Computer Networks I

3rd Year/ 2nd semester

Lecture No. 1

Overview of Data Communications and Networking

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Data Communication

Communication:

sharing information. Sharing can be local (face to face) or remote (over distance)

Tele communication:

(telephone, television, telegraphy) means communication at a distance remote communication. (tele: far)

Data communication:

exchange of data between two devices via transmission medium (wire cable)

Communicating devices

made up of : Hardware (physical equipment) and software

Data Communication

Effectiveness of data communication depends on :

- **Delivery : التوصيل**

System must deliver data to **correct destination**. Data must be received by only intended device or user.

- **Accuracy: الدقة**

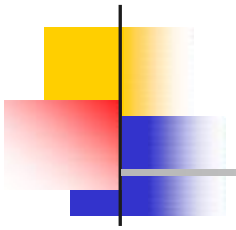
The system must deliver data accurately

- **Timeliness:التوقيت**

the system must deliver data in a timely manner. Data delivered later are useless.

- **Jitter: الاختلاف في وصول حزم البيانات**

Variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets.

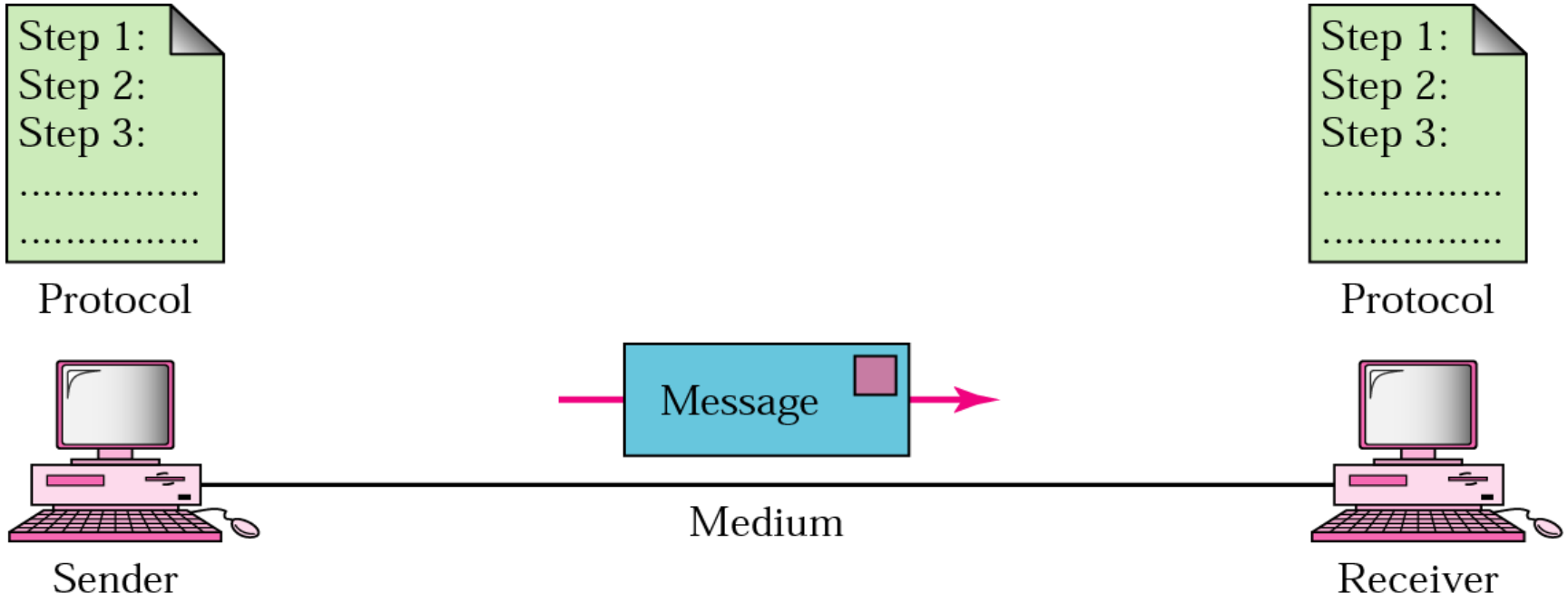


Data Communication

- Components
- Data Representation
- Direction of Data Flow

Components

Five components of data communication



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

Data representation

Text, numbers, images, audio, and video

Text:

- **ASCII:** 7-bit patteren(128 different symbols)
- **Extended ASCII:** 8-bit pattern (with an extra 0 at left from 00000000 to 0111111
- **Unicode**: 32 bits pattern (65,536,216) symbols, which is definitely enough to represent any symbol in the world.

Numbers: represented by bit pattern (binary number)

Images : represented by matrix of pixels (picture element), small dot. The size of pixel represent the resolution.

Audio: represent sound by continuous (analog) signal

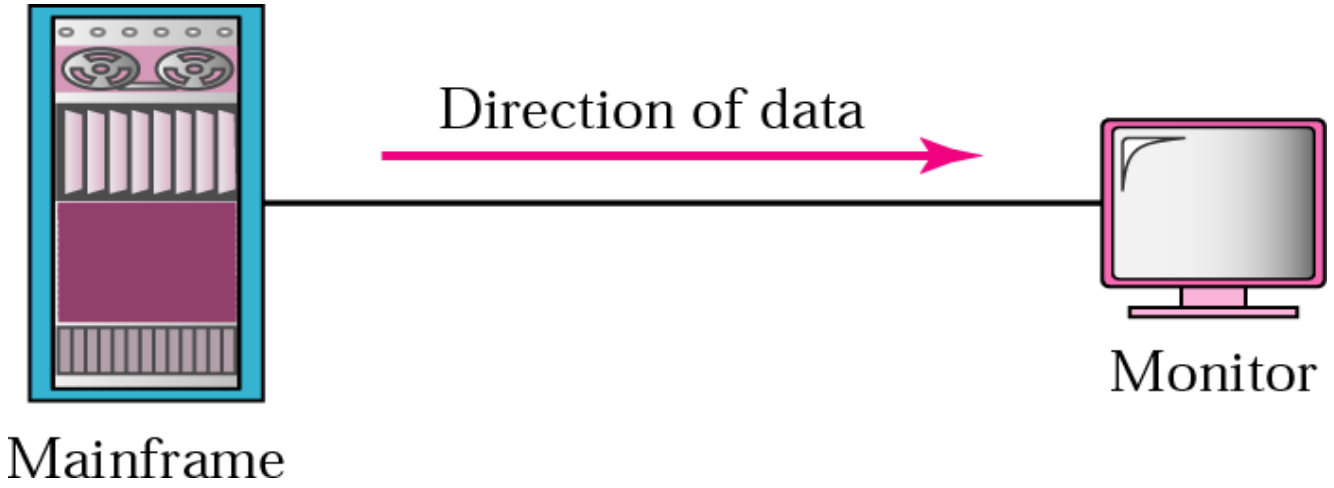
Video: can be analog or digital signal

Direction of data flow

Simplex, half duplex and full duplex

1. Simplex:

communication is unidirectional. (one-way-street). Only one of the two devices on a link can transmit; the other can only receive

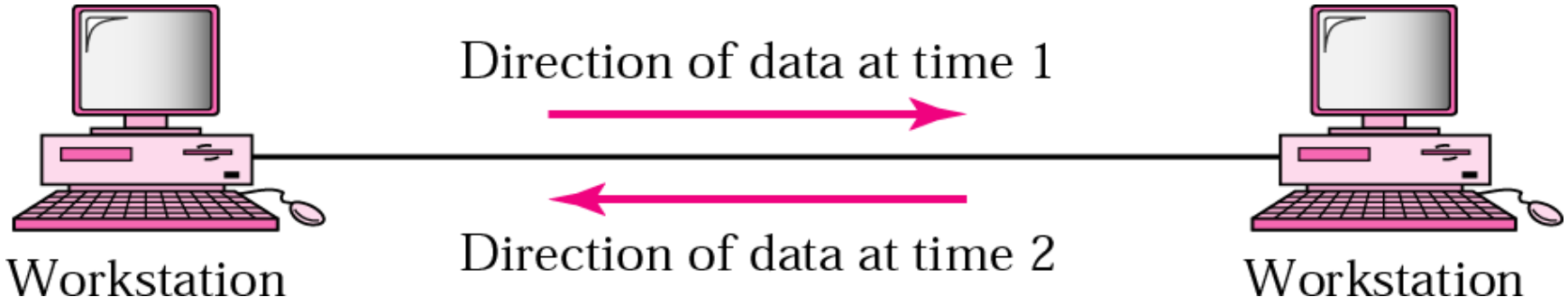


Ex: As Keyboard (only input) and monitors only output)

Direction of data flow

2. Half duplex:

Each station can both transmit and receive , **but not at the same time.** When one device is sending the other can receive and vice versa. one- lane road with two direction).

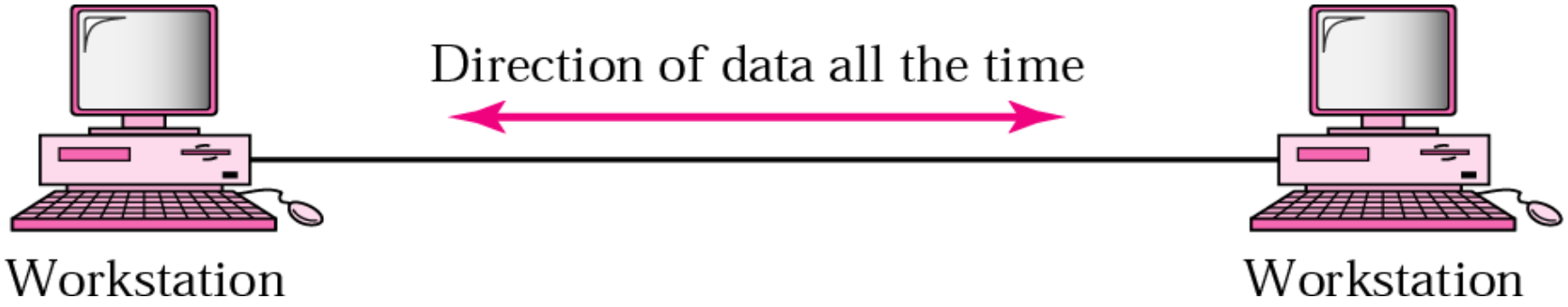


Direction of data flow

3. Full-Duplex:

Both stations can transmit and receive simultaneously. (telephone network)

Like two way street with traffic flowing in both directions at the same time.



Signals going in either direction share the capacity of the link in two ways:

- Either the link must contain two physically separate transmission paths one for sending and other for receiving.

- Capacity of the channel is divided between signals traveling in both direction

Networks

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

  Performance

  Reliability

  Security

- Physical Structures

  Type of connection

  Physical topology

- Categories of Networks

  (LAN, MAN and WAN)

Network criteria

1. Performance:

The performance depends on :

1.Number of user.

2.Type of transmission media.

3.Capabilities of connected hardware and the efficiency of software.

2. Reliability

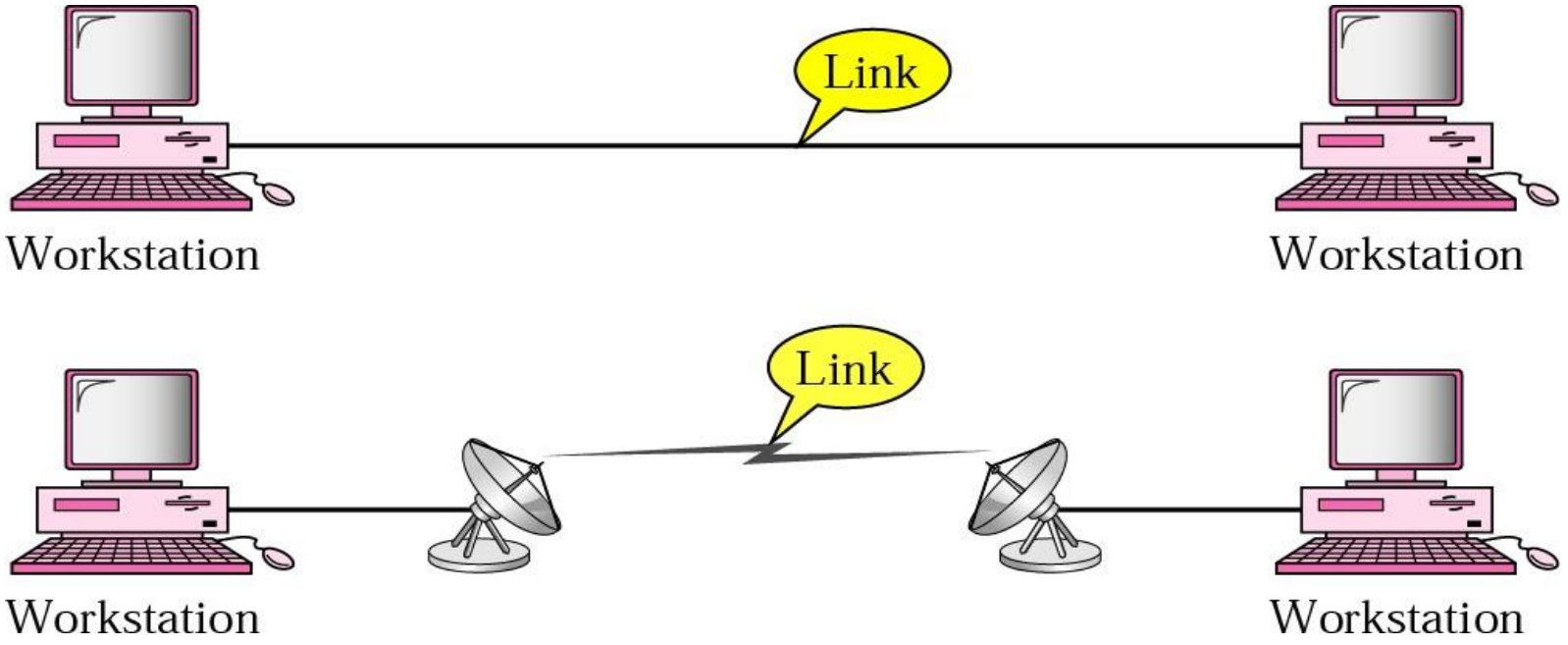
Measured by frequency of failure, the time it takes to recover from failure, and network's robustness in a catastrophe.

3. Security: Protecting data from unauthorized access.

Physical Structures: Type of connection

1. Point –to-point

Dedicated link between two devices. Most of them uses an actual length of wire or cable to connect the two ends but other options ,such as microwave satellite are possible.



change T.V channel by infrared remote control is **point- to -point connection**

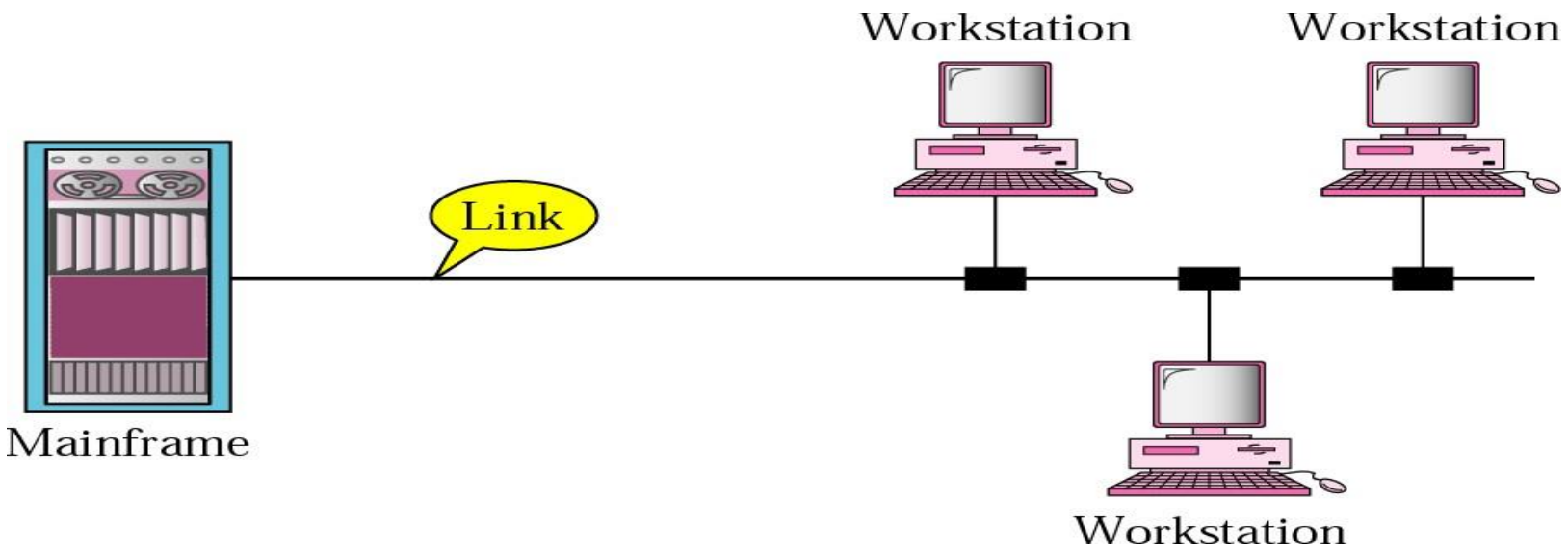
Physical Structures: Type of connection

2. Multipoint (multidrop) connection:

more than two devices share a single line. The capacity is shared either spatially or temporally.

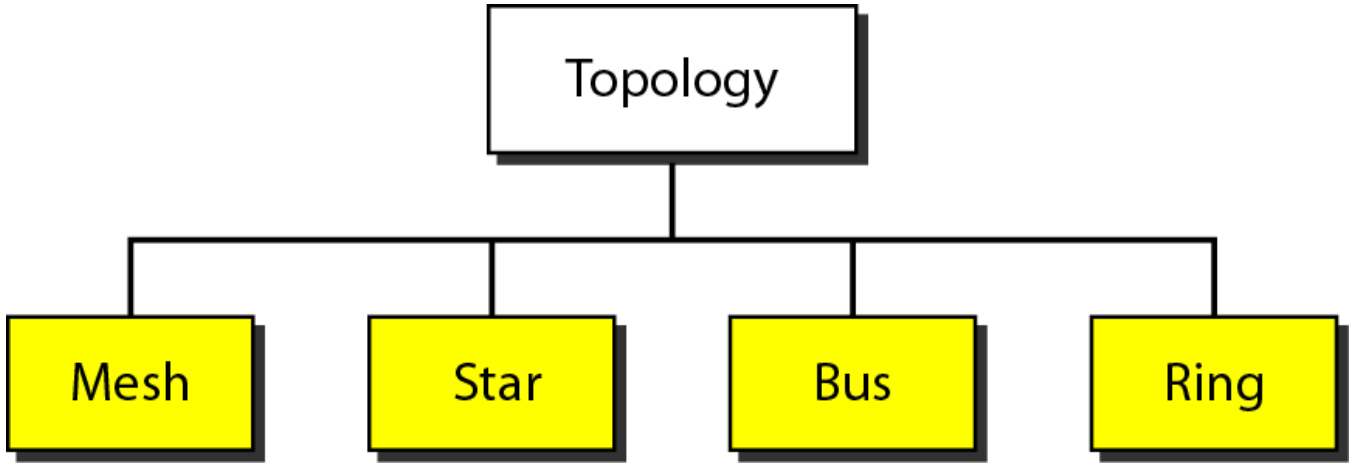
Spatially: Several devices can use link simultaneously

Temporally: Users take turns , it is a timeshared



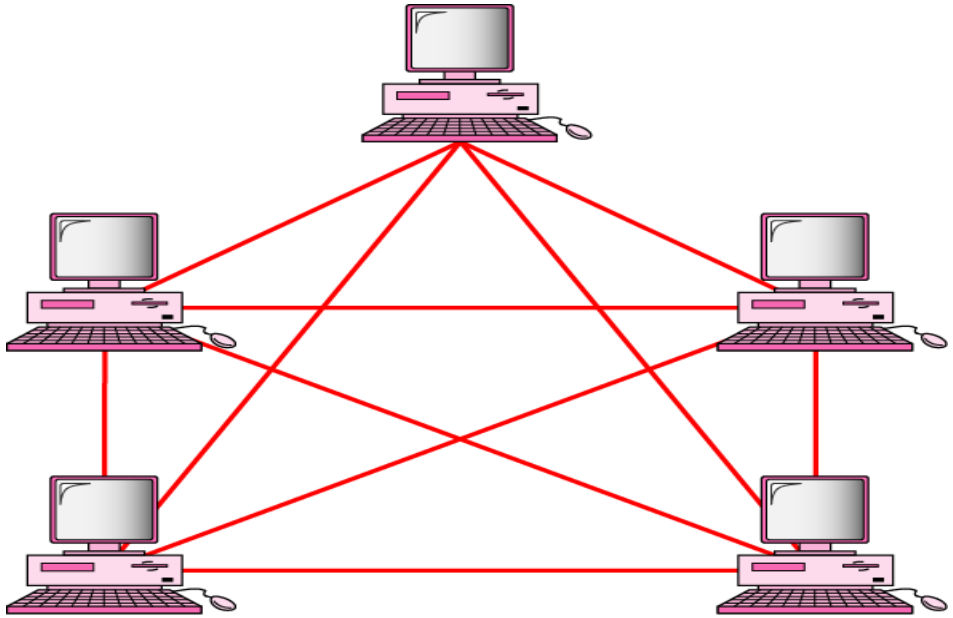
Physical Structures :physical topology

- The way in which a network is laid out physically.
- It is the geometric representation of the relationship of all the links and linking devices (nods) to one another.



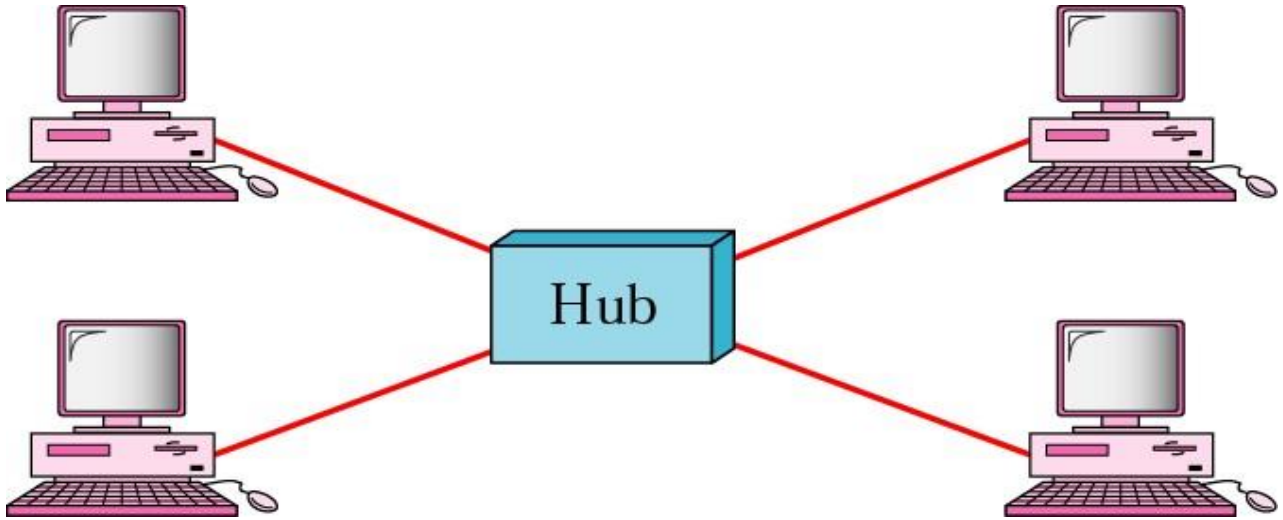
Fully connected mesh topology (for five devices)

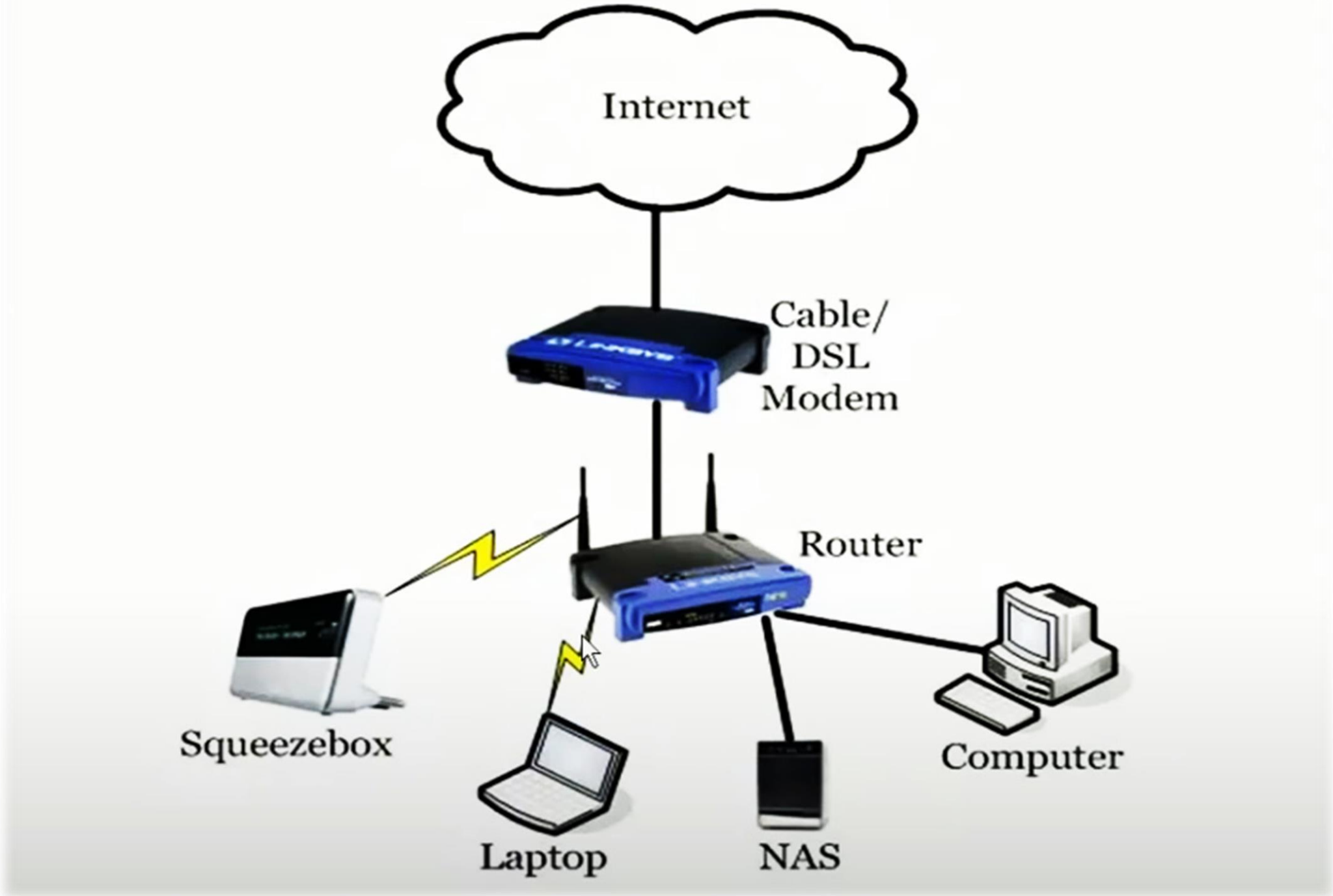
- Every device has a dedicated point-to-point link to every other devices
- Fully connected mesh network has $n(n-1)/2$ physical connection to link n devices.
- Every device on the network must have $n-1$ input/output (I/O) ports



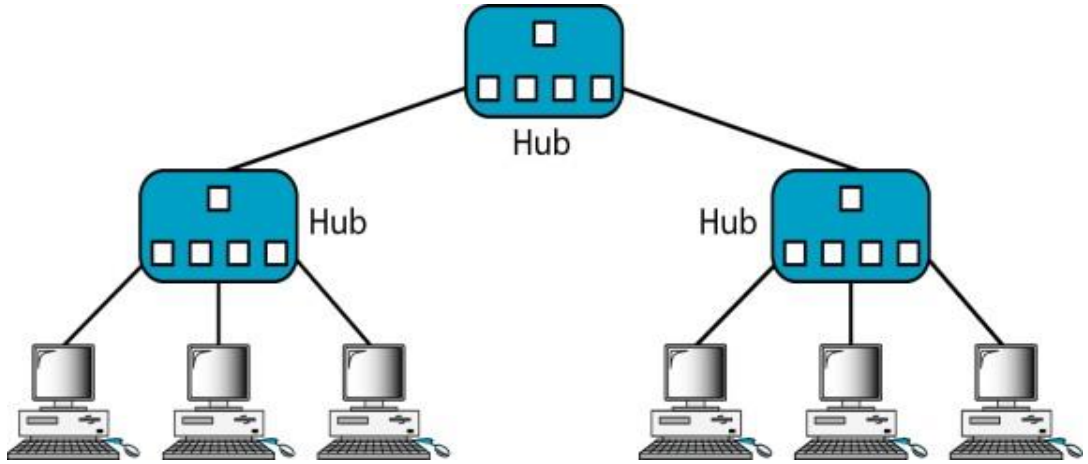
Star topology

- Each device has a dedicated point-to-point link only to a central controller (hub)
- Unlike a mesh , a star topology does not allow direct traffic between devices, if one device want to send data to another , it send it to the hub, which send it to other device




Internet
Cable/
DSL
Modem
Router
Squeezebox
Laptop
NAS
Computer

Tree topology : Is a variation of star



Not every device plugs directly into the central hub. The majority of devices connect to secondary hub that in turn is connected to the central hub

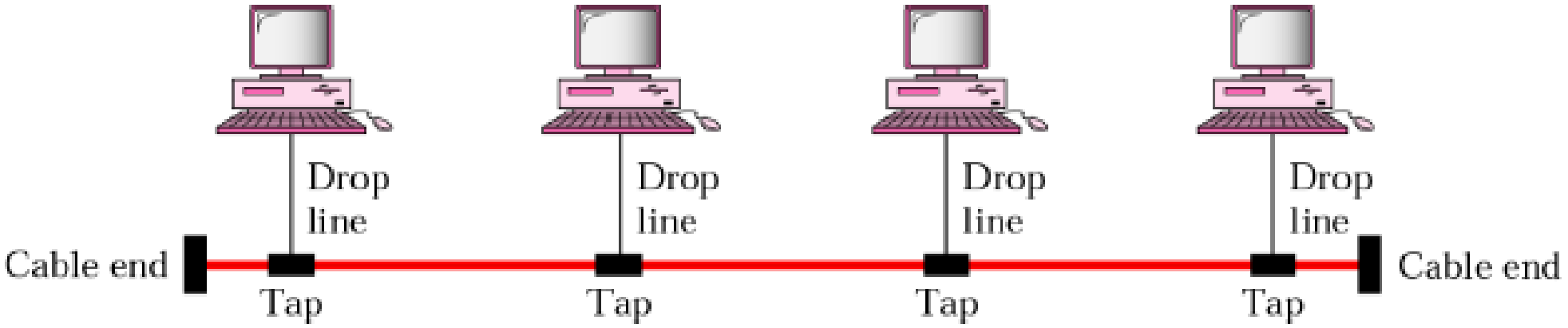
The advantages and disadvantages of tree topology are generally the same as those of star .The addition of secondary hubs bring more advantage:

- Allow more devices to be attached to a single central hub, therefore increase the distance a signal can travel between devices.

- Example of tree : Cable TV technology where the main cable from the main office is divided into main branches and each branch divided into smaller branches and so on.

Bus topology

•**Multipoint connection. Acts as a backbone to link all the devices in a network.**

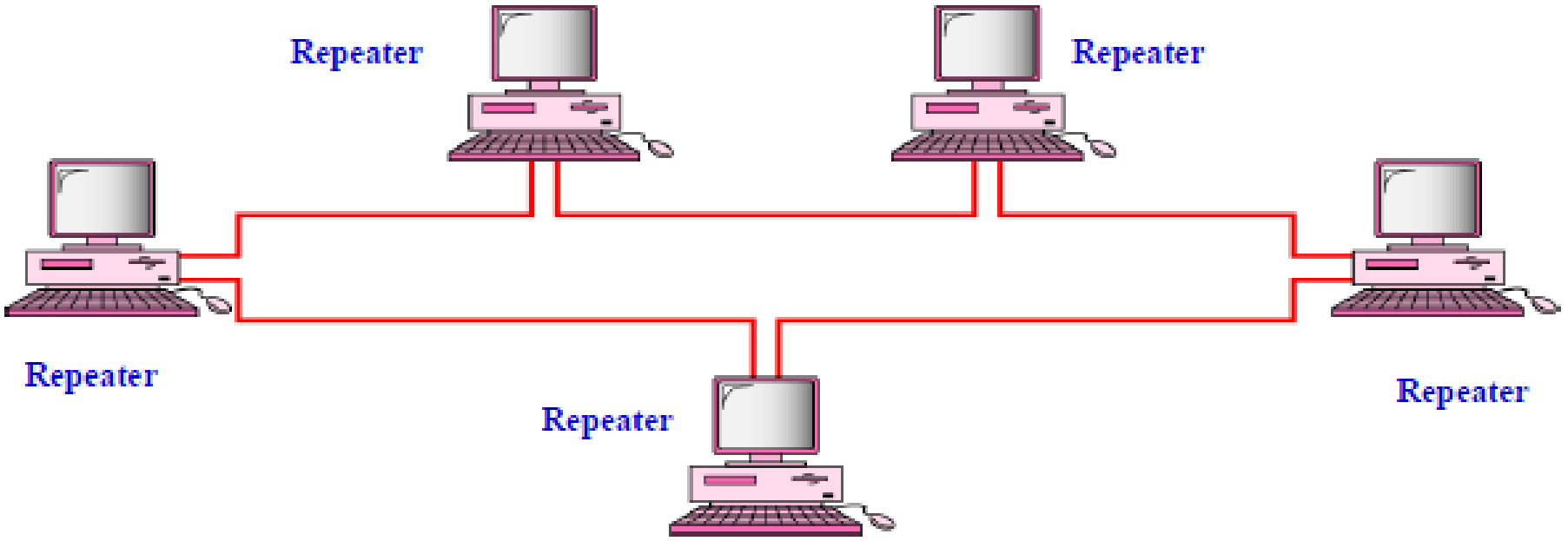


There is a limit on the number of taps a bus can support and on the distance between those taps

As a signal travels along the backbone, some of its energy is transformed into heat, therefore, it becomes weaker and weaker as it has travel farther and farther

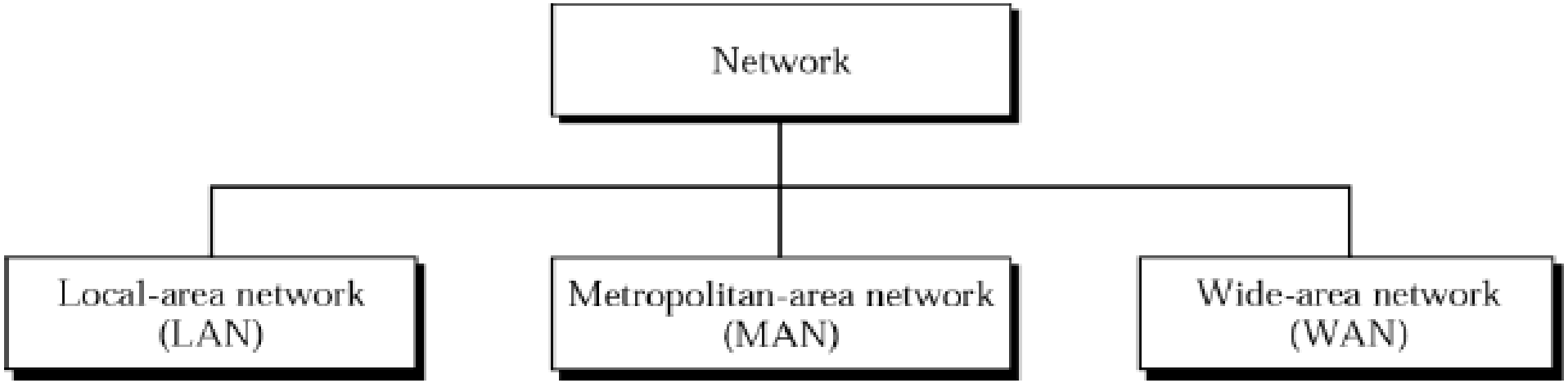
Ring topology

- Each device has a dedicated point-to-point connection only with the two devices on either side of it
- A signal is passed along the ring in one direction from device until it reaches its destination.
- Each device in the ring incorporate as repeater
- Repeater :regenerates the signal
- it receives a weakened signal, creates a copy, bit for bit, at the original strength



Networks categories

Network category is determined by its size, ownership, the distance it cover and its physical architecture.

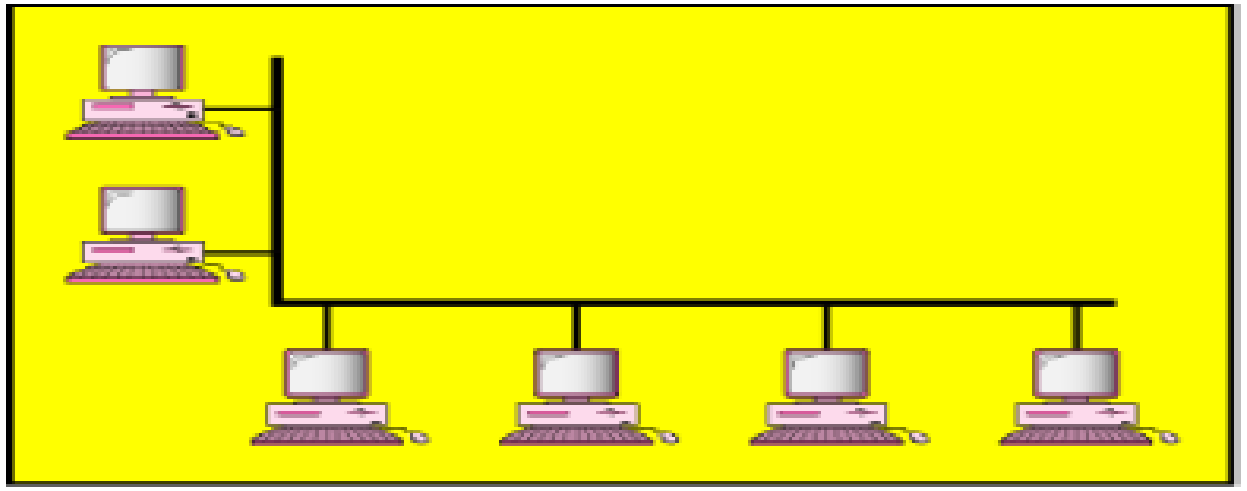


LAN

- Privately owned and links the devices in a single office, building or campus
- LANs designed to allow resources to be shared between PCs or workstations. The resources may be H.W (e.g. printer) or S.W(applications program) or data.
- In LANs one of the computers has a large capacity drive and becomes a server to other clients.
- S/W stored on server and used as needed by the whole group.
- LAN size determined by licensing restrictions(No of users per copy of S/W)
- LAN use only one type of transmission medium.
- The most common LAN topologies are bus, ring and star.
- Traditionally LAN have data rates in the 4 to 16 Mbps. Today Speed can reach to 100Mbps or 1000MBps(1G).

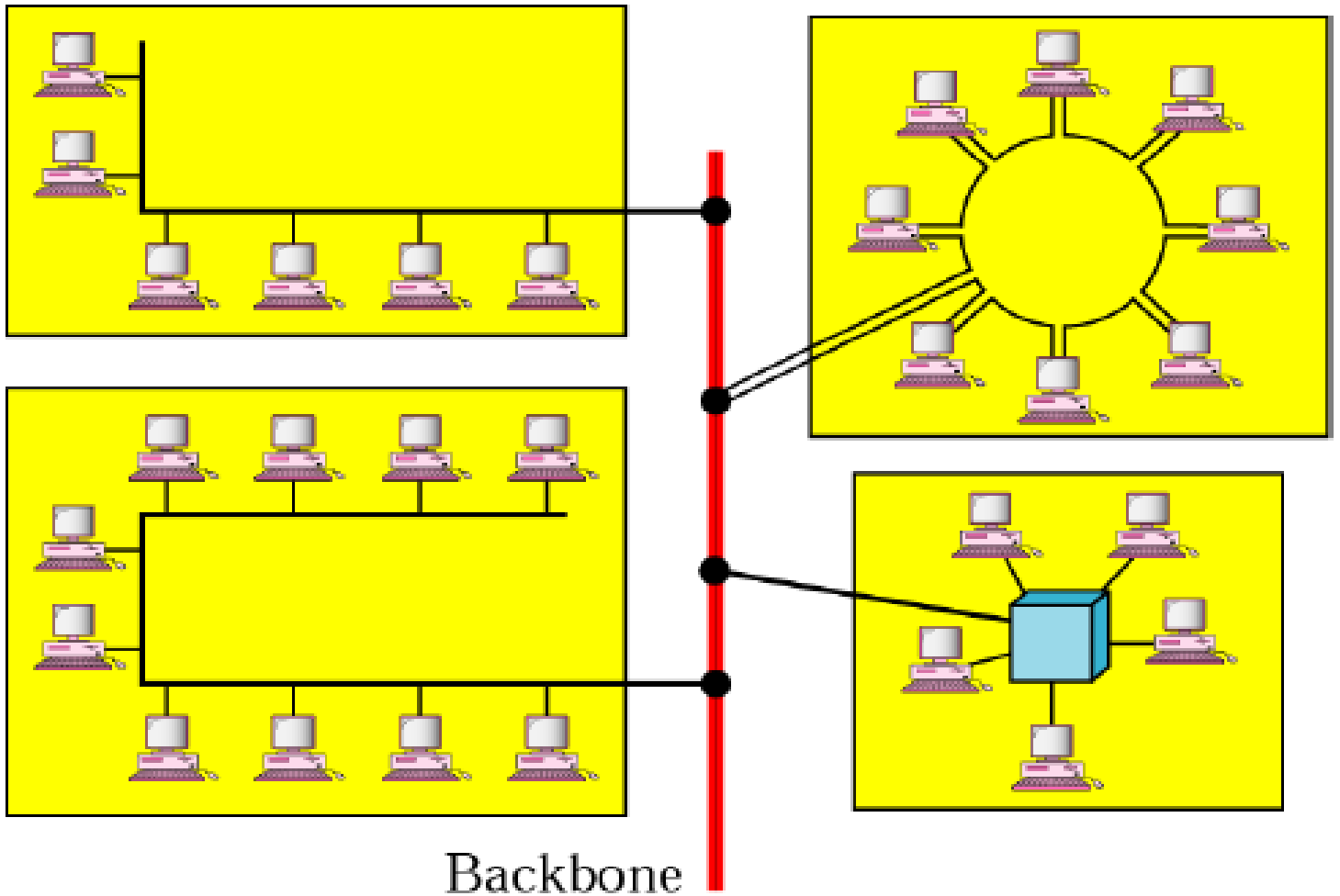
Single building LAN

- Used in business environments, links a workgroup of task-related computer.



a. Single-building LAN

Multiple -building -LAN



b. Multiple-building LAN

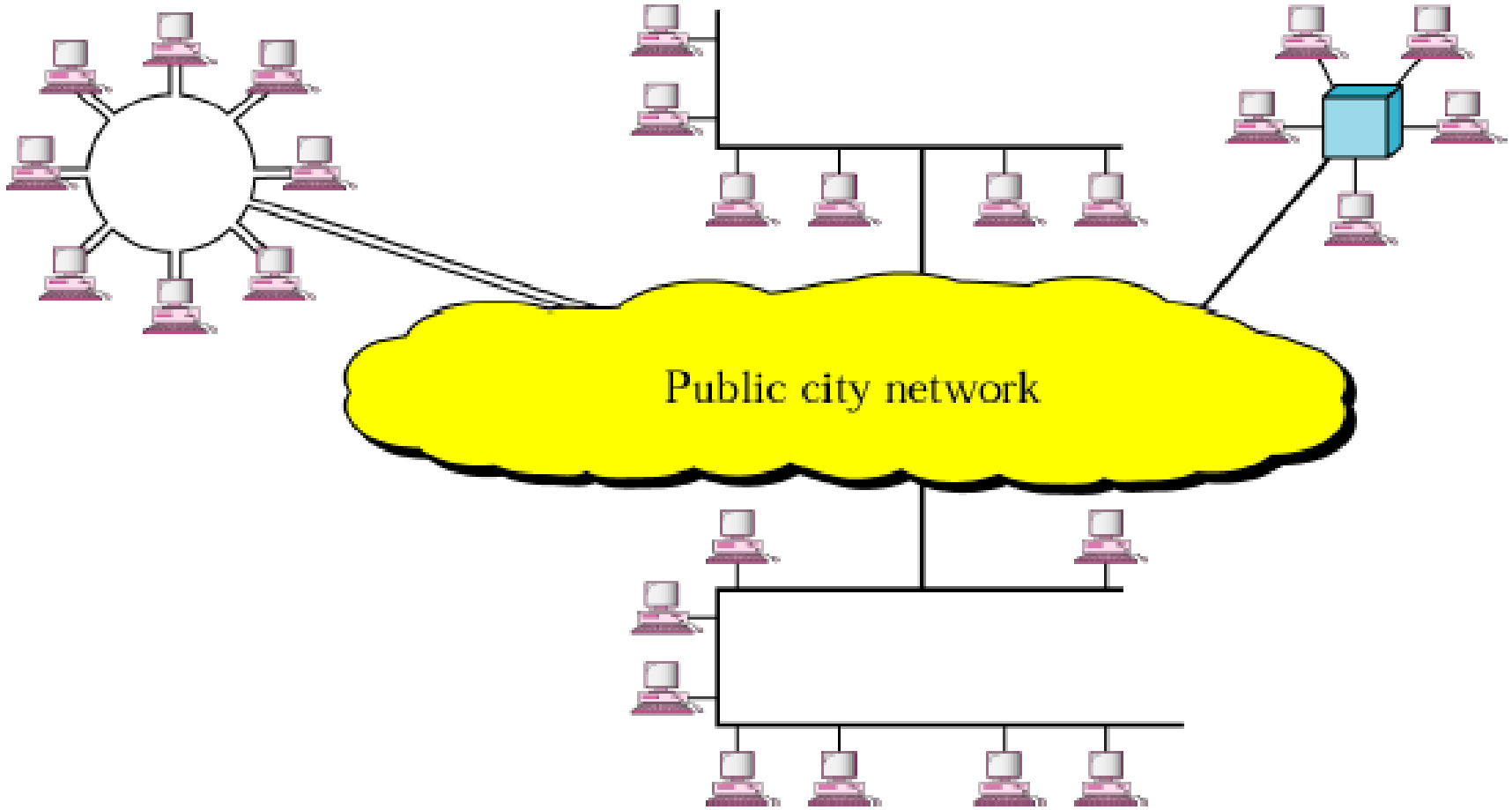
MAN (metropolitan)

- Owned by private company or it may be a service provided by public company (such as local tel.-company)
- Extended over an entire city.
- May be single network such as a cable television network, or it may be connected number of LANs into a large network so that resources may be shared LAN-TO- LAN.

Examples:

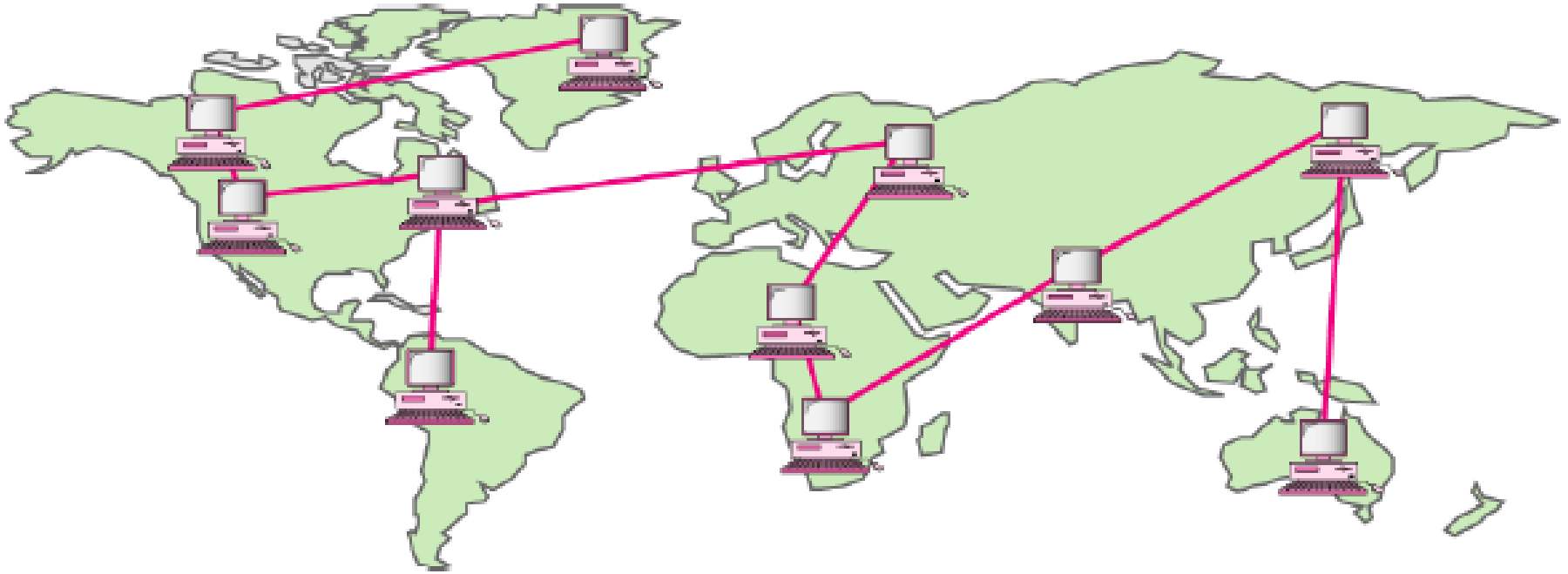
- Company can use MAN to connect the LANs in all its offices throughout the city.
- A part of the telephone line network that can provide DSL line to the customer

MAN



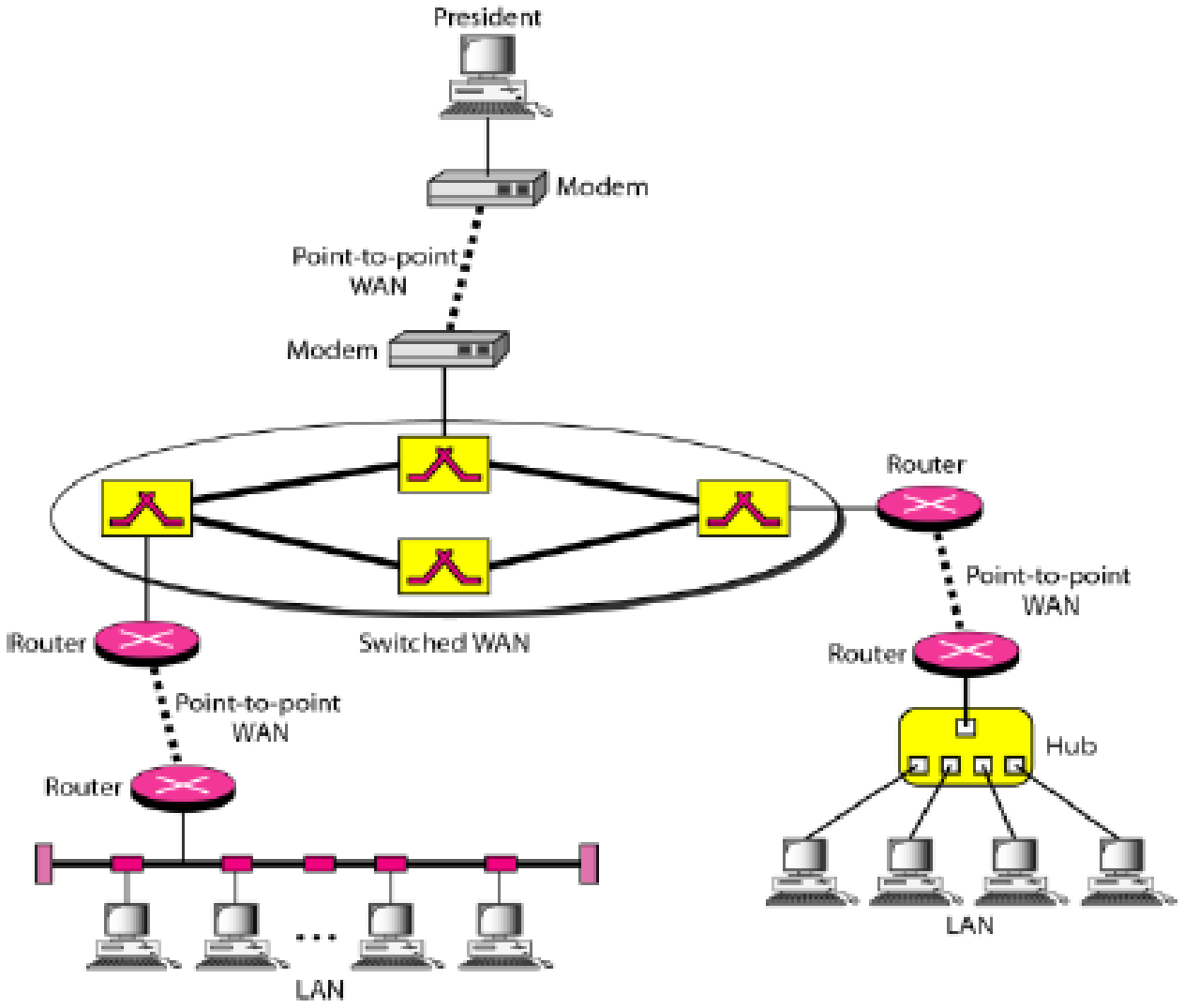
WAN

- Provides long distance transmission of data, voice , image and video information over large areas (country or whole world)
- In contrast to LAN, WAN may utilize public or private communication equipments or combination



Interconnections of networks :internetwork

An internet (small i) is two or more networks that can communicate with each other.



Protocols and *Standards*.

Protocol is synonymous with rule.
Standards are agreed-upon rules.

Protocols

- Syntax → format of the data
- Semantics → meaning of each section
- Timing → when data should be sent and how fast.

Standards

- De facto → by fact (not approved as a standard) بحكم الواقع
- De jure → by Law (approved) بحكم القانون

Protocols and Standards.

Standards Organizations

- International Organization for Standardization (ISO)
- International Telecommunication Union - Telecommunication Standards (ITU-T)
- American National Standards Institute (ANSI)
- Institute of Electrical and Electronics Engineers (IEEE)
- Electronic Industries Association (EIA)

Thank you for listening

Taqwa Altameemi