CN: WEEK 1

Importance of Computer Networks (Preliminary)

- In the world of Information Technology (IT) information is building block for effective communication.

- Communication is medium that helps us to drive our day to day professional and personal operations.

- Computer networking acts as base of everything as the most important IT solutions.

Things benefited with the help of computer networks:

Provides best way of business communication.

Streamline communication.

Cost-effective resource sharing.

Improving storage efficiency and volume.

Cut costs on software.

Cut costs on hardware.

Utilizes Centralized Database.

Increase in efficiency.

Optimize convenience and flexibility.

Allows File sharing.

sharing of peripherals and internet access.

Network gaming.

Voice over IP (VoIP).

Media Center Server.

Centralize network administration, meaning less IT support.

Flexibility.

Allowing information sharing.

Supporting distributed processing.

User communication.

Overcoming geographic separation.

In general, we can see “Communication” and “Sharing”, that is all networking is about in simple terms.

It enables everything that we do today. In the current scenario, the business would not work without computer networking

Why you should go for Networking?

- Networking is the fastest-growing field and the demand for skillful employees is increasing rapidly in this field.

- Also, factors like – job security, universal certification, etc in this field have an upper hand in comparison to other domains.

Job Profiles

- **Network Engineer:** They are particularly responsible for designing and managing the groups of computers networked together. Apart from that, the installation and configuration of network devices, troubleshooting processes, and technical support & assistance operations are also lead by them.
- **Network Analyst:** They are responsible for assessing the created network systems including documentation process, policy making, software installation, etc. They are the one who works from both the end i.e., identify the problem and then providing a solution.
- **Network Technician:** They are responsible for troubleshooting and repairing of the specific hardware and software devices. They also deal with help-desk services to repair or upgrade the systems. They should have extensive knowledge of various operating systems like – Linux, Unix, Windows, etc. along with the fundamentals of computer networking.
- **Network Solution Architect:** They are responsible for leading the design process of the network system. Also, they manage the existing networks and monitors the traffic. They have to provide efficient and cost-effective network design for the organization.
- **Network Programmer:** They are responsible for writing codes or scripts for the network analysis, such as diagnostics or monitoring utilities. They are also responsible for the configuration and assessment of the APIs and the integration of new technologies into the existing network structure.

Which Networking Certification is good?

- **Cisco Certification:** Cisco is a hardware and software networking multinational company. It offers various levels of network certifications. Some of the most important CISCO Certifications are listed below:

CCNA: Cisco Certified Network Associate (CCNA) certification is concerned with the process of installation, set up, configuration, troubleshooting and operating a routed and switched computer network. It acts as a prerequisite for more advanced certifications.

CCNP: Cisco Certified Network Professional (CCNP) certification is recommended for the IT Professionals who have some experience in networking and are looking for more exposure and growth in this field. However, the validity of this certification is for 3 years, after which it requires a renewal.

CCIE: Cisco Certified Internetwork Expert (CCIE) certification are for those who have some expertise in designing and handling complex network systems.

- **Wireshark WCNA Certification:** The Wireshark Certified Network Analyst (WCNA) Certification program concerns the analysis of packets and protocols for the network troubleshooting, optimization, and security purpose. The exam for this certification consists of following areas
  - **Wireshark Functionality**
  - **TCP/IP Network Communications**
  - **Network Troubleshooting**
  - **Network Security**

- **SolarWinds Certified Professional Certification:** SolarWinds Certified Professional certification is provided by SolarWinds which concerns the ability to handle network and system management products.

- **Juniper Certification:** Juniper Networks provides the certifications at various levels – Associate, Specialist, Professional and Expert. Some of the major Juniper Certifications are listed below –

JNCIA: It is designed for the Associate Level. This certification exam is concerned with the basic knowledge of networking and functionality of the Juniper Networks.

JNCIS: It is designed for the Specialist Level. The purpose of it is to analyze the intermediate-level understanding of the candidate in the respective domain i.e., data center, routing & switching or security.

JNCIP: It is designed for the Professional Level. This certification exam is concerned with the wider knowledge of networking domains and advances the functionality of the Juniper Networks.

JNCIE: It is designed for the Expert Level. The purpose of this certification is to validate the expertise of the networking professionals in the concerned field.

- Some of the top networking companies across the world are listed here.
  - **IBM**
  - **Cisco Systems**
  - **Intel**
  - **Brocade**
  - **Juniper**
  - **Verizon**
  - **Microsoft**
  - **Siemens**

INTRODUCTION

Data Communications:

- When we communicate, we are sharing information. This sharing can be local or remote.

- Between individuals, local communication usually occurs face to face, while remote communication takes place over distance.

- 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.*

- *Transmission of digital data between two or more computers.*

- *Effectiveness of a data communications system depends on four fundamental characteristics:*

➢ *Delivery*

➢ *Accuracy*

➢ *Timelines*

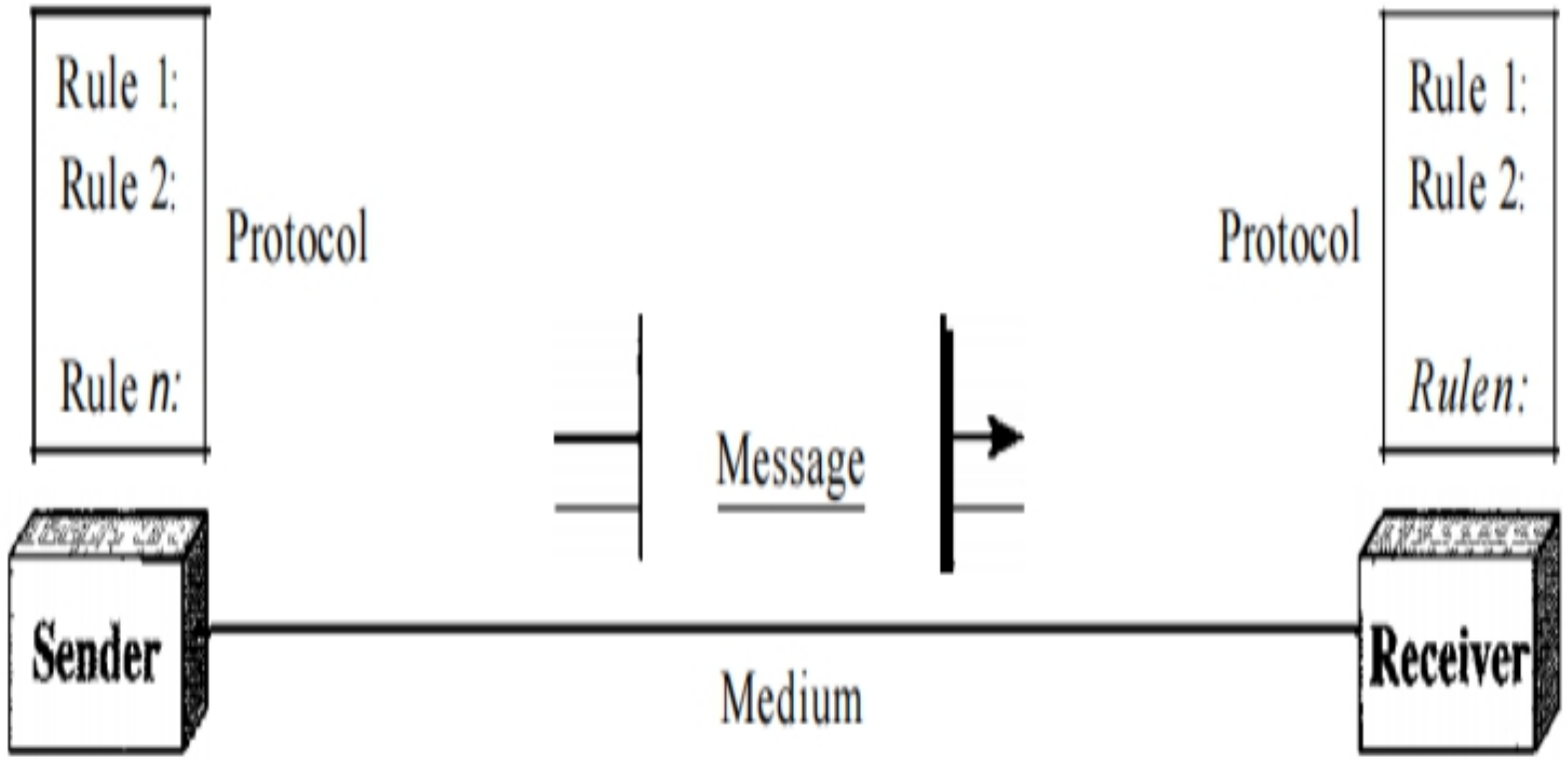
➢ *Jitter.*

- **Delivery.** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

- **Accuracy.** The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.

- **Timeliness.** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called real-time transmission.

- **Jitter.** Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. For example, let us assume that video packets are sent every 5 ms. If some of the packets arrive with 3-ms delay and others with 4-ms delay, an uneven quality in the video is the result.

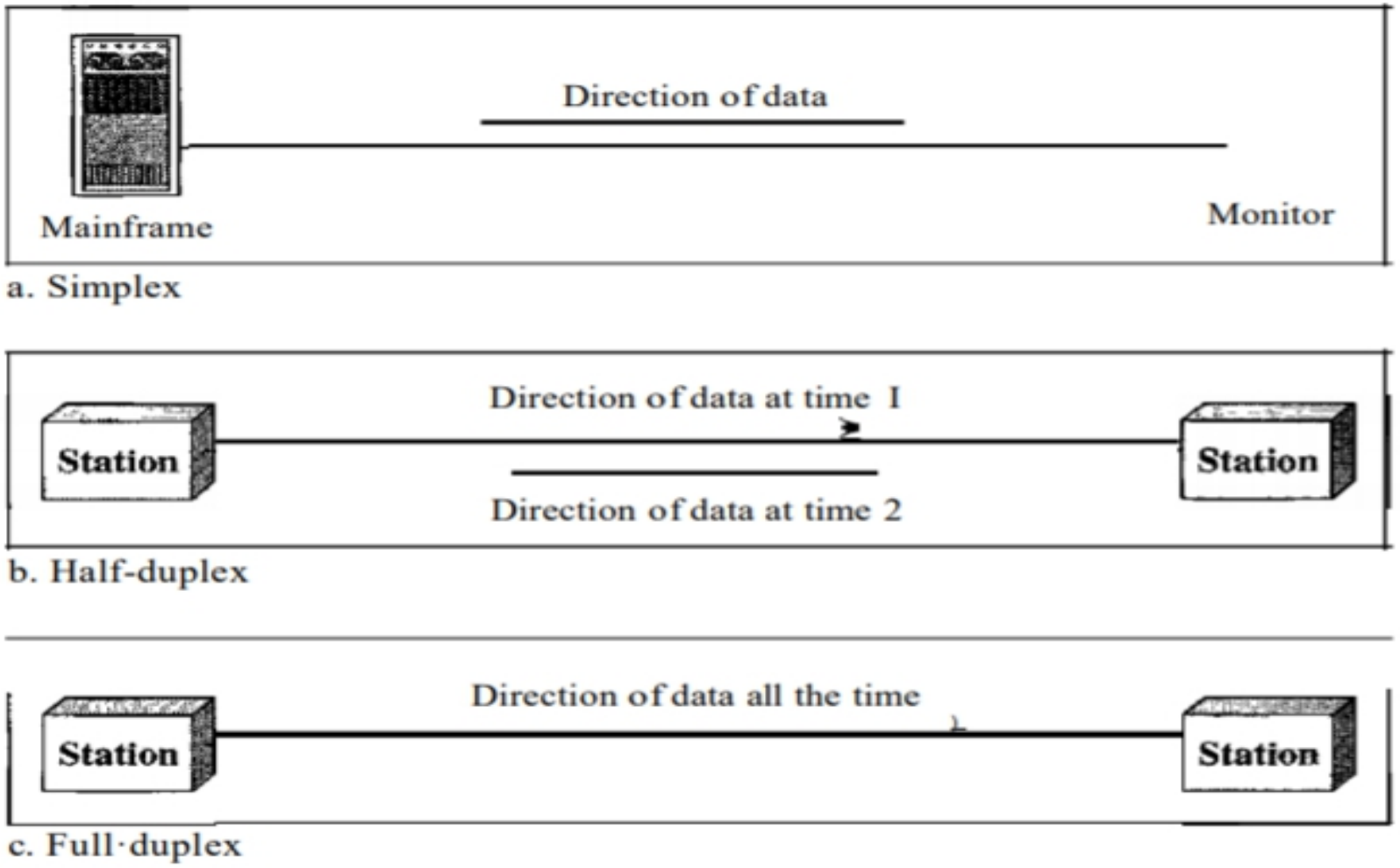


Five components of data communication

Information today comes in different forms such as text, numbers, images, audio, and video. A data communications system has five components:

- **Message.** The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
- **Sender.** The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
- **Receiver.** The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
- **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.
- **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.

Communication between two devices can be simplex, half-duplex, or 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. Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output.

- **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. Walkie-talkie and CB (citizens band) radios are both half-duplex systems.

- **Full-Duplex:** In full-duplex mode, both stations can transmit and receive simultaneously. One common example of 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.

NETWORKS

- A network is a set of devices (often referred to as nodes) connected by communication links so that various devices can interact with each other through a network.

- 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.

- The aim of the computer network is the sharing of data & resources among various devices.

- Most networks use distributed processing, in which a task is divided among multiple computers. Instead of one single large machine being responsible for all aspects of a process, separate computers handle a subset.

A network must be able to meet certain criterias, these are mentioned below

Performance: Performance can be measured in many ways, including transit time and response time. Transit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an inquiry and a response. Performance is often evaluated by two networking metrics: throughput and delay.

Reliability In addition to accuracy of delivery, 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 Network security issues include protecting data from unauthorized access, protecting data from damage and development, and implementing policies and procedures for recovery from breaches and data losses.

Important uses Of Computer Network are:

- **Resource sharing:** Resource sharing is the sharing of resources such as programs, printers, and data among the users on the network without the requirement of the physical location of the resource and user.

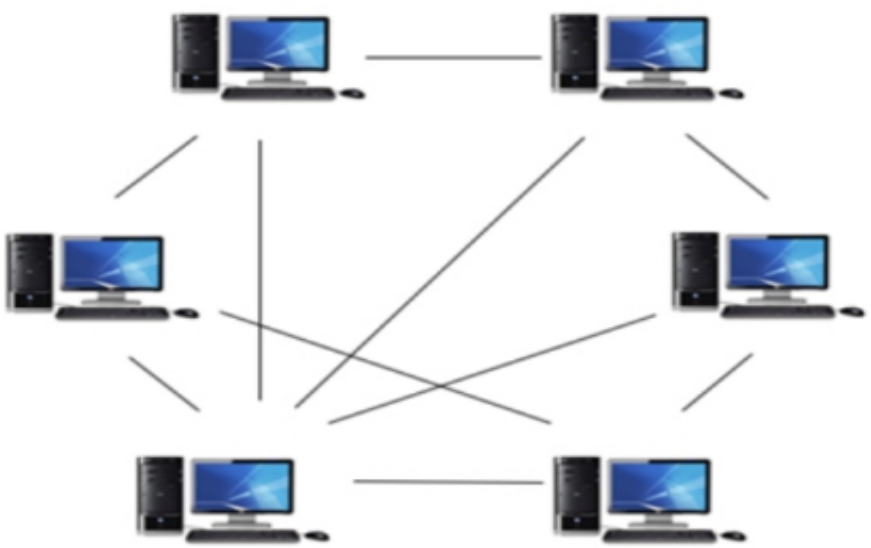
- **Server-Client model:** Computer networking is used in the server-client model. A server is a central computer used to store the information and maintained by the system administrator. Clients are the machines used to access the information stored in the server remotely.

- **Communication medium:** Computer network behaves as a communication medium among the users. For example, a company contains more than one computer has an email system which the employees use for daily communication.

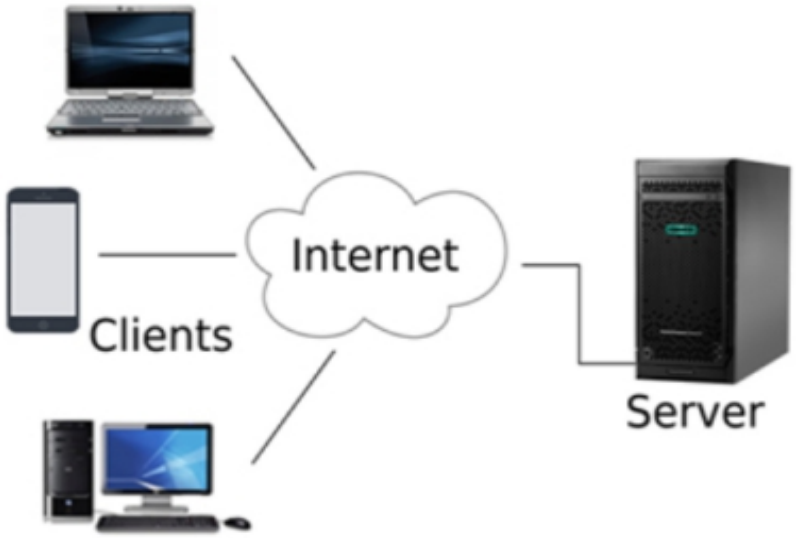
- **E-commerce:** Computer network is also important in businesses. We can do the business over the internet. For example, amazon.com is doing their business over the internet, i.e., they are doing their business over the internet.

Computer Network Architecture

It defines how tasks are allocated to the computer. The two types of network architectures are Peer-To-Peer network and Client/Server network.



Peer-To-Peer



Client/Server

Peer-To-Peer network

- Peer-To-Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- Peer-To-Peer network is useful for small environments, usually up to 10 computers.
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.

Client/Server Network

- Client/Server network is a network model designed for the end users called clients, to access the resources such as songs, video, etc. from a central computer known as Server.
- The central controller is known as a server while all other computers in the network are called clients.
- A server performs all the major operations such as security and network management.
- A server is responsible for managing all the resources such as files, directories, printer, etc.
- All the clients communicate with each other through a server. For example, if client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

Advantages Of Peer-To-Peer Network:

- It is less costly as it does not contain any dedicated server.
- If one computer stops working but, other computers will not stop working.
- It is easy to set up and maintain as each computer manages itself.

Disadvantages Of Peer-To-Peer Network:

- In the case of Peer-To-Peer network, it does not contain the centralized system . Therefore, it cannot back up the data as the data is different in different locations.
- It has a security issue as the device is managed itself.

Advantages Of Client/Server network:

- A Client/Server network contains the centralized system. Therefore we can back up the data easily.
- A Client/Server network has a dedicated server that improves the overall performance of the whole system.
- Security is better in Client/Server network as a single server administers the shared resources.
- It also increases the speed of the sharing resources.

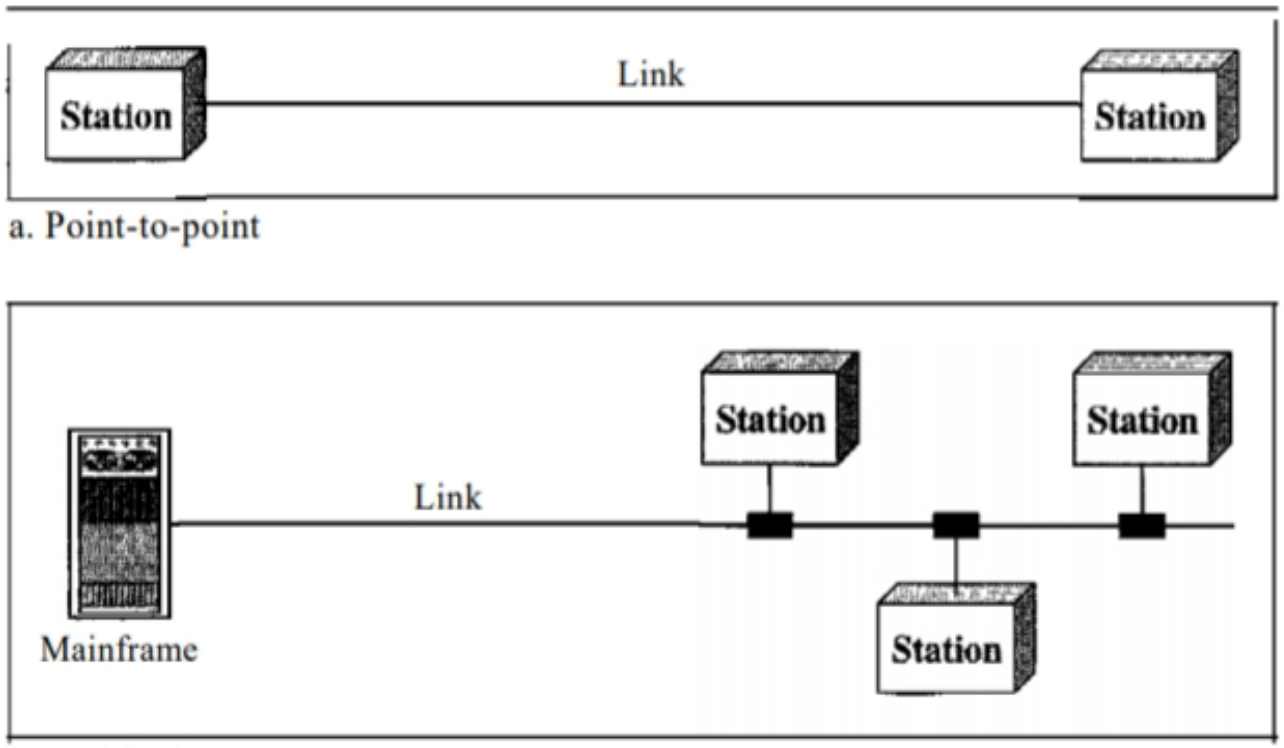
Disadvantages Of Client/Server network:

- Client/Server network is expensive as it requires the server with large memory.
- A server has a Network Operating System(NOS) to provide the resources to the clients, but the cost of NOS is very high.
- It requires a dedicated network administrator to manage all the resources.

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

For communication to occur, two devices must be connected in some way to the same link at the same time.

There are two possible types of connections: point-to-point and multi-point.



Types of connections: point-to-point and multipoint

- ***Point-to-Point*** A point-to-point connection provides a dedicated link between two devices. The entire capacity of the link is reserved for transmission between those two devices.

- ***Multipoint*** A multipoint connection is one in which more than two specific devices share a single link. In a multipoint environment, the capacity of the channel is shared.

END