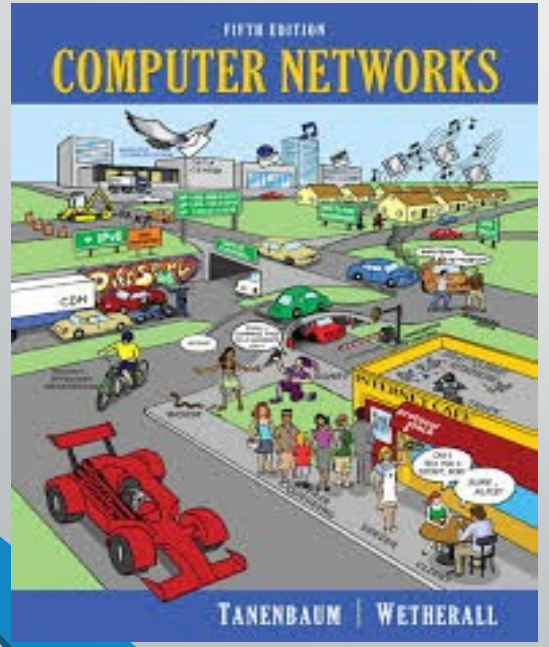
Computer Networks

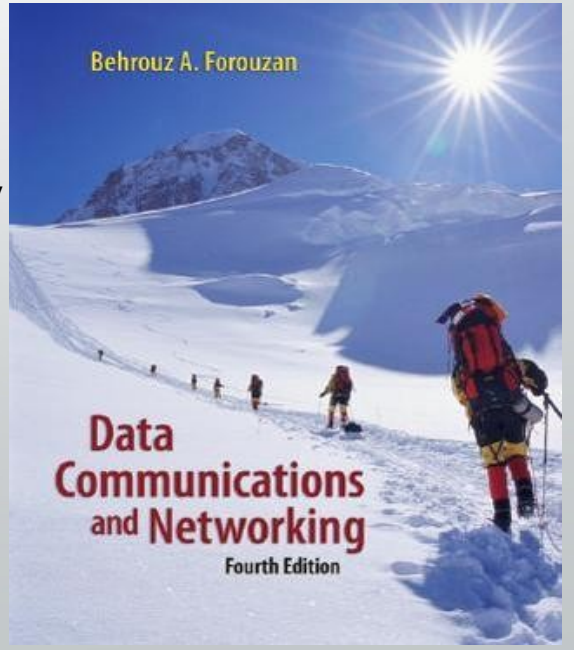
Lecture 01

Course Materials

- **Textbooks**
- Computer Networks by A Tanenbaum
- Data Communications and Networking By Behrouz A.



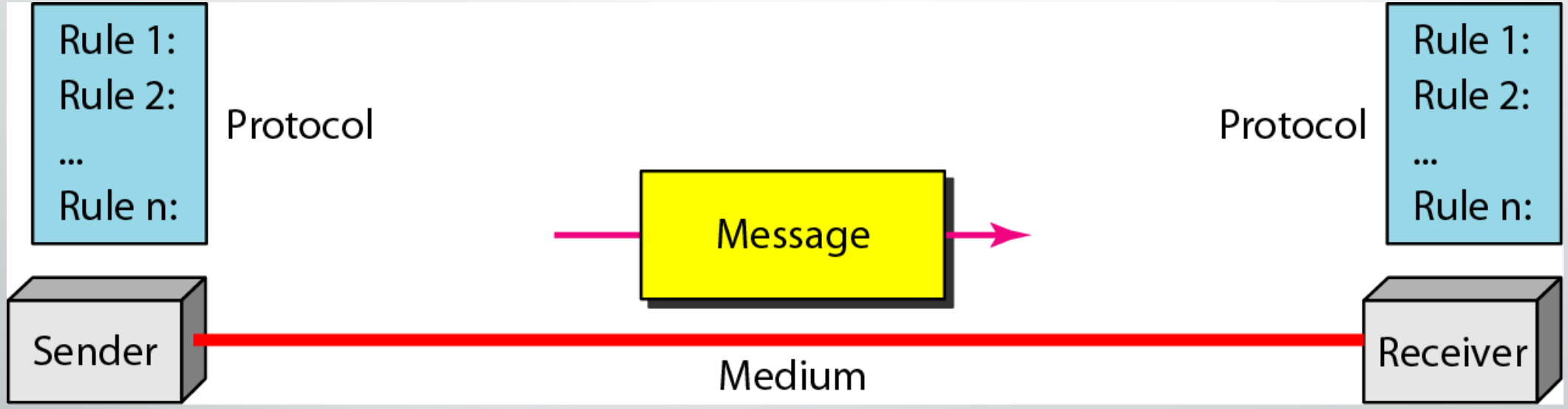
- Lecture slides(Will be uploaded regularly



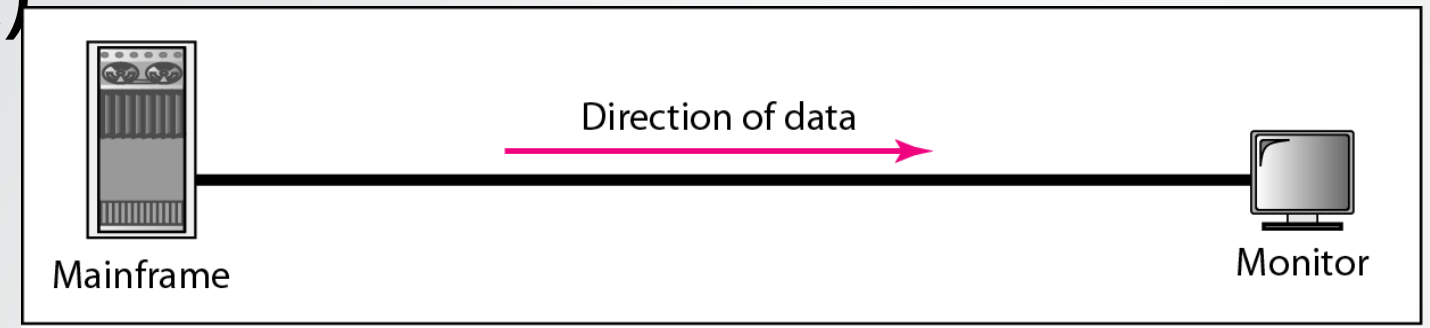
What is computer network?

- 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. A link can be a cable, air, optical fiber, or any medium which can transport a signal carrying information.

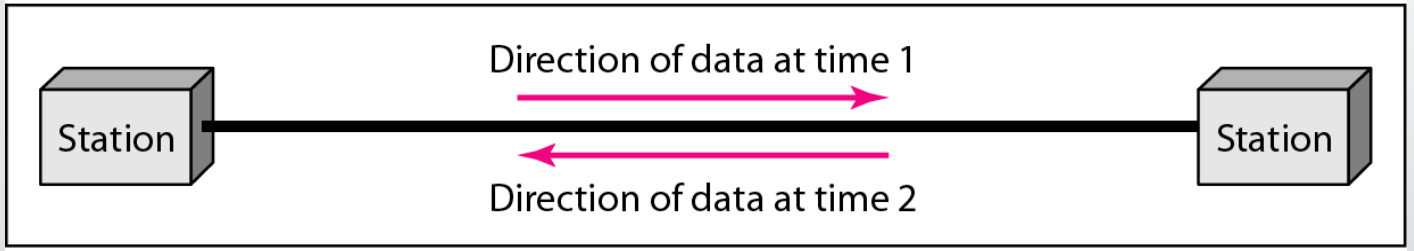
Components of a data communication system



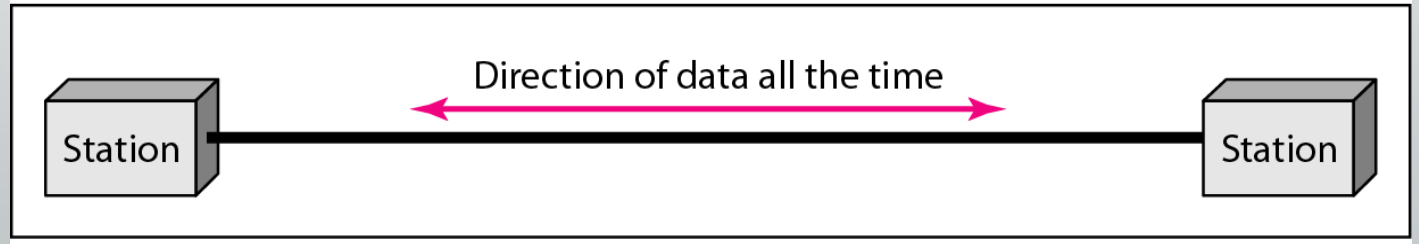
Data flow (simplex, half-duplex, and full-duplex)



a. Simplex



b. Half-duplex



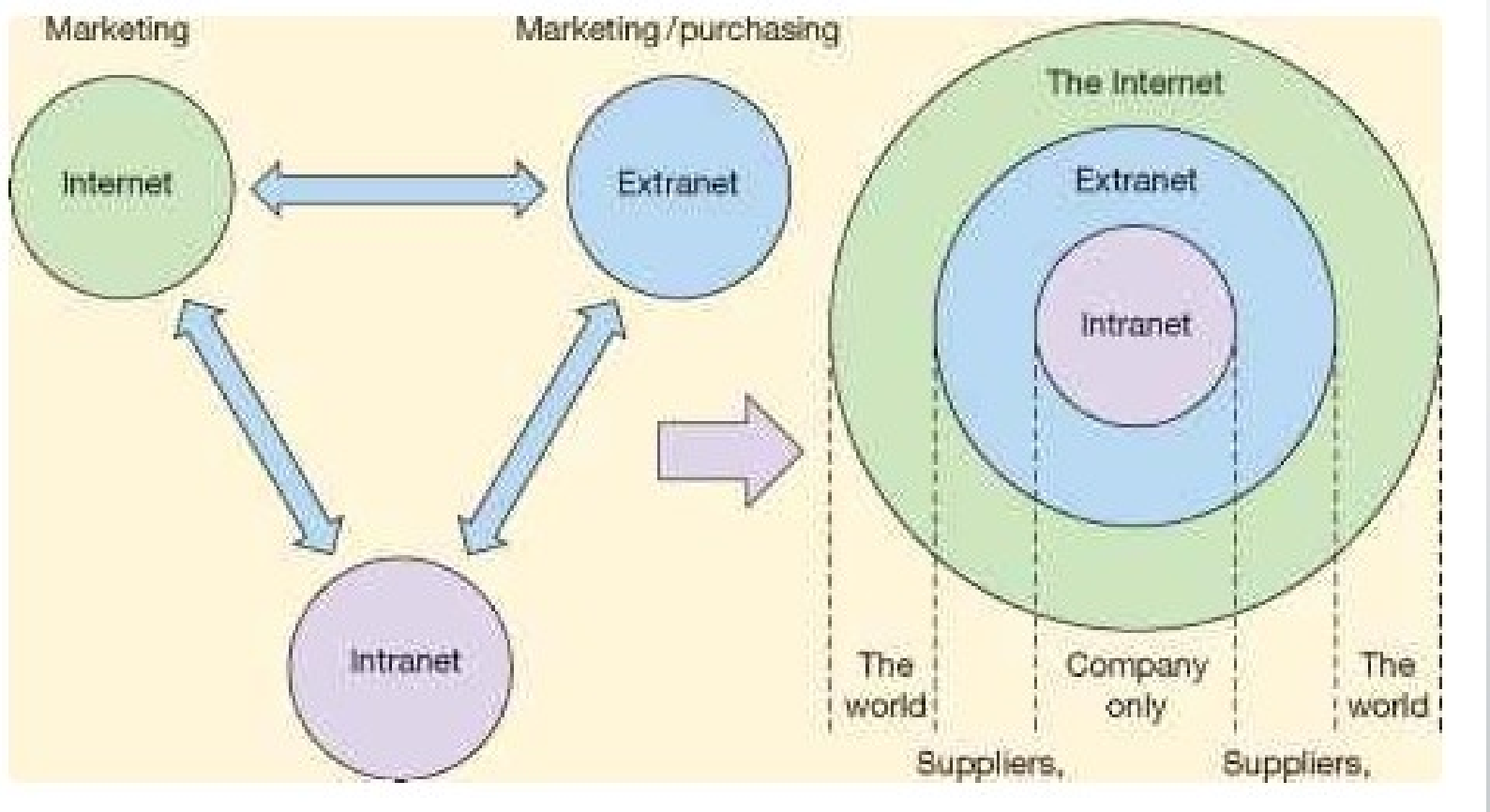
c. Full-duplex

Intranet & Extranet

An **Intranet** is a private local network which is structured within an organization or a company. It’s a private network because no other outsider to that organization can access the intranet. Only the users (may be employees of the company) of the network are allowed to connect the LAN with individual network passwords to access the company’s intranet.

Extranet An extranet is a private network that allows businesses to share information and communicate with authorized external parties.

Intranet & Extranet



Benefit of a network

File sharing: A network makes it easy for everyone to access the same file and prevents people from accidentally creating different versions.

Printer sharing: With a network, several computers can share the same hardware. For example, you might need a more expensive printer to handle the added workload, it's still cheaper to use a network printer than to connect a separate printer to every computer in your office.

Communication and collaboration: It's hard for people to work together if no one knows what anyone else is doing. A network allows employees to share files, view other people's work, and exchange ideas more efficiently. In a larger office, you can use e-mail and instant messaging tools to communicate quickly and to store messages for future reference

Shared Internet access: If you have several computers but just one phone line, a network makes using the Internet much easier.

Network Criteria

- Performance
  - Depends on Network Elements
  - Measured in terms of Delay and Throughput
- Reliability
  - Failure rate of network components
  - Measured in terms of availability/robustness
- Security
  - Data protection against corruption/loss of data due to:
    - Errors
    - Malicious users

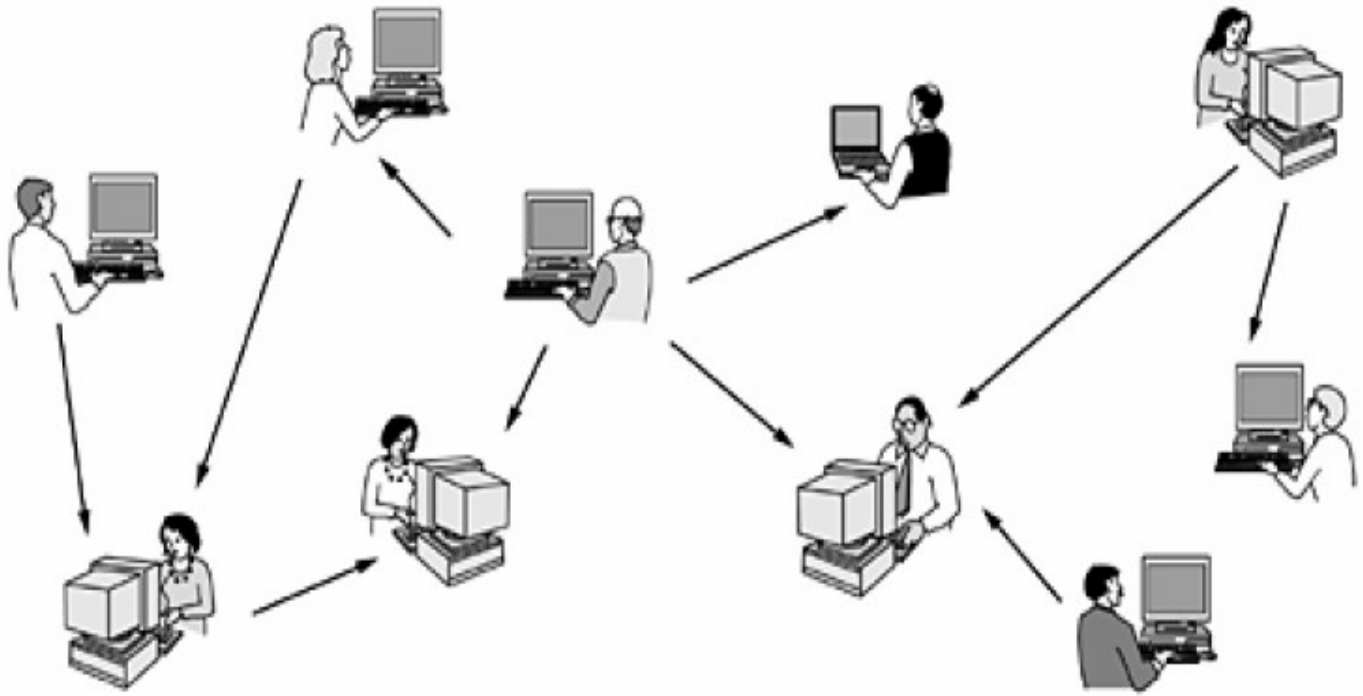
How network are categorized?

- Architecture
- Transmission technology
- Scale
- Topology

Architecture based type:

****What is peer-to-peer communication?**

Peer-to-peer communication is a form of computer networks in which individuals who form a loose group can communicate with others in the group as shown below.



Peer-to-peer communication is different from client-server model in the sense that here is no fixed division into-clients and servers.

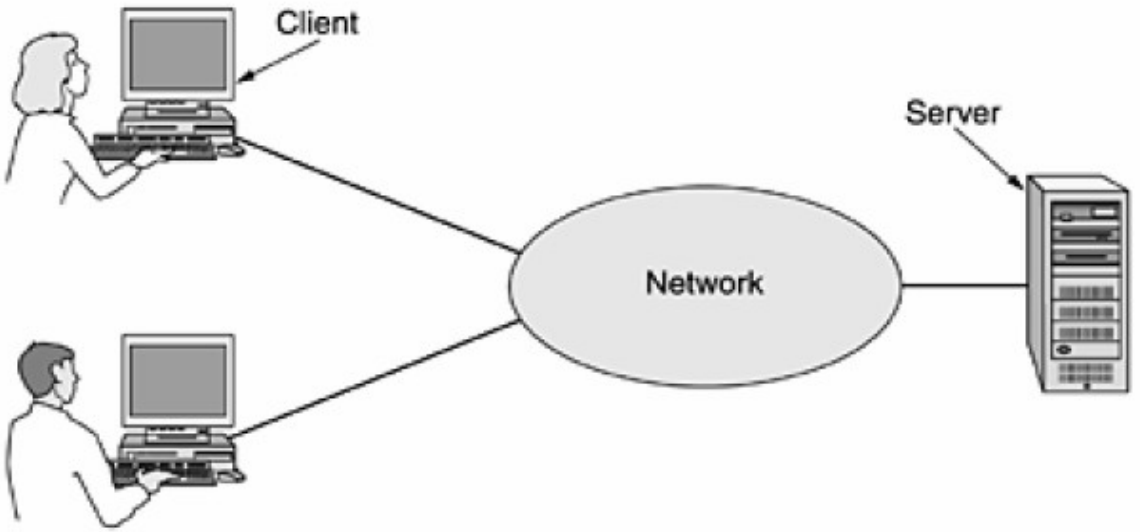
Architecture based type (cont…)

****Briefly explain the Client-Server Model.**

The client server model is an architecture of computer networks. Sometimes, in a large organization, information is stored in more powerful, high capacity computer called the *server*. The *server* is centrally housed and maintained by a system administrator. All other computers in that organization are referred to as *client* if they use information contained in the server. The clients are usually less-powerful, simpler machines. The total arrangement is referred to as *client-server model* as illustrated in the following figure.

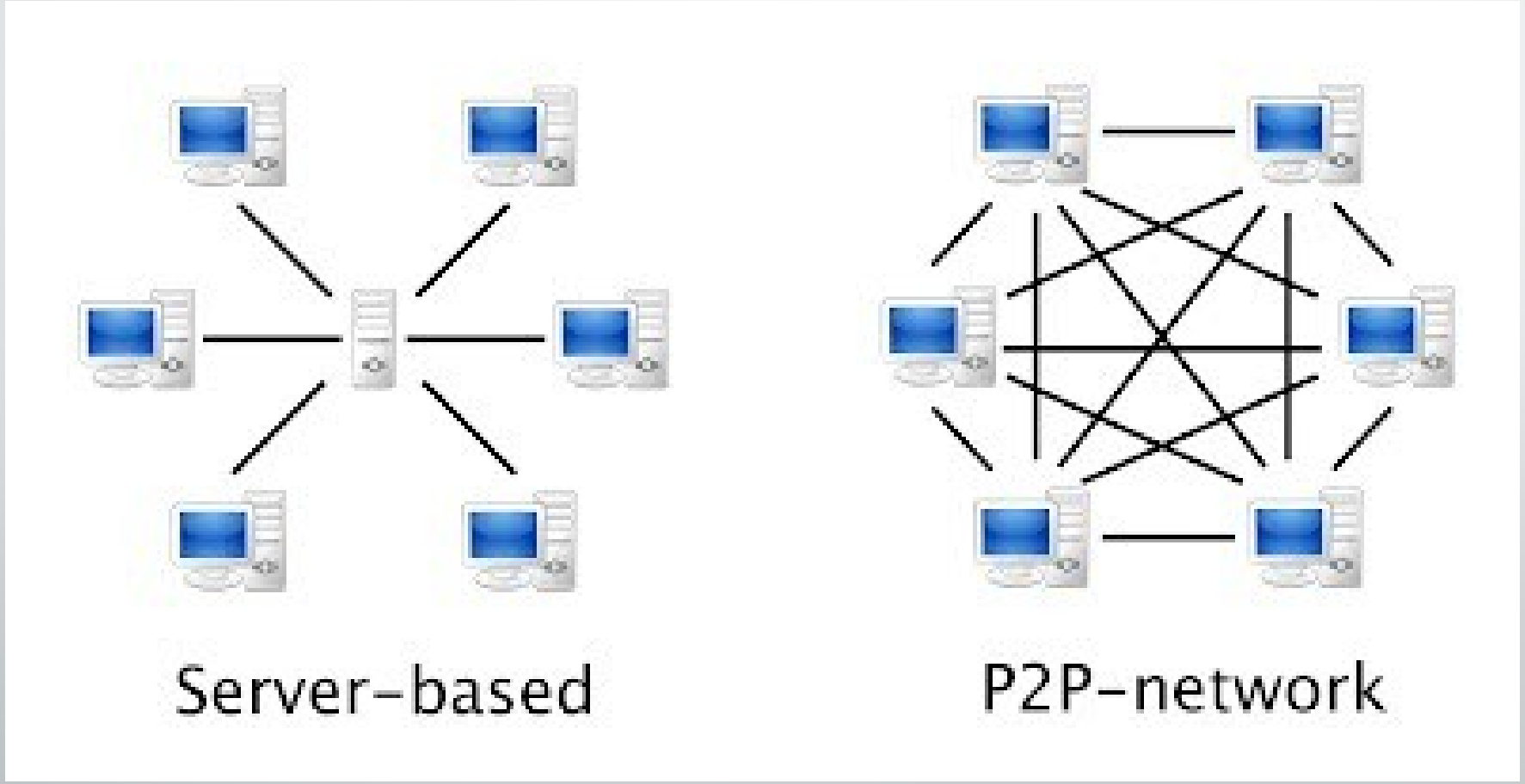
Architecture based type (cont…)

A network with two clients and one server.

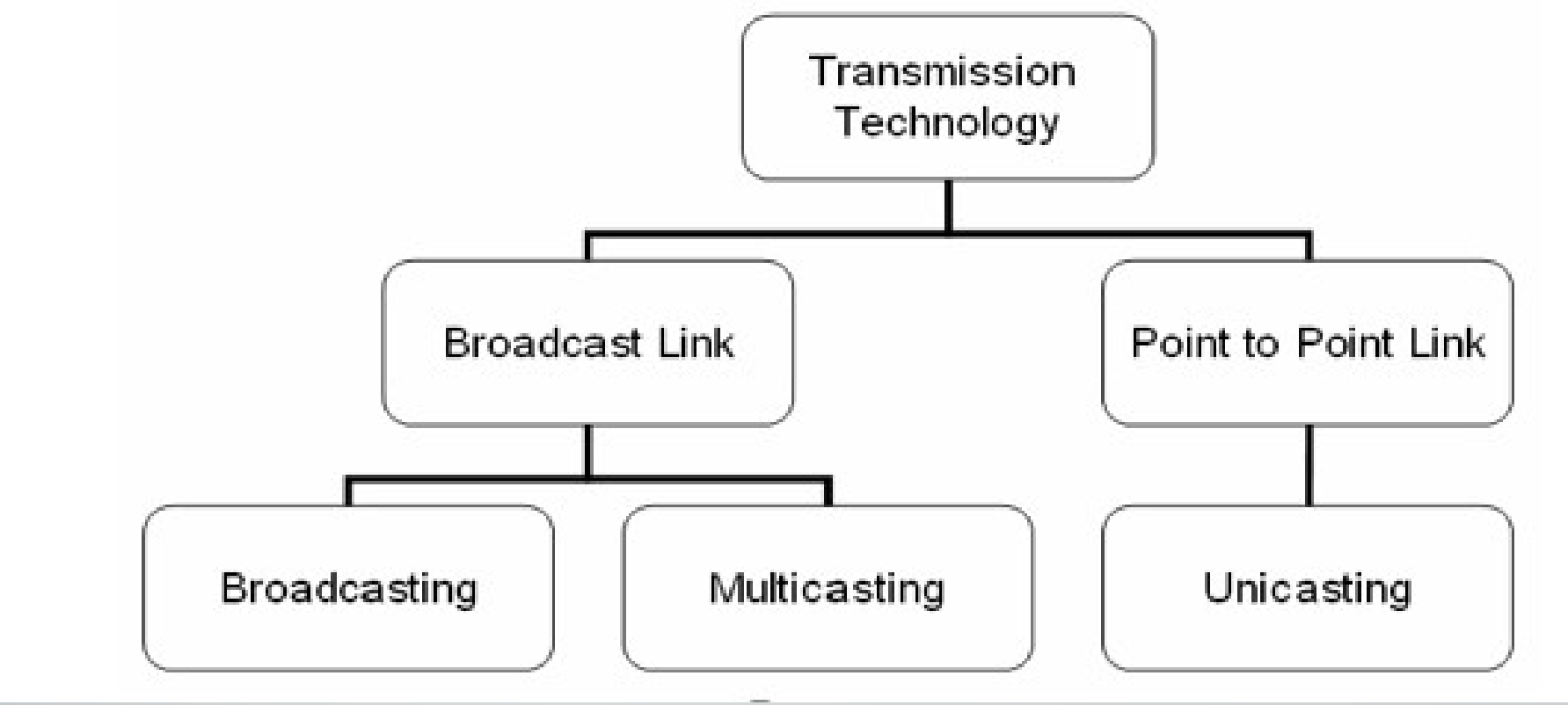


For example, let us consider a factory where all information are stored in the server and automatically updated. Now, if an employee is assigned to prepare a spreadsheet on recent information, he simple uses his desktop *client* to request information from *server* and accomplishes his task.

Architecture based type (cont…)



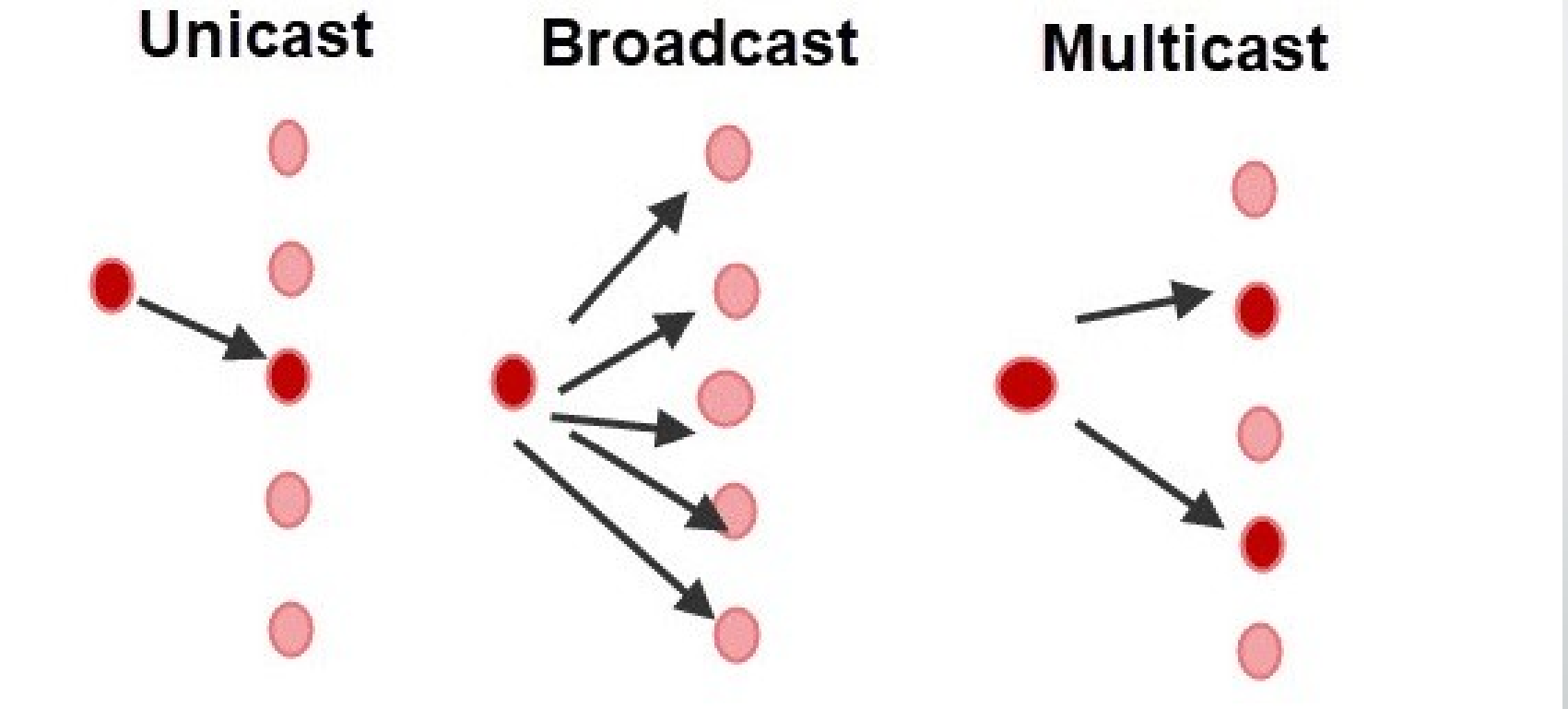
Transmission based type



Transmission based type (cont…)

- **Unicast** is the term used to describe communication where a piece of information is sent from one point to another point. In this case there is just one sender, and one receiver.
- **Broadcast** is the term used to describe communication where a piece of information is sent from one point to all other points. In this case there is just one sender, but the information is sent to all connected receivers.
- **Multicast** is the term used to describe communication where a piece of information is sent from one or more points to a set of other points. In this case there is may be one or more senders, and the information is distributed to a set of receivers (there may be no receivers, or any other number of receivers).

Transmission based type (cont…)

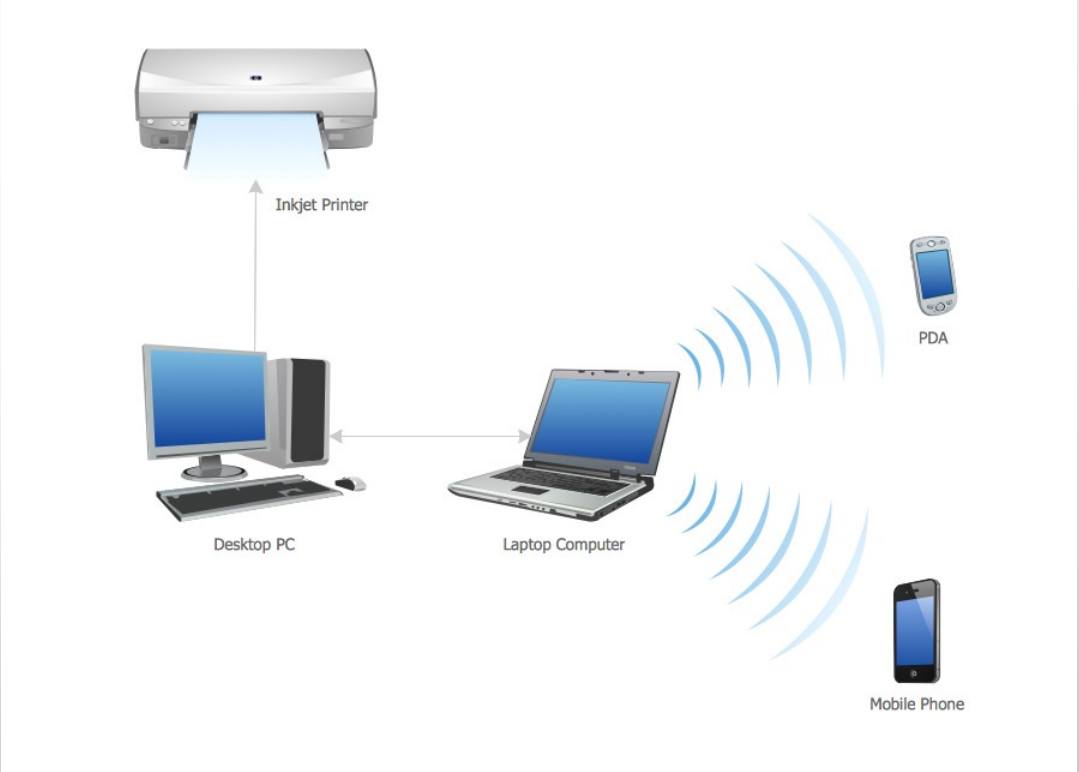


Scale based type

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

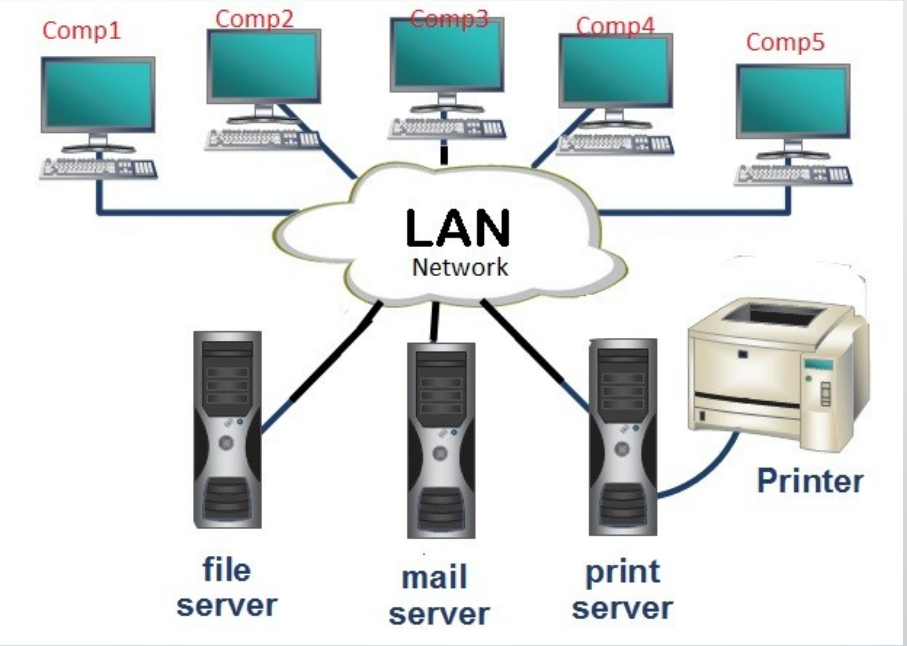
Personal Area Network

A personal area **network** (**PAN**) is a computer **network** for interconnecting devices centered on an individual person's workspace. A **PAN** provides data transmission among devices such as computers, smartphones, tablets and personal digital assistants.

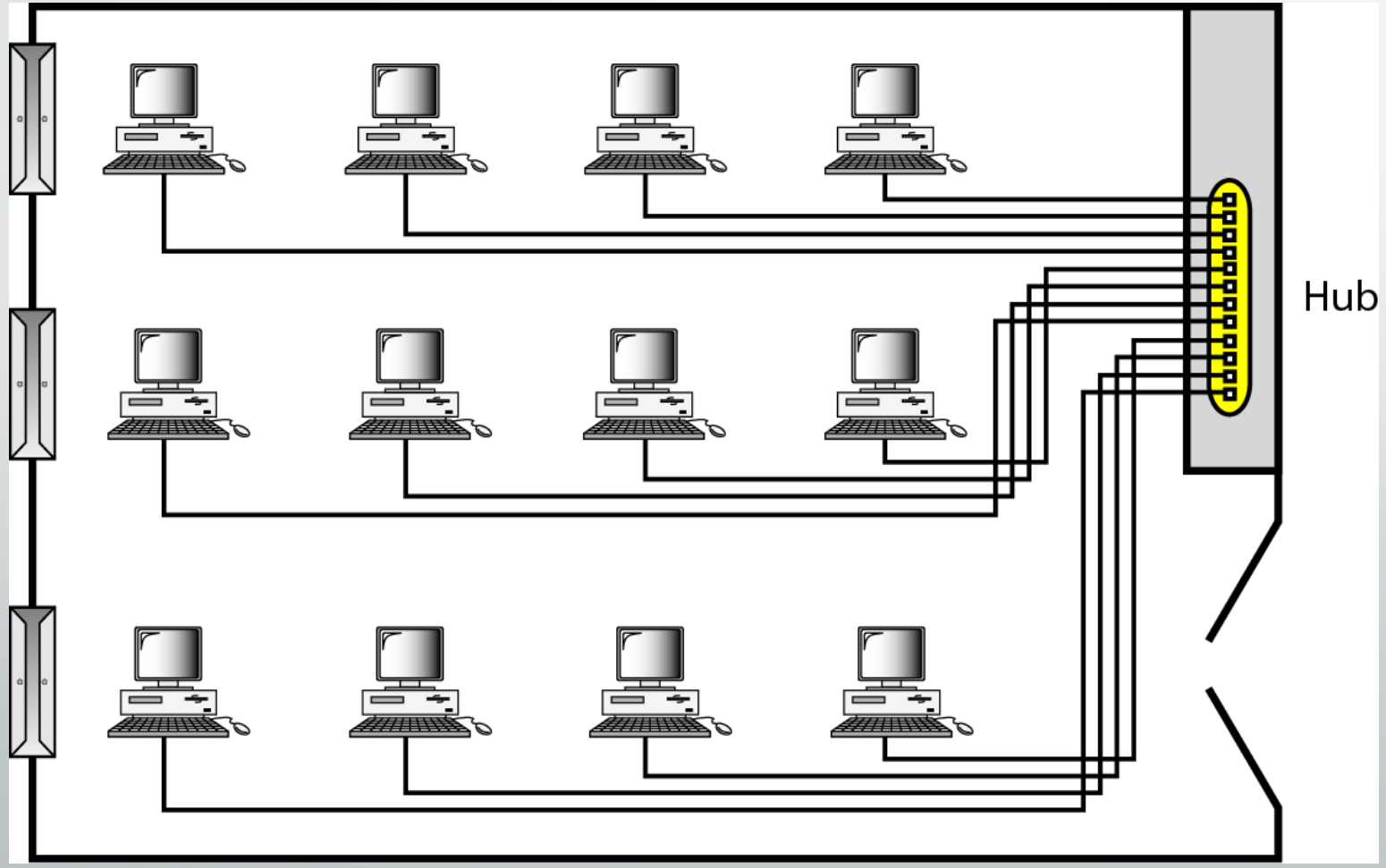


Local Area Network

A **local area network** (**LAN**) is a computer **network** that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building.

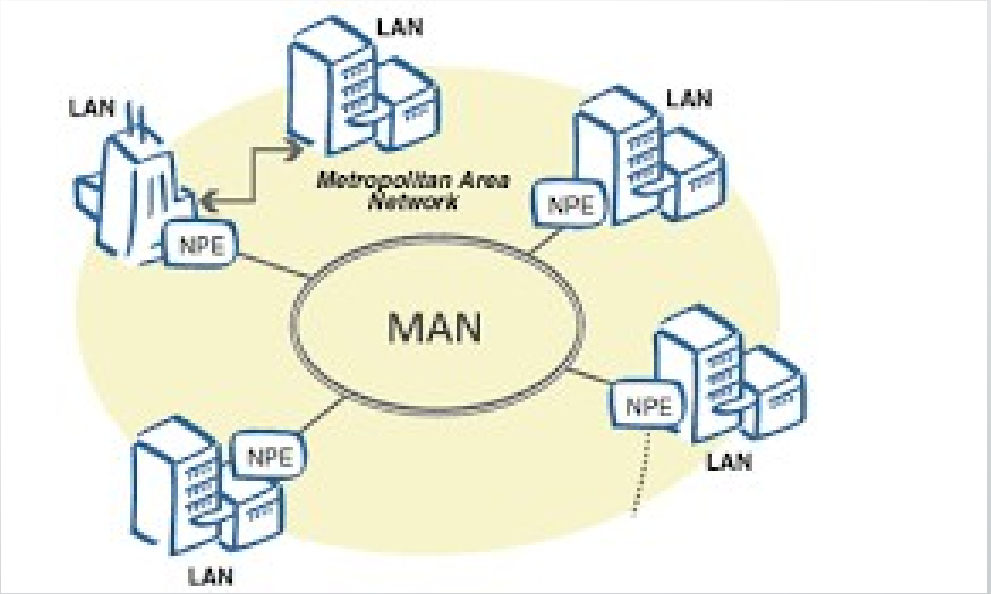


An isolated LAN connecting 12 computers to a hub in a closet



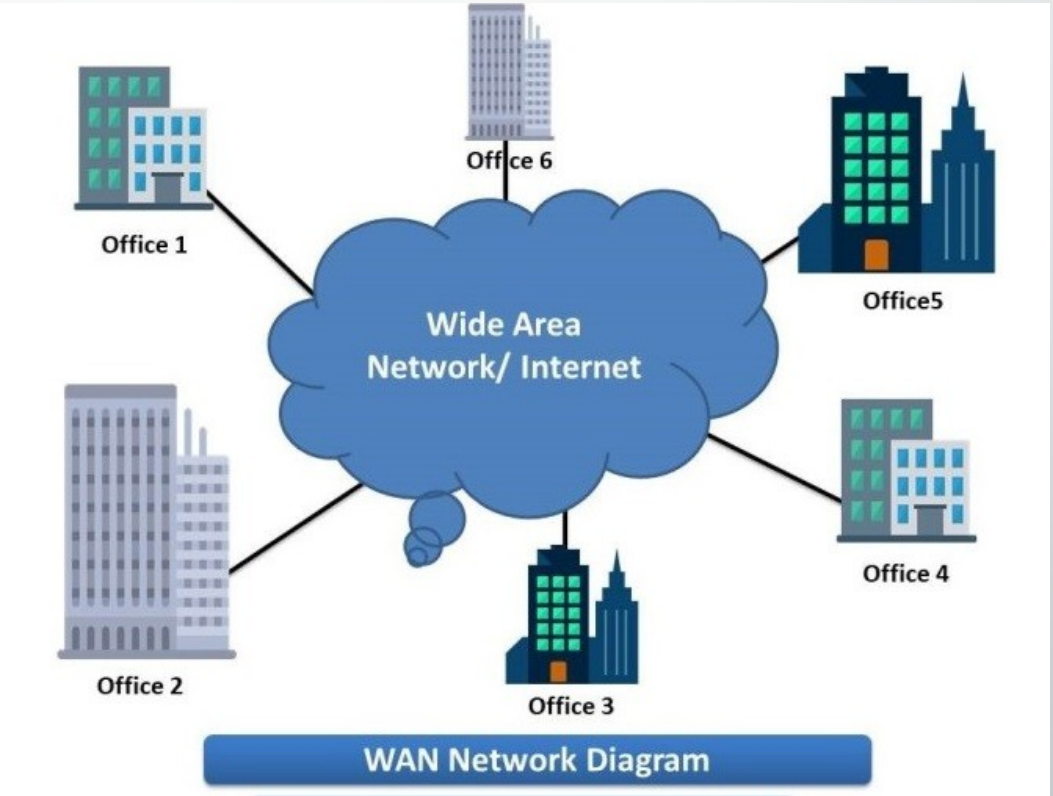
Metropolitan Area Network

A metropolitan area **network** (**MAN**) is a computer **network** that usually spans a city or a large campus. A **MAN** usually interconnects a number of local area **networks** (LANs) using a high-capacity backbone technology

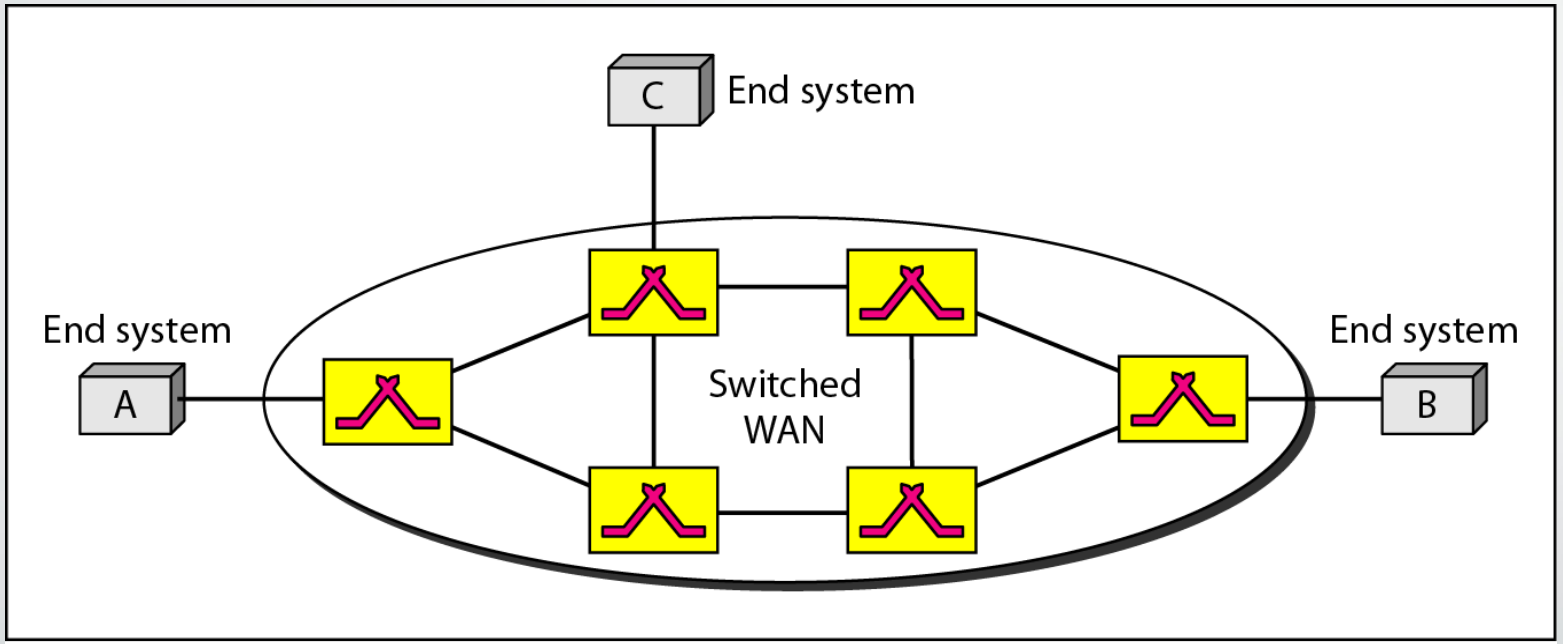


Wide Area Network

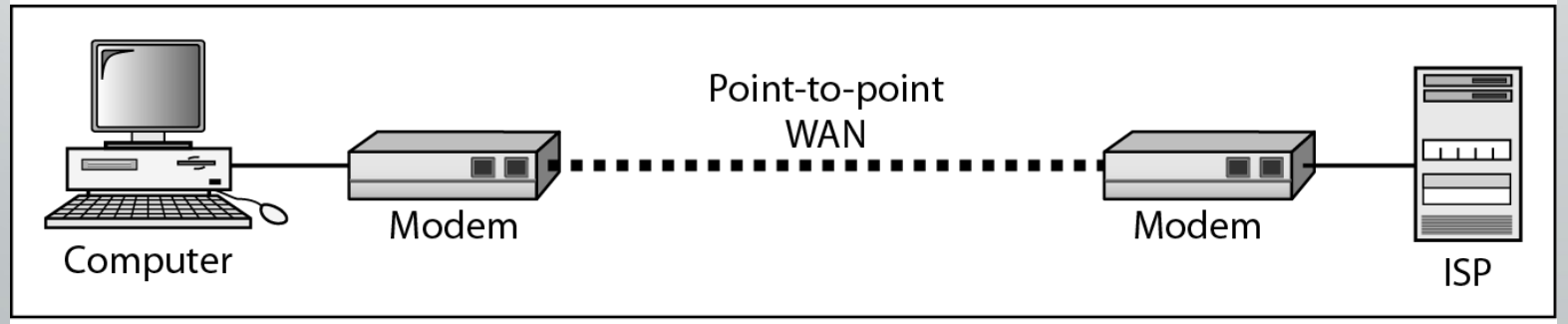
A **WAN** (**wide area network**) is a communications **network** that spans a large geographic area such as across cities, states, or countries. They can be private to connect parts of a business or they can be more public to connect smaller **networks** together.



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

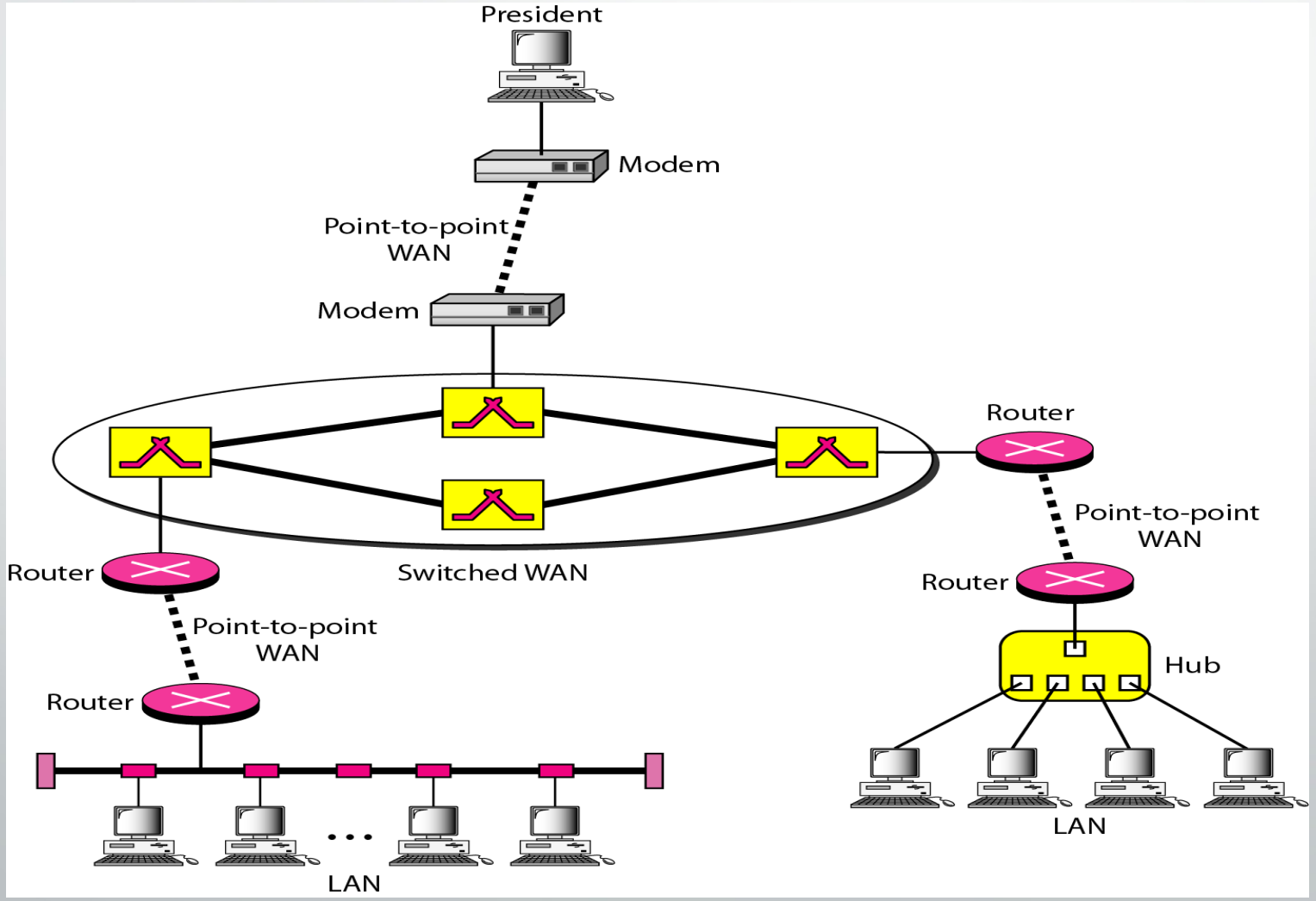


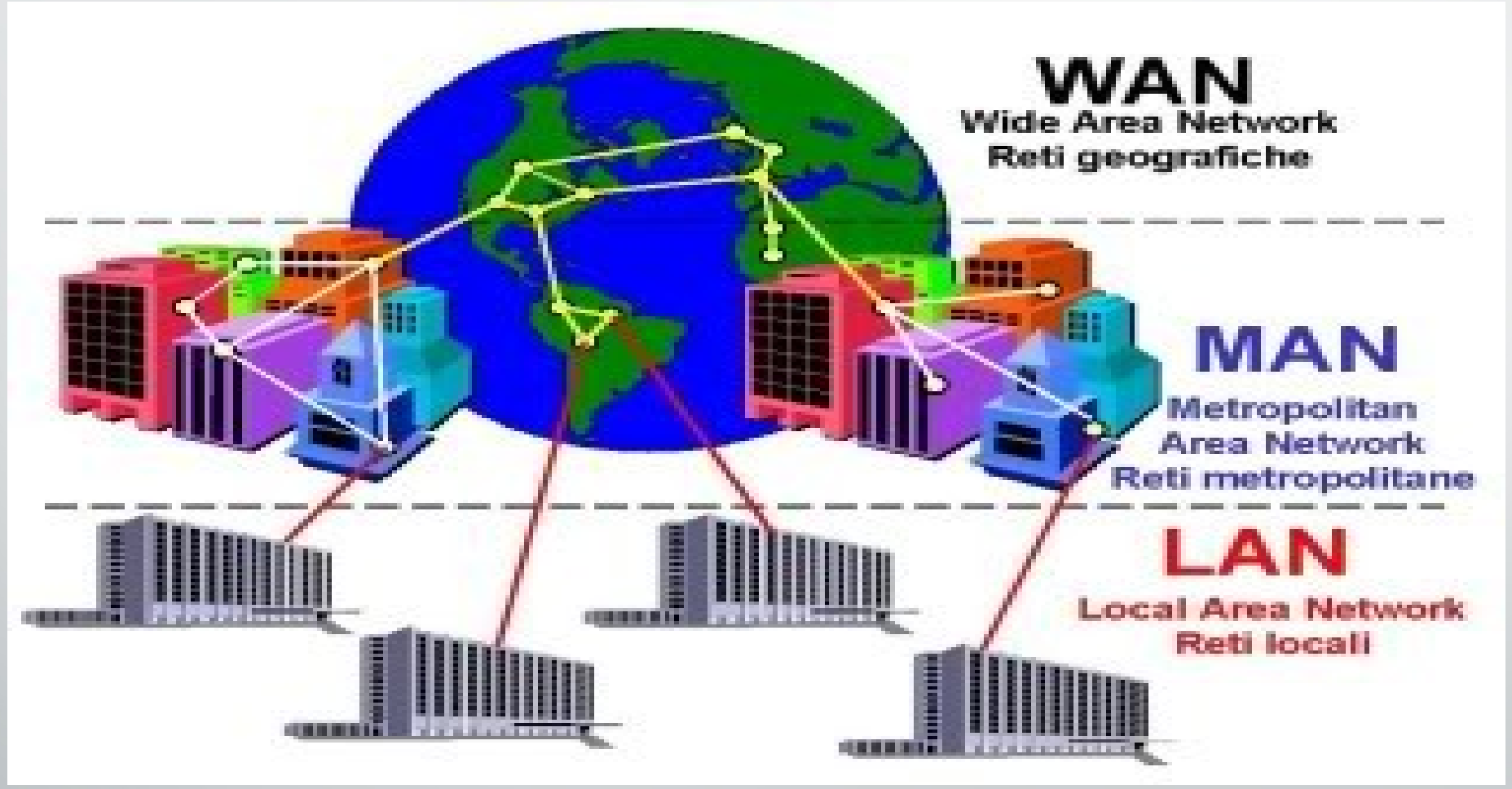
a. Switched WAN



b. Point-to-point WAN

A heterogeneous network made of four WANs and two LANs



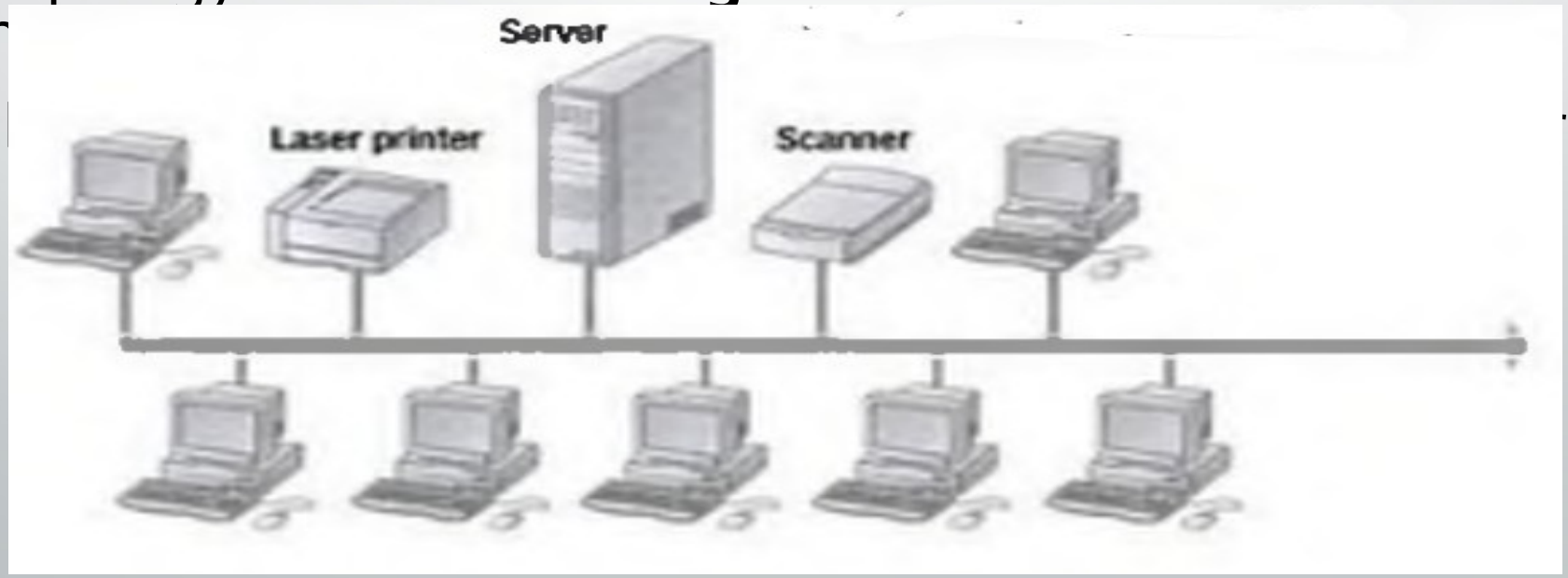

WAN
Wide Area Network
Reti geografiche
MAN
Metropolitan
Area Network
Reti metropolitane
LAN
Local Area Network
Reti locali

Network Topologies

- Topology the logical layout of the cables and devices that connect the nodes of the network.
- Network designers consider several factors when deciding which topology or combination of topologies to use:
  - the type of computers and cabling in place,
  - the distance between computers,
  - the speed at which data must travel around the network, and
  - the cost of setting up the network.

Network Topology: Bus

- A bus topology network uses one cable . All the nodes and peripheral devices are connected in a series to that cable.
- This topology's main **advantage** is that it uses the least amount of cablin
- A bro k.

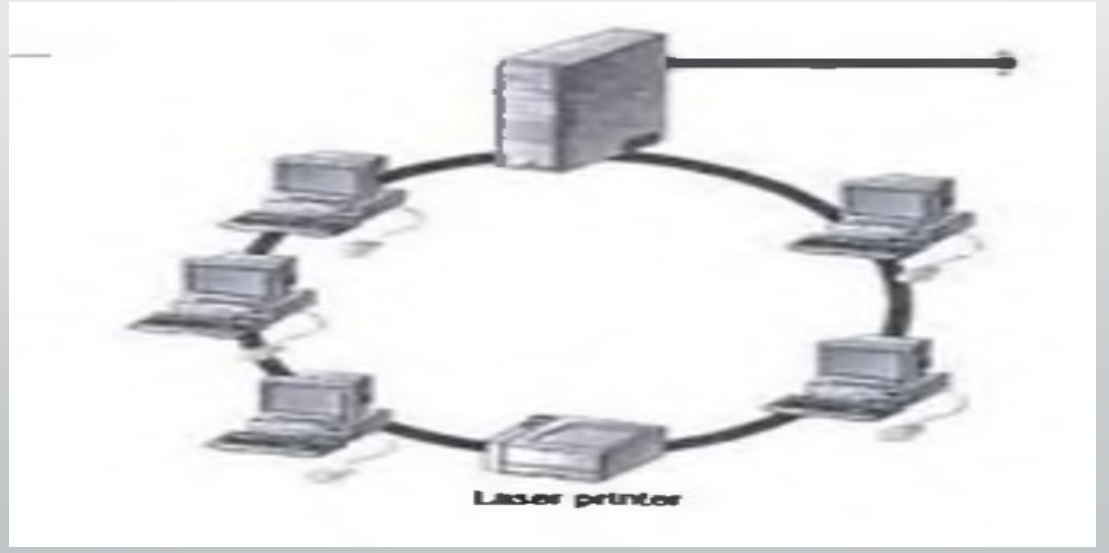


Network Topology: Star

- In a star network, all nodes are connected to a device called a hub and communicate through it.
- In a star topology, a broken communication between a node and the hub does not affect the rest of the network.
- If the hub is lost, however, all nodes connected to that hub are unable to communicate.

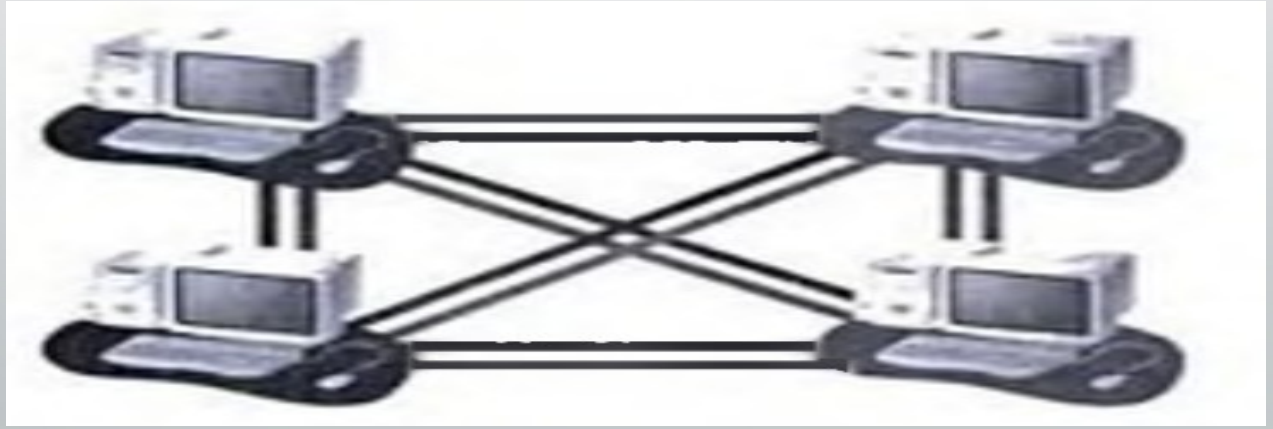
Network Topology: Ring

- The ring topology connects the network' s nodes in a circular chain, with each node connected to the next.
- The last node connects to the first, completing the ring.
- Each node examines data as it travels through the ring.
- If the ring is broken, however, the entire network is unable to communicate.

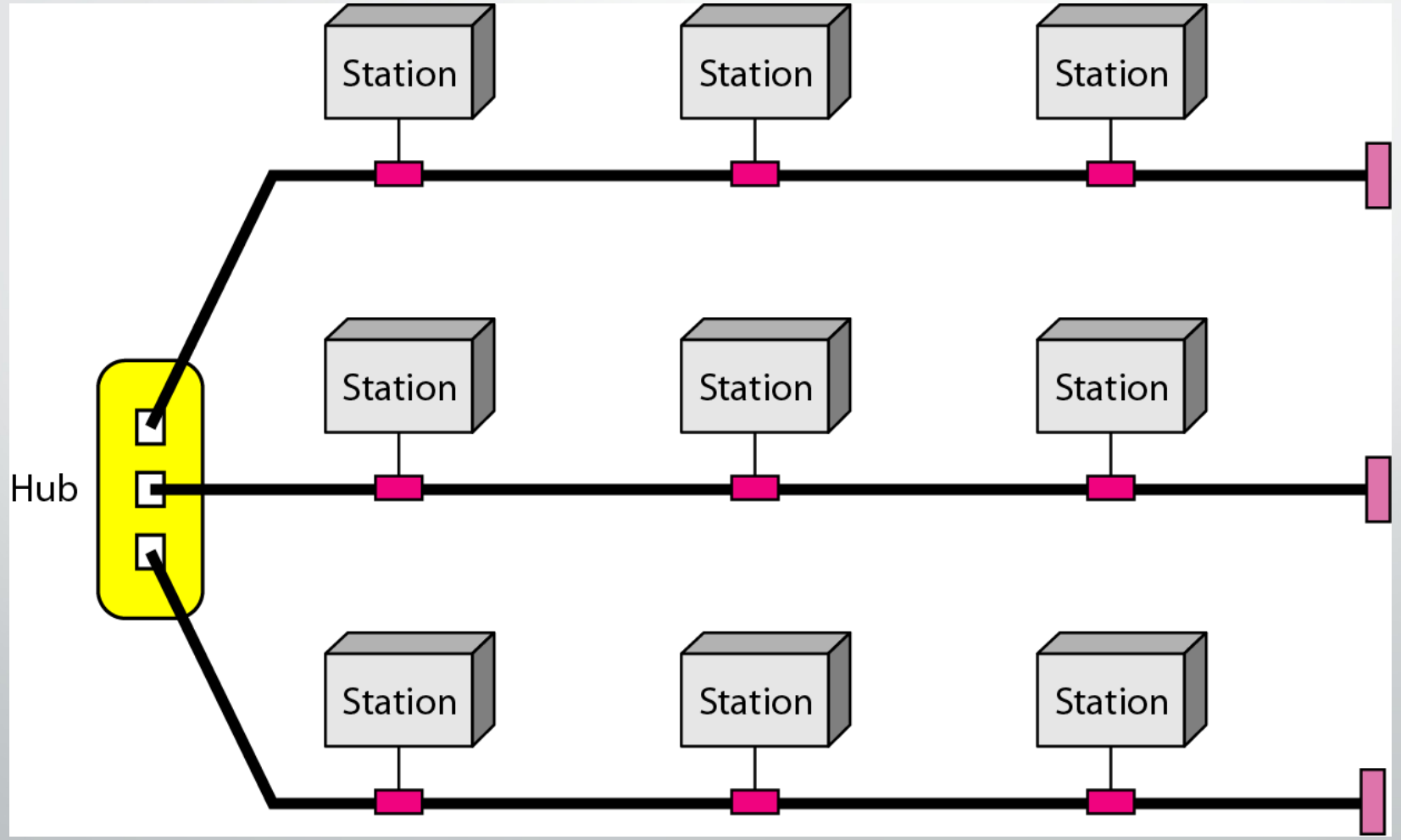


Network Topology: Mesh

- The mesh topology is the least-used network topology and the most expensive to implement .
- In a mesh environment, a cable runs from every computer to every other computer.
- If you have four computers, you must have six cables—three coming from each computer to the other computers.
- The big advantage to this arrangement is that data can never foil to be delivered; if one connection goes down, there arc other ways to route the data to its destination.



A hybrid topology: a star backbone with three bus networks



**Describe different uses of computer networks:

(i) Business Applications:

Most of the organizations have a substantial number of computers. For example, in a manufacturing organization, one computer may monitor production while another doing payroll. However, all the computers need to share resources like information, software etc. They may also share printer, scanner, and other hardware resources. Thus computer networks play a great role in business sector.

(ii) Home Applications:

Though personal computer requires network less than that of business organization computer do, they still need several networks for several reasons.

1. To access remote information.
2. For person-to-person communication.
3. For interactive entertainment.
4. For E-commerce.

(iii) Mobile Users:

The concept of personal computer is being smaller day be day. People prefer buying laptops, notebooks or PDAs to having a desktop PC. Since they like to have a portable office, they need to connect with many other forms of computers. Recent inventions in wireless technology provides this field with a new dimension. It should be noted that wireless networking and mobile computing are distinct, though, they are closely related.

***What are the *social issues* related to a computer network?**

Although computer networks have several useful applications in almost every area, it should care about some social issues.

(i) Sometimes shared contents of a network are controversial with respect to politics, religion and laws. Such things bring different views to a front.

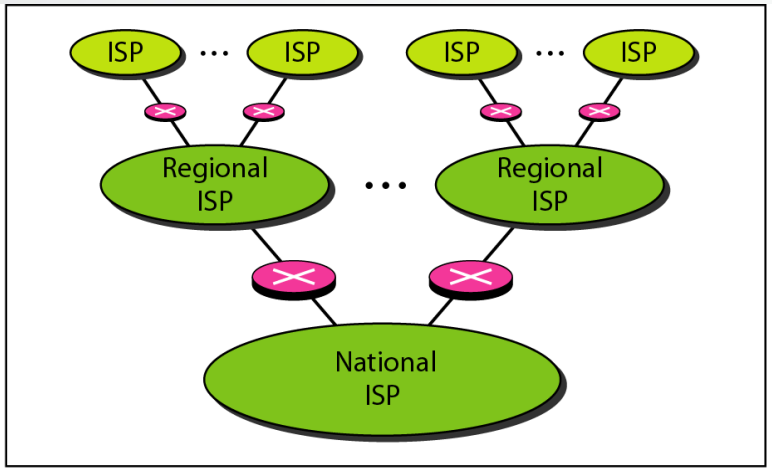
(ii) Sometimes important documents on a network can be hacked, cracked or damaged by others that cause economical and technical loss to the corresponding users.

(iii) Viruses and other threats like spam can attack a computer connected to a less secured network.

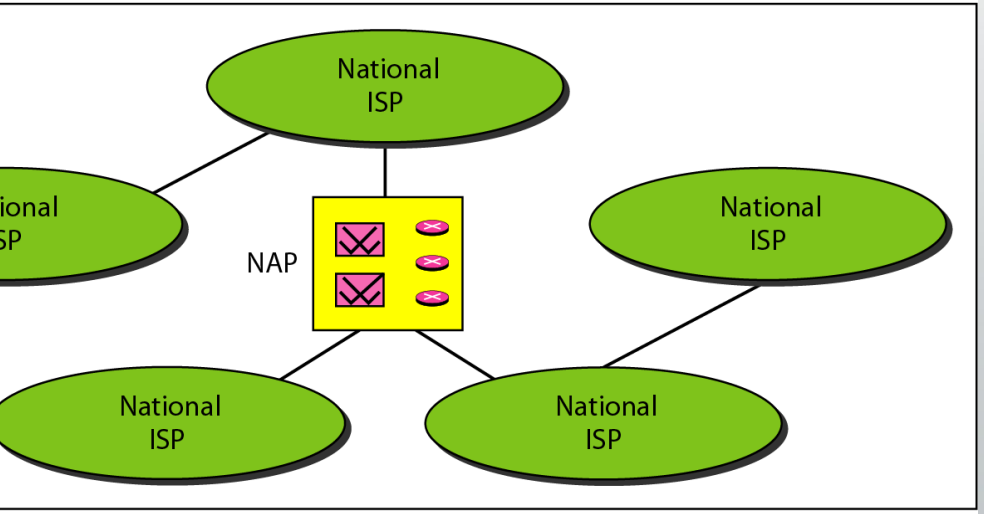
THE INTERNET

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

Protocol

Protocol: A protocol is a set of rules and standards that basically define a language that devices can use to communicate. It determines what is communicated, how it is communicated and when it is communicated There are a great number of protocols in use extensively in networking, and they are often implemented in different layers. The key elements of a protocol are

- Syntax,
- Semantics
- Timing

Elements of a Protocol

- Syntax
  - Structure or format of the data
  - Indicates how to read the bits - field delineation
- Semantics
  - Interprets the meaning of the bits
  - Knows which fields define what action
- Timing
  - When data should be sent and what
  - Speed at which data should be sent or speed at which it is being received.

Some Network Terminologies

- Network Topology

Topology of a network describes the way the computers and the nodes of the network are interconnected. There are a number of possible topologies

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

- Links

The physical connections that connects the nodes are known as links. A link may be through a pair of wires, a coaxial cable, an optical fiber or through a satellite.

Basic Terminology

- **Internetwork:** It is a general term describing multiple networks connected together. The Internet is the largest and most well-known internetwork.
- **Firewall:** A firewall is a program that decides whether traffic coming into a server or going out should be allowed. A firewall usually works by creating rules for which type of traffic is acceptable on which ports. Generally, firewalls block ports that are not used by a specific application on a server.

Basic Terminology (cont...)

- In a network, any connected device is called as ***host***. A host can serve as following ways:

  A host can acts as a ***Client***, when he is requesting information.

  A host can acts as a ***Server***, when he provides information.

  A host can also request and provide information, is called ***Peer***.
- **VPN (Virtual Private Network)**: A VPN allows for information to be securely sent across a public or unsecure network, such as the Internet. Common uses of a VPN are to connect branch offices or remote users to a main office.

Basic Terminology (cont...)

- **Packet:** A packet is a unit of data sent between devices. When you load a web page, your computer sends packets to the server requesting the web page and the server responds with many different packets of its own, which your computer stitches together to form the web page. The packet is the basic unit of data that computers on a network exchange.

“Stay hungry. Stay foolish.”
-Steve Jobs