Computer Networks

DATA COMMUNICATIONS

Data communications are the exchange of data between two nodes via some form of transmission medium. The term *telecommunication* means communication at a distance. The word *data* refers to information presented in whatever form is agreed upon by the parties creating and using the data.
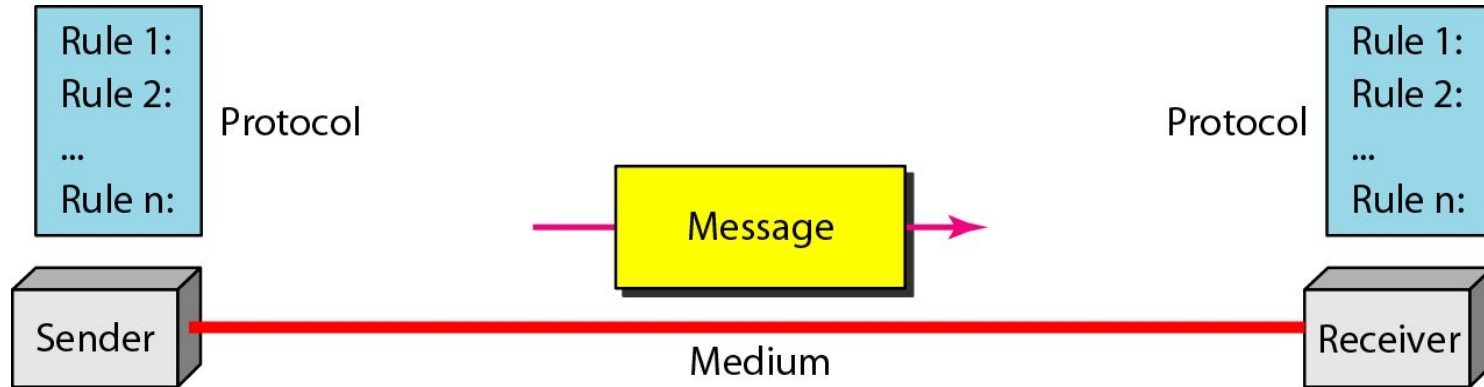
Effectiveness of Data Communication system:

Delivery
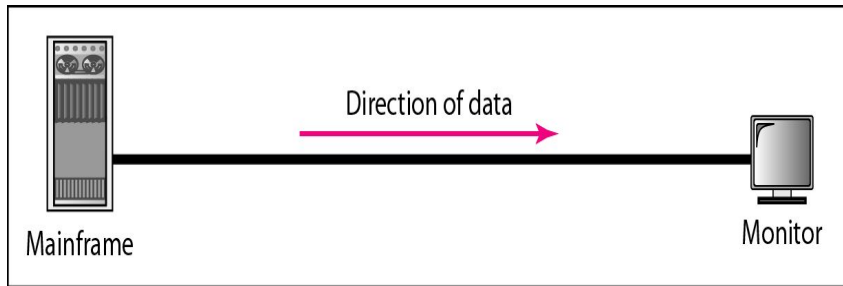**Accuracy**
Timeliness
Jitter

Five components of data communication

Data Representation

- Text (set of bit pattern called code)
- Number (bit pattern)
- Images (bit pattern ,matrix of pixel, RGB)
- Audio (continuous not discrete)
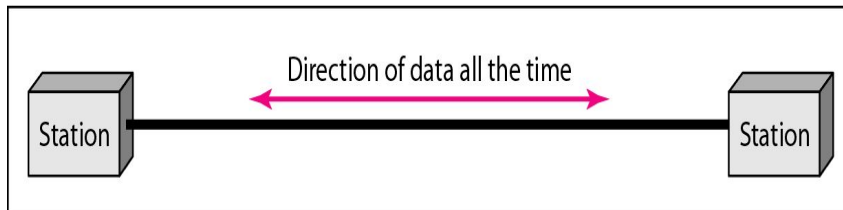- Video (continuous e.g. TV camera, combination)

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

Direction of data

Mainframe   Monitor

a. Simplex

Direction of data at time 1

Station   Station

Direction of data at time 2

b. Half-duplex

Direction of data all the time

Station   Station

c. Full-duplex

- Simplex mode can use entire capacity of channel to send data.

- Half Duplex mode can use entire capacity of channel to send data for each direction.

- Capacity of channel is divided between signal travelling in both directions.

1-2   NETWORKS

A *network* is a set of 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.

Distributed Processing
Network Criteria
Physical Structures
Network Models
Categories of Networks
Interconnection of Networks: Internetwork

Distributed Processing

- Task is divided among multiple computers.
- Separate computer handle subset of task.
- Secure (authentication)
- Data prevention
- Efficient

Network Criteria

- A network must be able to meet certain criteria .The most important of are:
- Performance (transit time,response time) is often evaluated by throughput and delay.
- Factors:
- Number of users
- Type of transmission mdeium

Reliability

- Reliability is measured by:
- Frequency of failure
- Time it takes a link to recover from failure
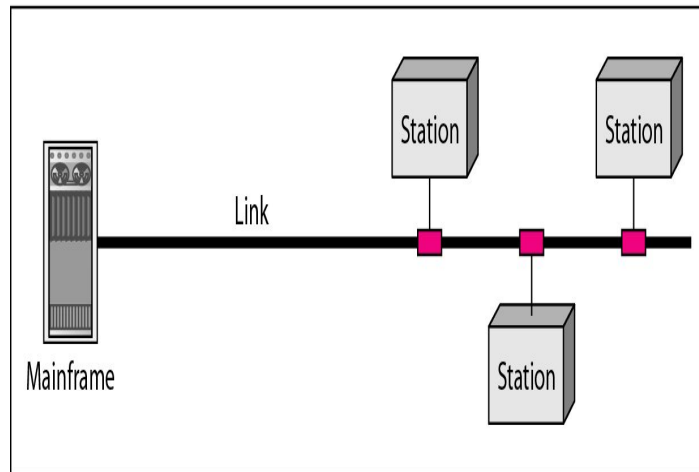- Network robustness

Security

- Protection from unauthorized user
- Encryption
- Integrity
- Protecting data from damage
- Developing policies and procedures for data recovery from breaches

Types of connections: point-to-point and multipoint
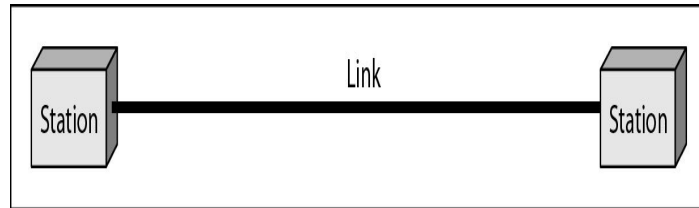
a. Point-to-point

b. Multipoint

- Dedicated link btw devices,use entire capacity e.g tv remote ,satellite link
- More than two node share a single link
- Same time sharing (temporally shared)
- Takes turns (time shared connection)

Physical Topology

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

- Two or more devices connected to a link and two or more links form topology.

- Geometric relationship of all the links and linking devices.
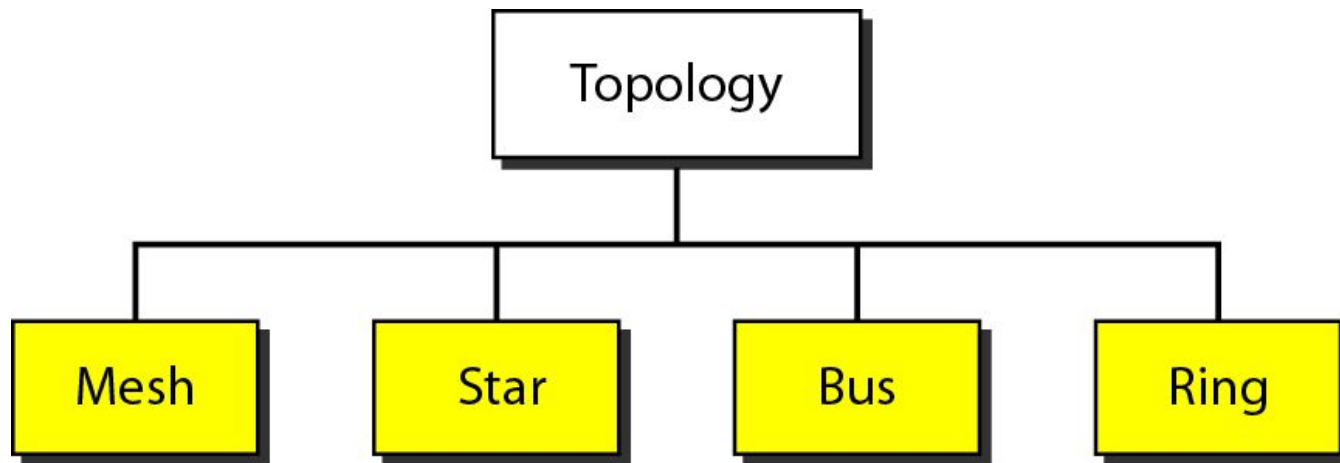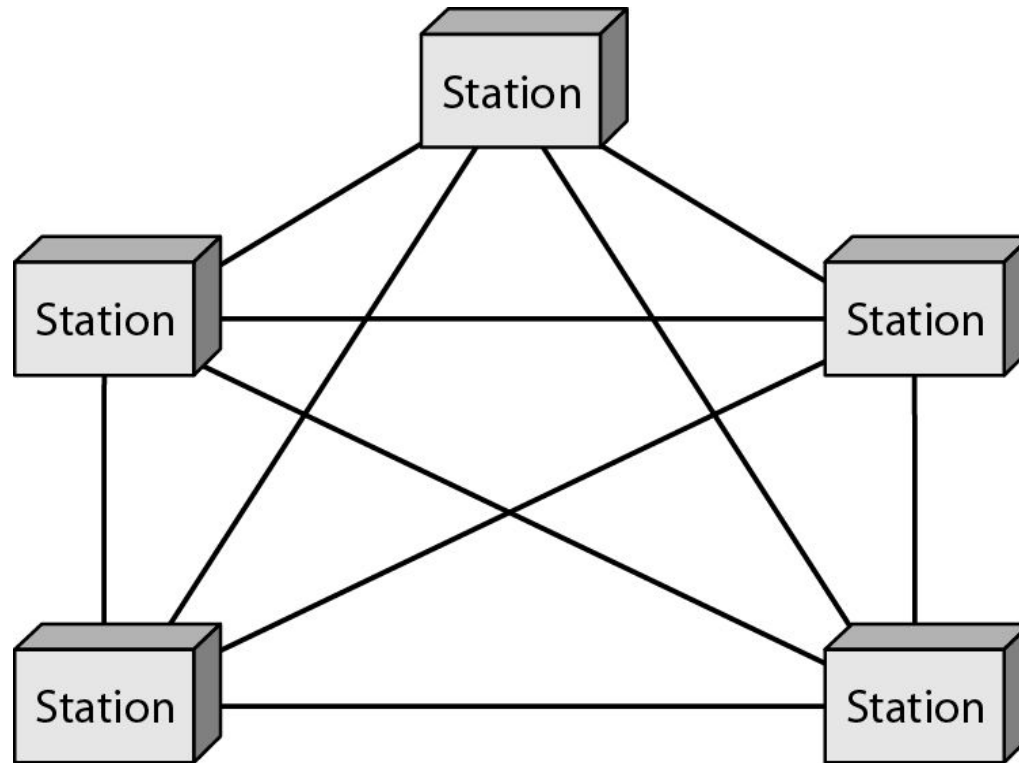
Categories of topology

# Figure 1.5 *A fully connected mesh topology (five devices)*

Mesh Topology

- Each device has dedicated point –to –point link.

- Each node must be connected to n-1 nodes.

- Total number of links n(n-1).if links are duplex then n(n-1)/2.

- Each node must have n-1 I/O ports.

Mesh Topology

- Advantages:
- Dedicated link (traffic load)
- Robust
- Privacy
- Fault Isolation
- Disadvantages:
- Number of I/O ports
- Number of links

# A star topology connecting four stations
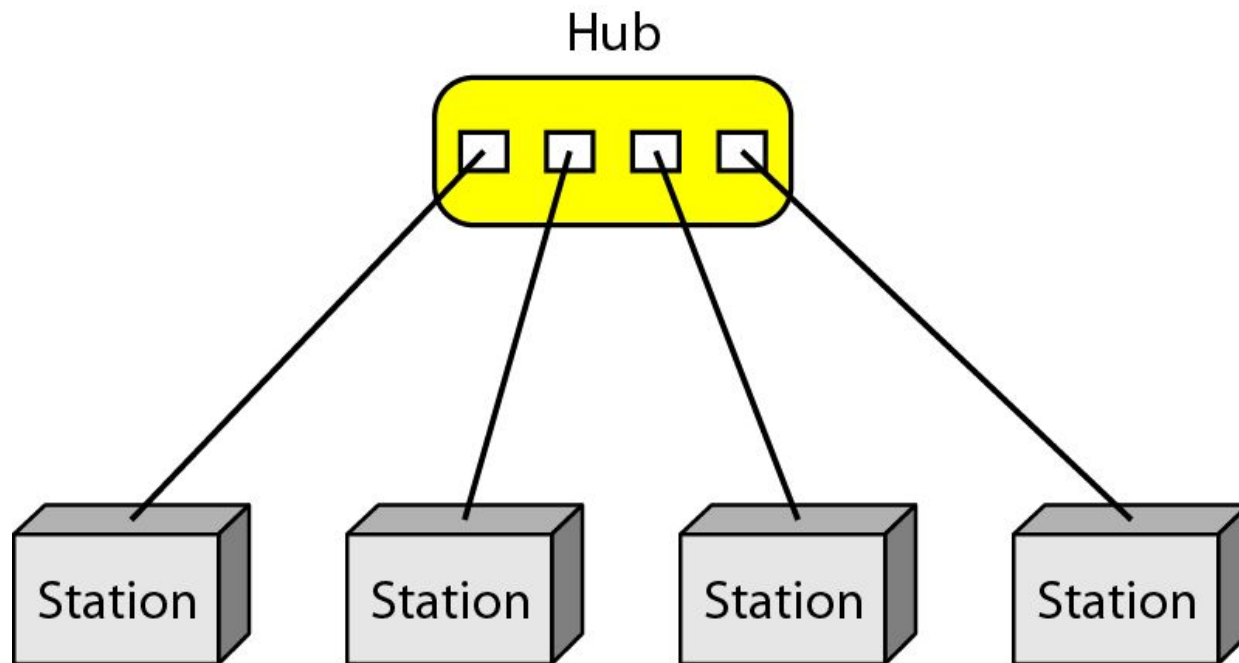
Star Topology

- Each device has dedicated point-to-point link with central hub.

- Hub acts as an exchange.

- Less expensive than mesh.

- Far less Cabling .each device require one i/o port

- Robust (hub detects link failure).

- East addition and deletion.

- Dependency of whole topology on one single point, the hub.
- It requires less cabling than mesh that is why it is used in LAN.

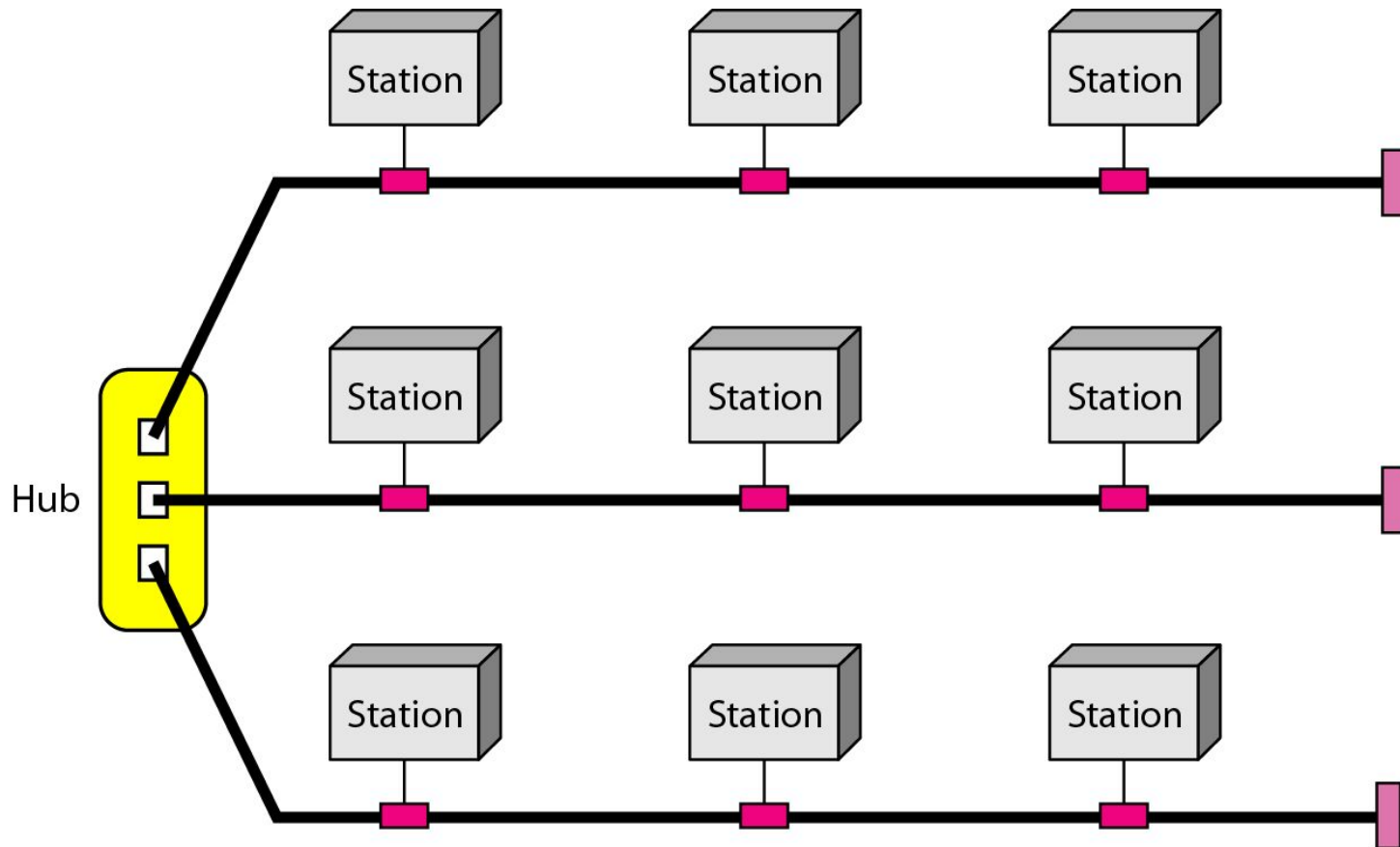# A bus topology connecting three stations
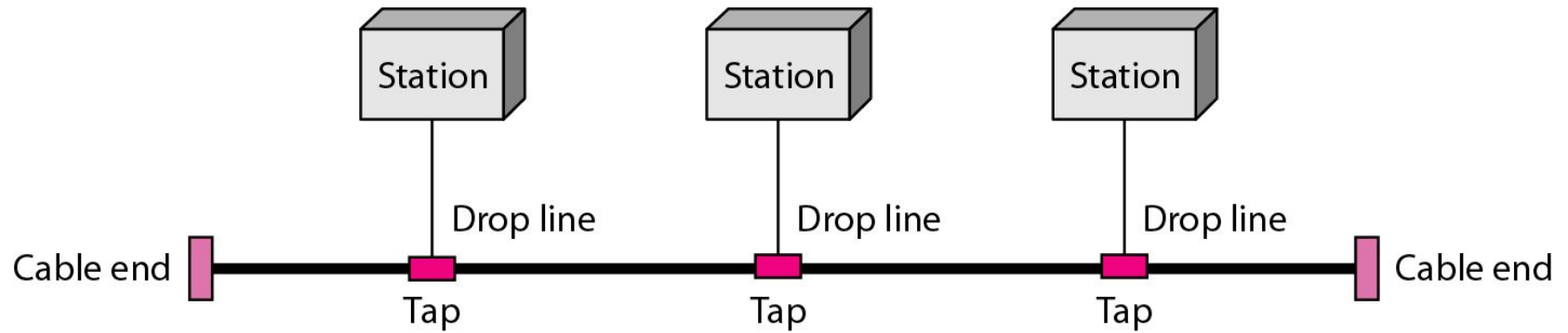
Bus Topology

- Multipoint topology

- Nodes are connected to the bus with drop lines and Taps.

- Tap is connector.

- Limit number of taps on bus (Signal travel along bus some energy is transformed into heat energy).

- advantages:
- Ease of installation.
- Less cabling
- Disadvantages:
- Fault Isolation
- Difficult to add new devices
- Fault in bus cable stops all transmission

A hybrid topology: a star backbone with three bus networks

A ring topology connecting six stations
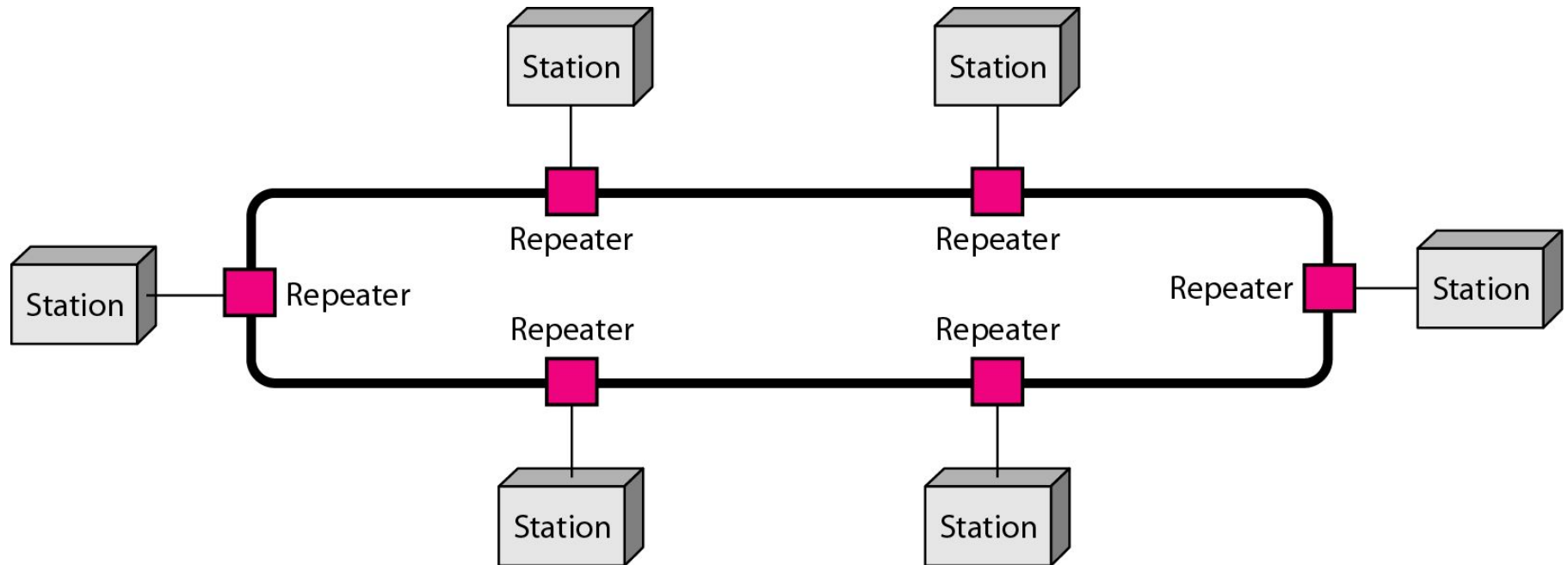
Ring Topology

- In a ring topology, each device has a dedicated point -to-point connection with only the two devices on either side of it.

- Signal transmission in one direction

- Each device incorporates a repeater.

- Easy installation (addition and deletion).

- Alarm

- Unidirectional traffic (dual ring ,switch)
- Ring topology was prevalent when IBM introduced its LAN Token ring.
- Today higher speed LANs has made this topology less popular.

Network Model

- Computer network is created by different entities.

- Standards are needed so that these heterogeneous with one another.

- OSI (open system interconnection) model

- Seven layer model

- Internet Model

- Five layer model

Categories of Networks

- The category into which falls is determined by its size.
- LAN
- WAN
- MAN

LAN

- Privately owned network
- Can be as simple as two PCs
- Size few KM
- Design to share resources
- Server (size)
- Transmission medium
- Most common topology (star ,ring and bus)
- Early LANs had data rate 4 to 16 Mbps.Today however ,speed are normally 100 or 1000 Mbps.
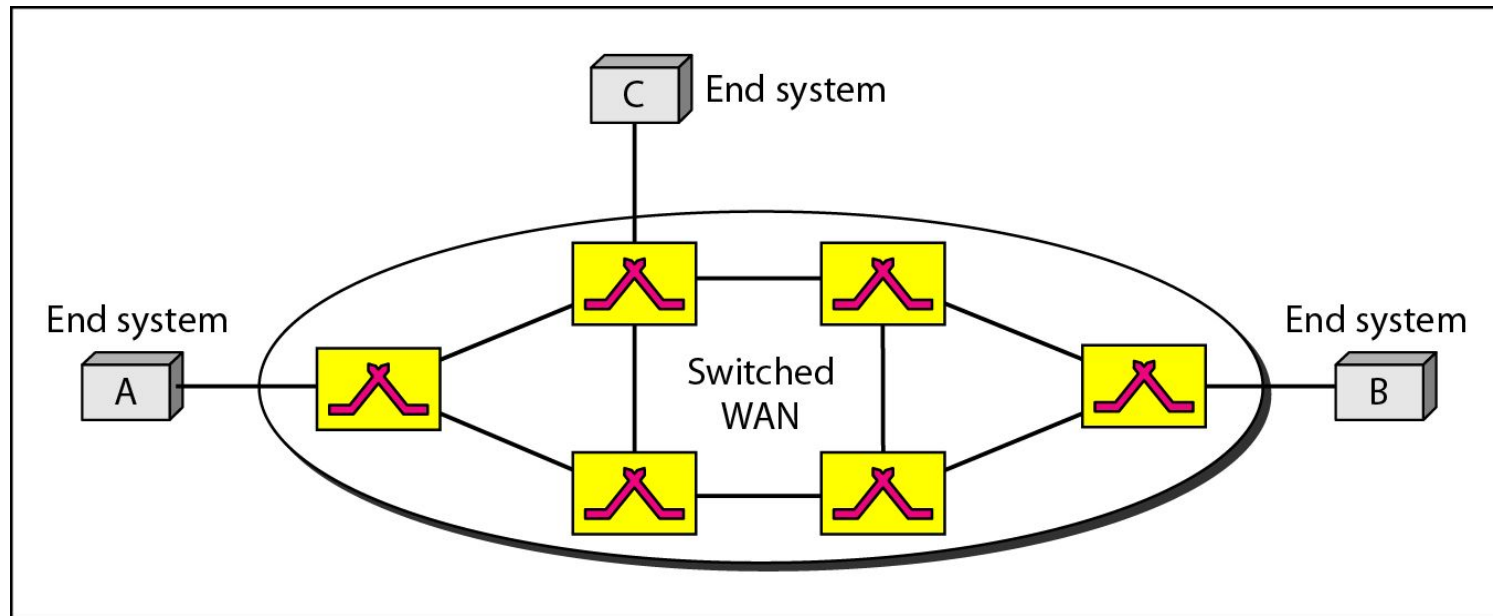
An isolated LAN connecting 12 computers to a hub in a closet
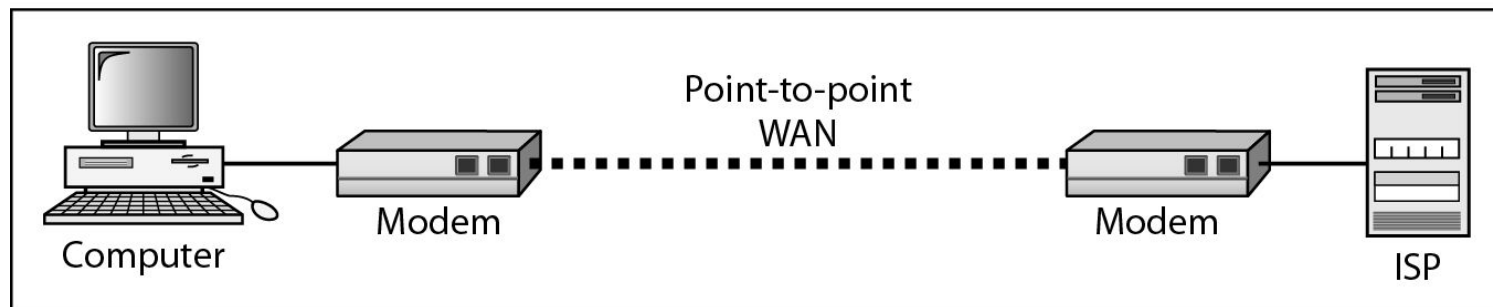

Hub
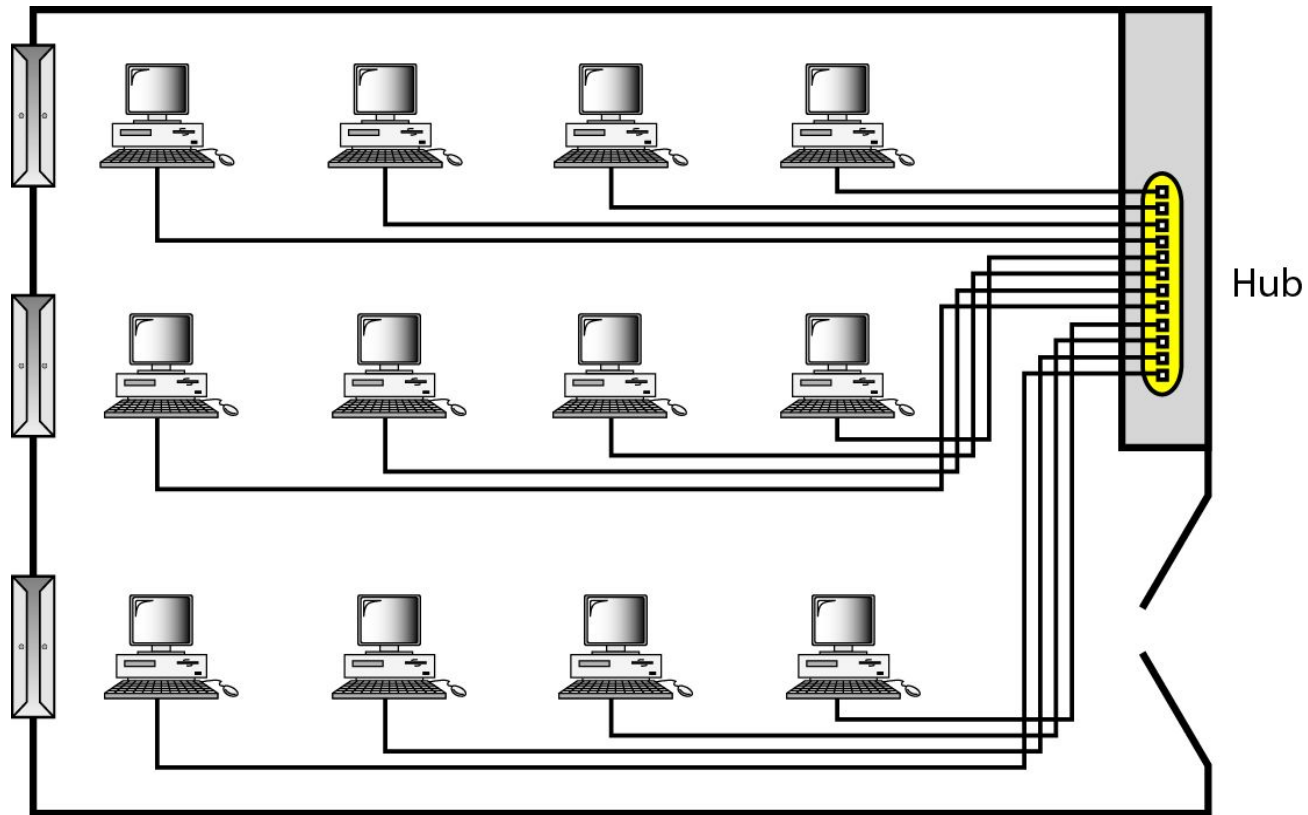
Wide Area Network

- Long distance transmission
- Switched WAN
- Provide connection btw end users
- Switched WAN is replaced by more efficient net work Frame relay.
- Point to point WAN
- Wireless WAN

WANs: a switched WAN and a point-to-point WAN
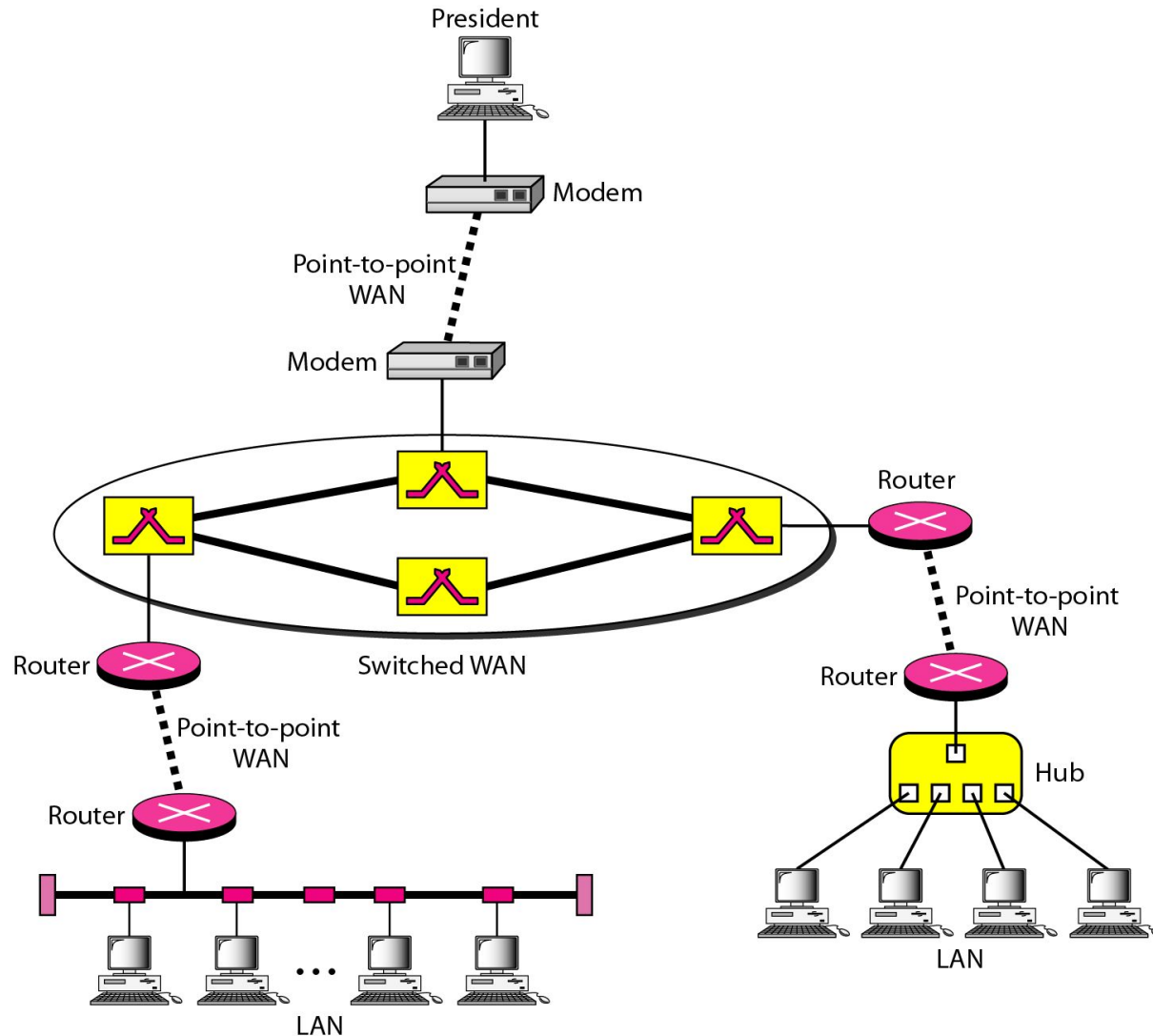

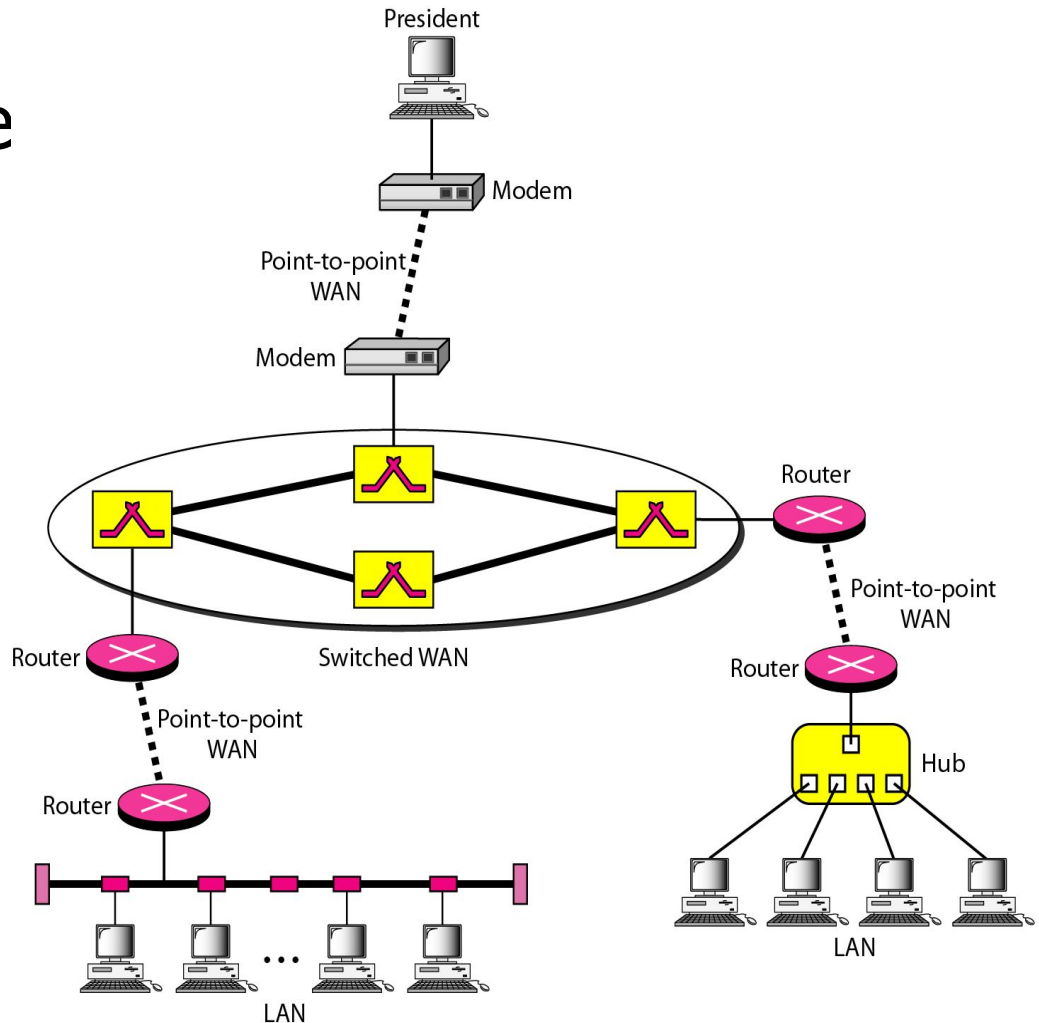a. Switched WAN

b. Point-to-point WAN

MAN

- Size btw LAN and WAN
- Cover area inside town or a city
- It is designed for customers who need a high speed connectivity.
- Example High Speed DSL line
- Cable TV network

A heterogeneous network made of four WANs and two LANs

President

Modem

Point-to-point
WAN

Modem

Router

Point-to-point
WAN

Router

Switched WAN

Router

Point-to-point
WAN

Router

Hub

LAN

LAN

Internetwork

- When two or more networks are connected ,they become an internetwork, or internet

President

Modem

Point-to-point WAN

Modem

Router

Switched WAN

Point-to-point WAN

Router

Router

Router

Point-to-point WAN

Hub

Router

LAN

LAN

LAN

1.35

THE INTERNET

The Internet has revolutionized many aspects of our daily lives. It has affected the way we do business as well as the way we spend our leisure time. The Internet is a communication system that has brought a wealth of information to our fingertips and organized it for our use.

Hierarchical organization of the Internet
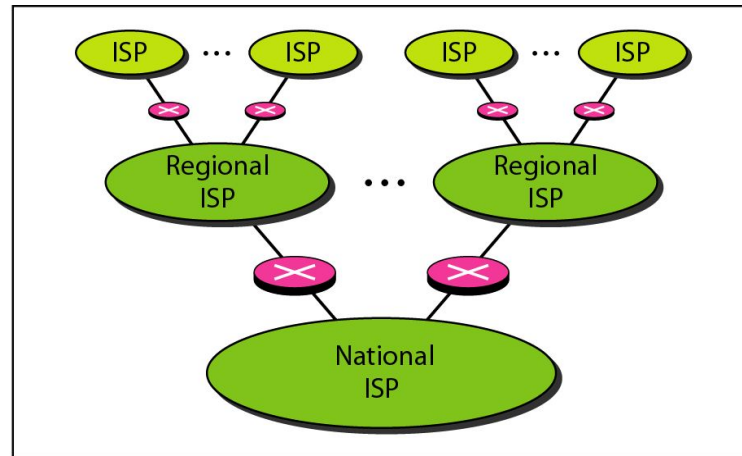
a. Structure of a national ISP
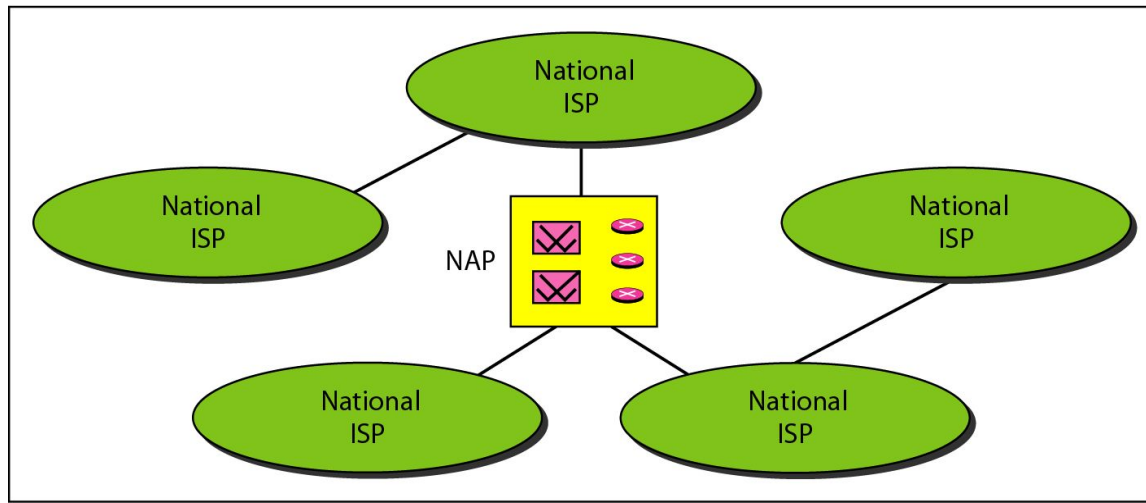
b. Interconnection of national ISPs

- International Internet Service Provider:
- At the top of hierarchy Connects nation together.
- National Internet Service Provider:
- To Provide connectivity btw end users these backbone network use NAP.
- Peering Point

- Regional Internet Service Provider:
- Smaller ISP
- 3rd level of hierarchy
- Connected to one or more nation ISPs
- Smaller data rate
- Local Internet Service Provider:
- Direct service to end user
- Connected to one or more Regional ISPs
- Provide service to end user e.g college,uni

PROTOCOLS AND STANDARDS

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

Protocols:

Set of rules that govern data communication:

What is communicated

How it is communicared

When it is communicated

Key element of protocol are

Syntax:the term syntax refers to the structure or format of data

Semantics : meaning of each section of bits

How particular pattern is interpreted what actions to be taken based on interpretation.

- Timing: refers to two characteristics
- When data should be sent and how fast they can be sent.