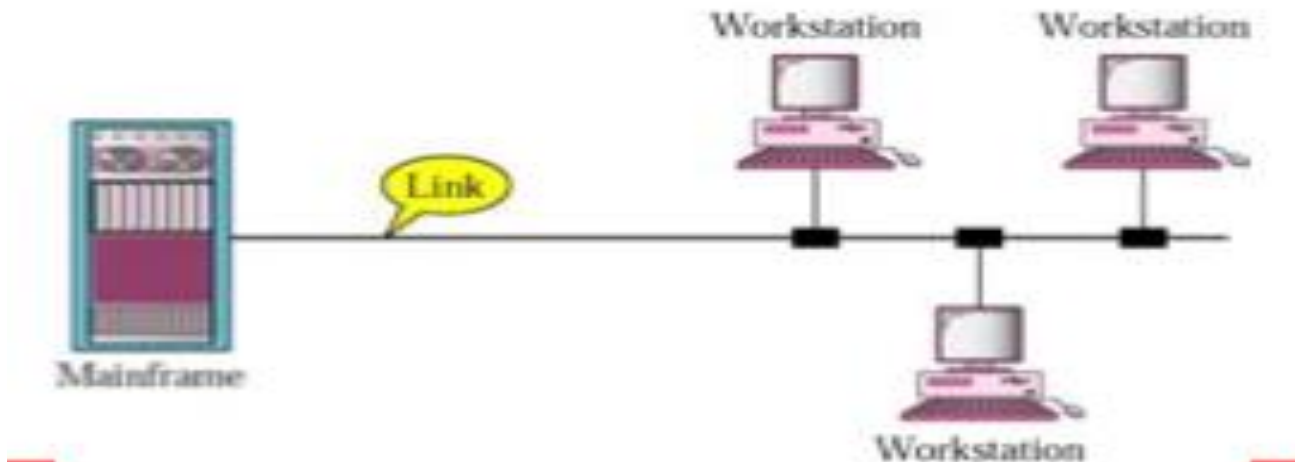
Type of Connection – Multipoint

A multipoint (also called multidrop) connection

Two or more devices share a single link

In a multipoint environment, **the capacity of the channel is shared**, either spatially or temporally.

If several devices can use the link simultaneously, it is a *spatially shared* connection. If users must take turns, it is a *timeshared* connection.

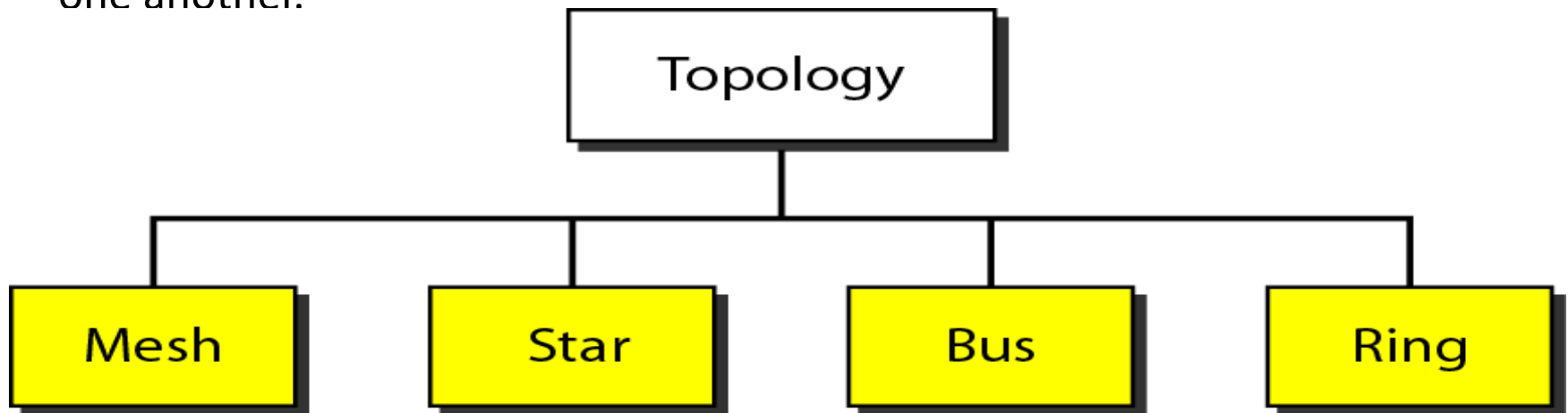


Network Topology

The term *network topology* refers to the way in which a **network is laid out physically**.

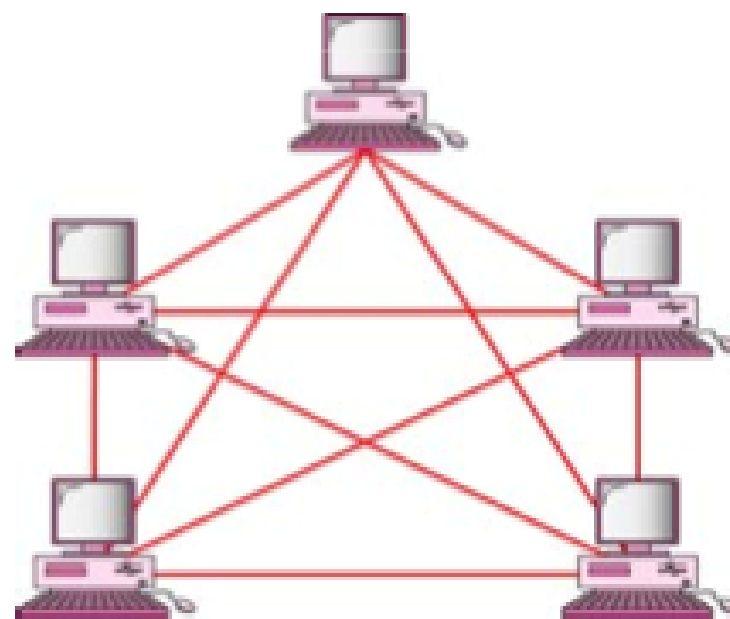
Two or more devices connect to a link; two or more links form a topology.

The topology of a network is the geometric representation of the relationship of all the links which linking devices (usually called nodes) to one another.



MESH Topology

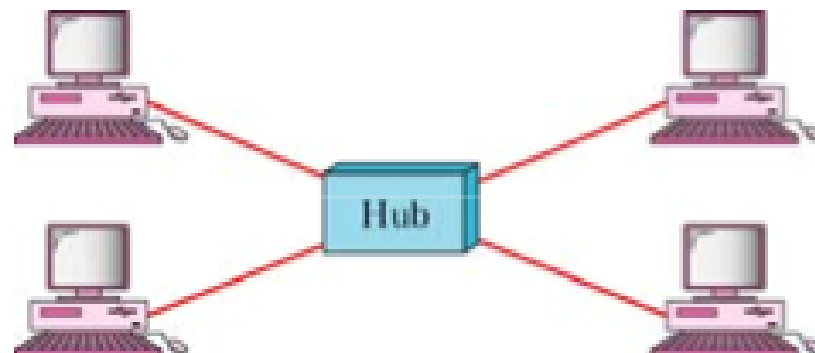
- Every device has a dedicated point-to-point link to every other devices
- Dedicated
 - Link carries traffic only between the two devices it connects
 - A fully connected mesh network has $n(n-1)/2$ physical channels to link n devices
 - Every device on the network must have $n-1$ input/output (I/O) ports
- Advantage
 - Less traffic, robust, secure, easy to maintain
- Disadvantage
 - Need more resource (cable and ports), expensive



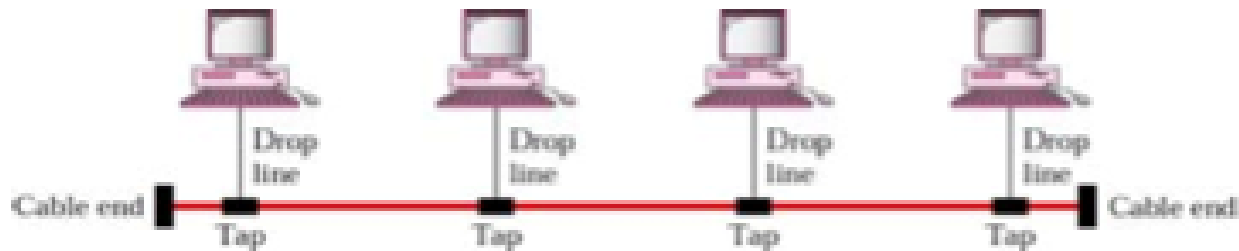
$n(n-1)/2$ physical links

STAR Topology

- Each device has a dedicated point-to-point link only to a central controller, usually called a hub.
- No direct traffic and link between devices
- Advantages
 - Less expensive
 - Easy to install and reconfigure
 - Robustness
- Disadvantage
 - Single point of failure

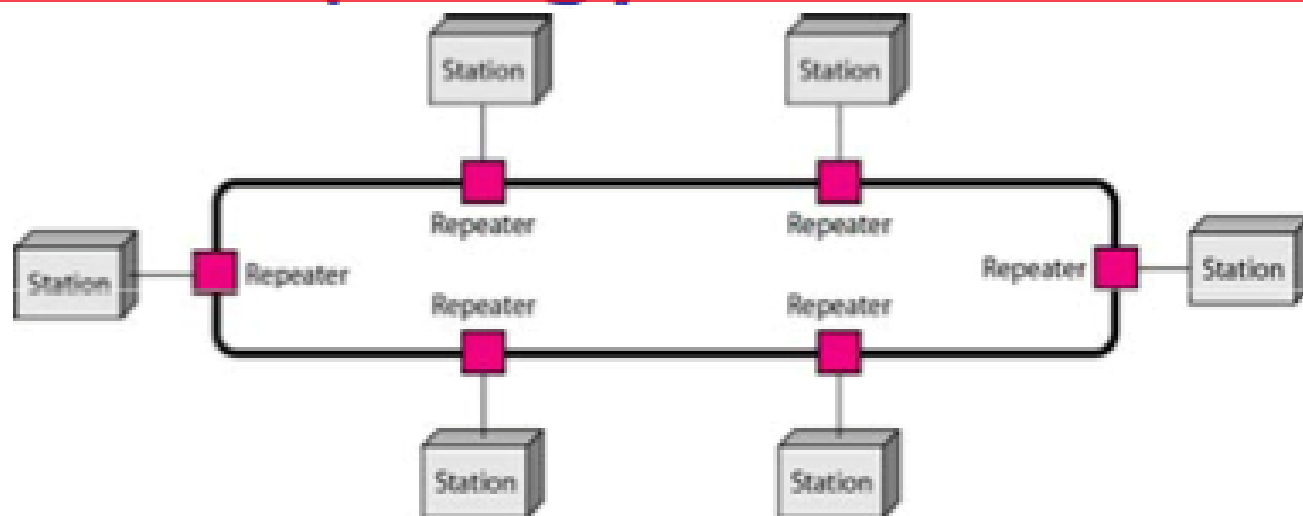


BUS Topology



- A multipoint topology
- All devices are linked through a *backbone* cable
- Nodes are connected to the bus cable by drop lines and taps.
 - Drop line
 - A connection running between the device and the main cable
 - Tap
 - A connector that either splices into the main cable or punctures the sheathing of a cable to create a contact with the metallic core
- Advantage:
 - Ease of installation
- Disadvantages:
 - Difficult reconnection and fault isolation
 - Broken or fault of the bus cable stops all transmission

RING Topology



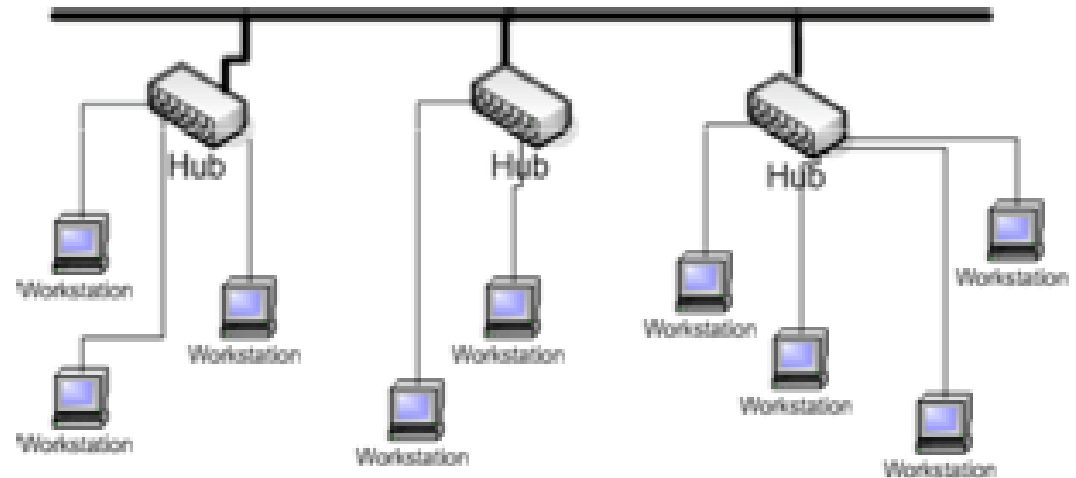
- Each device is dedicated point-to-point connection only with the two devices on either side of it
- A signal is passed along the ring in the direction, from device to device, until it reaches its destination
- Each device in the ring incorporates a repeater

- Advantages
 - Relatively easy to install and reconfigure
 - Fault isolation is simplified
- Disadvantage
 - Unidirectional traffic

Tree Topology

Tree topologies integrate multiple topologies together

Example: Tree topology integrates multiple star topologies together onto a bus



- Advantages:
 - Point-to-point wiring for individual segments.
 - Supported by several hardware and software vendors.
- Disadvantages:
 - 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.

Categories of Networks.

The category into which a network falls is determined by its **size**

1- Local Area Network (LAN)

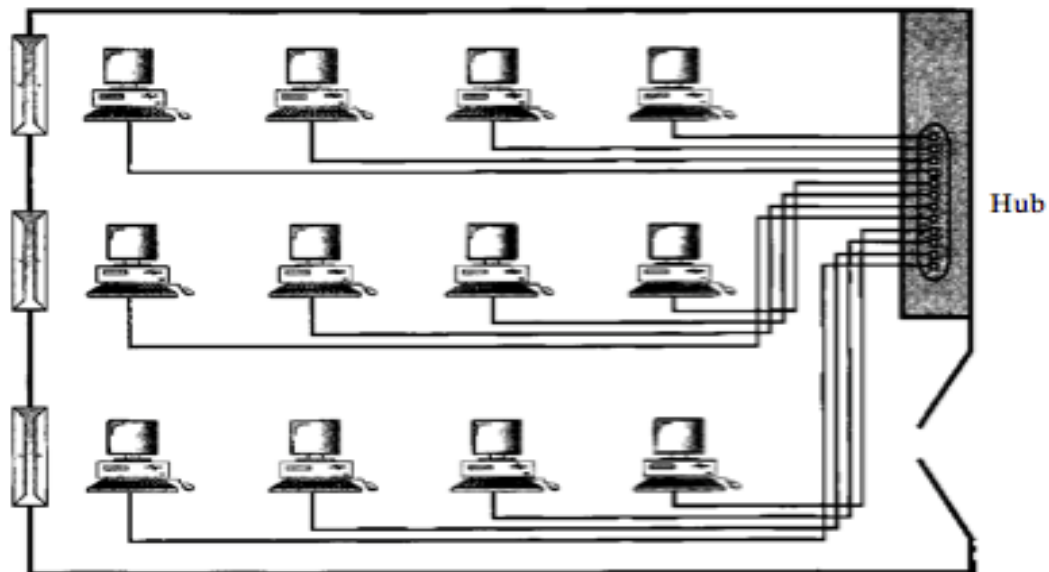
2- Metropolitan Area Network (MAN)

3- Wide Area Network (WAN)

Local Area Network (LAN)

A local area network (LAN) links the devices in a single office, building, or campus

-LAN size is limited to a few kilometers.

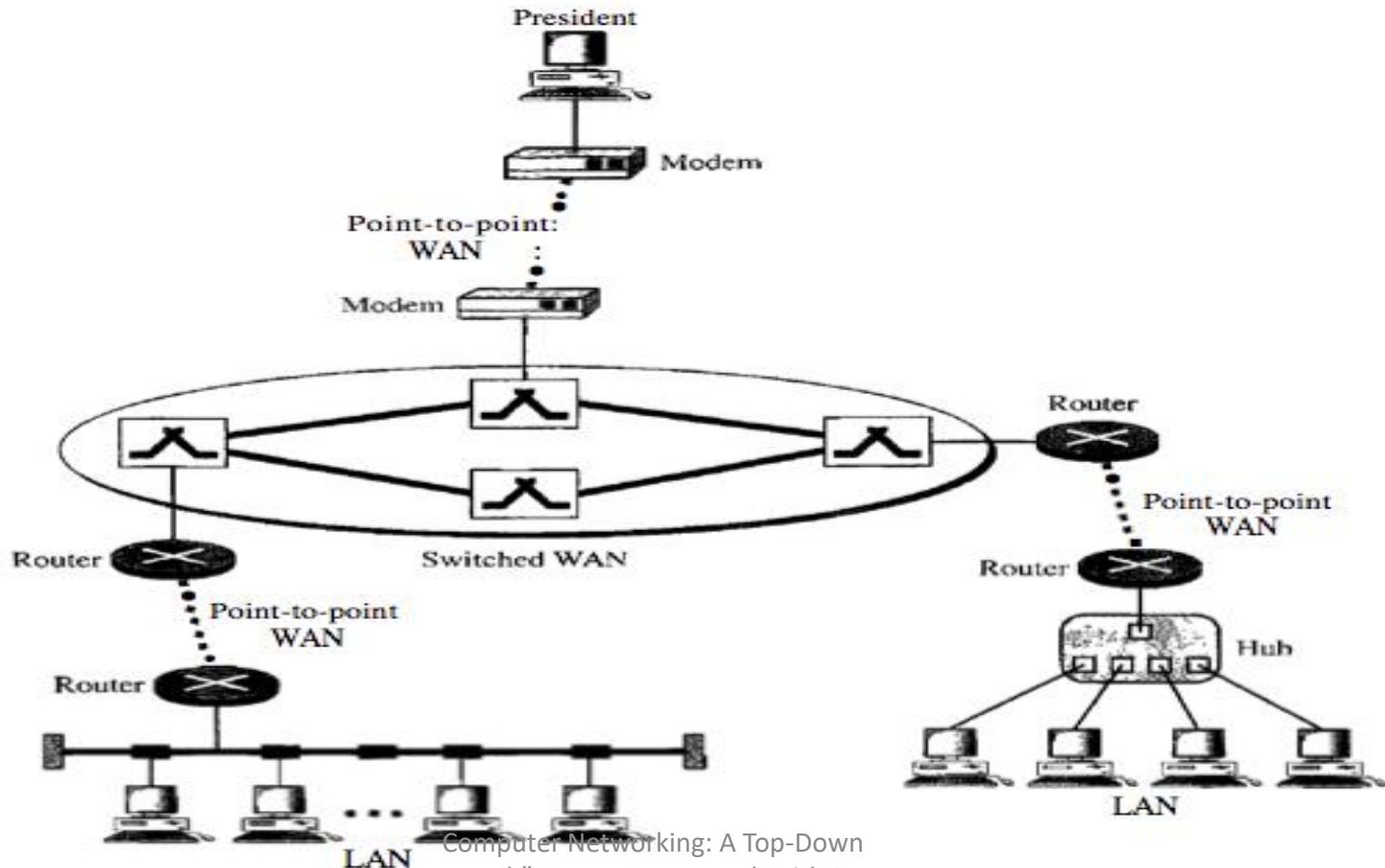


Metropolitan Area Network (MAN)

- A metropolitan area network (MAN) is a network with a size between a LAN and a WAN. It normally covers the area inside a town or a city.
- MAN size is limited to 50 kilometers.
- A good example of a MAN is the part of the telephone company network that can provide a high-speed DSL line to the customer

Wide Area Network (WAN)

- A wide area network (WAN) covers large geographic areas that may comprise a country, a continent, or even the whole world.



END OF LECTURE



Participation Time



Reference

Computer Networking: A Top-Down Approach", James Kurose and Keith Ross ,
5th edition