

Computer Network:

Nodes connected through communication links makes a computer network.

Why we need a computer network?

The computer network is mainly used for resource sharing which inturn saves a lot of infrastructure cost as well.

Nodes:

↓

Any device capable of sending/receiving data generated by other nodes in the network.

Examples of nodes:

- Servers
- Printers
- Security cameras
- Bridges
- Routers
- Switches
- Computers etc

Types of Nodes:

Nodes can be intermediary or end nodes

End Nodes:

These nodes are the starting or the ending point of the communication.

For example:

- PC
- Printer
- Server
- Tablet
- Smart Phone

Intermediary Nodes:

These nodes are in between the end nodes which forward the data between the end devices.

For example:

- Router
- Modem
- Cell Tower
- Hub
- Switch etc

Communication links:

The connection which facilitate communication between the nodes. These links carries the information. A Communication link can be wired or wireless

Examples of Communication links:

Cable (Wired Communication)

Space (Wireless Communication)

Components of a computer network:

A computer network is made of:

Nodes:

Hub

Repeater

PC

Printer

Server

Tablet

Smart Phone

Router

Modem

Cell Tower

Switch etc

Media:

★ Wired Media (Guided Medium):

In wired media, data is converted into signals (Electrical signals or light signals)

- **Ethernet Cable:**

It come in 2 variations(Straight through cable for connecting different devices and Cross over for same devices). Data here is in the form of electrical signals.

- **Fibre optic cable:**

Data is going to be carried in the form of light waves.

- **Coaxial cable:**

Carries data in the form of electrical signals.

- **USB Cable:**

Used to connect a computer and a smart phone. Data is in the form of electrical signals.

- ★ **Wireless Media (Unguided Media):**

In Wireless network, data is communicated through waves

Infrared (Example: short range communication - TV remote control)

Radio : Higher than Infrared (Example: Bluetooth, Wi-Fi)

Microwaves (Example: Cellular System)

Satellite (Example: Long range communication - GPS)

Services:

Network provide us the following services:

- ☐ e-mail
- ☐ Storage services (Google drive)
- ☐ Instant messaging
- ☐ Online games
- ☐ Accessing websites
- ☐ File sharing etc.

Basic Characteristics of a Computer network:

There are 4 basic Characteristics a computer network should pocess which are:

- ☐ Fault tolerance
- ☐ Scalability
- ☐ Quality of Service
- ☐ Security

Fault tolerance:

The ability to:

1. Continue working despite failures
2. Ensure no loss of service

For example, If someone get back to home daily from his office through the same route, but somehow there came a blockage in the way. The person obviously will not go back to the office rather he will choose another route to reach home. Similarly, If someone is visiting something on the internet and due to some failure in the link or the router, the communication should not stop. i.e: The data should take another route and give us response.

Scalability:

The ability to:

1. Grow based on the needs
2. Have good performance after growth

For example, every second a new user become a part of the internet but still the internet does not slow down and have good performance even after the growth of users.

Quality of Service:

The ability to:

1. Set Priorities
2. Manage data traffic to reduce data loss, delay etc.

For example, one person is sending an email, and another person is talking on VoIP. The same router receives both the data at the same time. A delay of 1 second in email communication is not a big problem but a delay of one second in real time communication is a problem. So VoIP should be given priority and forwarded first and then email should be forwarded because VoIP is a real time communication.

Security:

The ability to prevent:

- ★ Unauthorized access
- ★ Misuse
- ★ Forgery (In Cyber security, Forgery means faking digital data or messages to deceive or manipulate.)

The ability to provide:

- ★ Confidentiality (Data should be converted into a form understandable only by sender and receiver)
- ★ Integrity (The state in which the data is sent should be received by the receiver. i.e the data should not get modified by hackers on its way to destination)
- ★ Availability (Availability means that users have timely and reliable access to data when they need it. This means that systems must be protected from tampering)

Data Communication:

Exchange of data between nodes via some form of link (Transmission Medium) such as cable.

Data Flow:

The data is going to flow from one node to another node.

Data flow can be:

1. Simplex:

Communication is always unidirectional in simplex data flow. Here one device will transmit and the other will receive. For example: Keyboards.

2. Half-Duplex:

Communication is in both directions but not at the same time. If one device is sending, the other device can only receive and vice versa. For example: Walkie-Talkies.

3. Duplex or Full-Duplex:

Communication is in both directions simultaneously. Here the devices involved in the communication can send and receive data at the same time. For example: Telephone line.

Common Schemes in any communication:

All communication schemes will have the following things in common.

- ☐ Source or sender
- ☐ Destination or receiver
- ☐ Channel or media

To make the communication effective both sender and receiver must mutually agree upon certain rules so that the communication does not become useless

Protocols:

Rules that govern data communication.

Protocol determines:

- ☐ What is communicated?
- ☐ How it is communicated?
- ☐ When it is communicated?

Before discussing protocols in computer networks, let's first have a look at the protocols in human communication.

Protocols in Human Communication:

Protocols are necessary for human communication and include:

- ★ An identified sender and receiver
- ★ Common language and grammar
- ★ Speed and timing of delivery
- ★ Confirmation or acknowledgment requirements

If the above rules are taken care of, then only the communication can be effective.

Likewise, to have an effective communication in a network we must have to have the below rules to be taken care of.

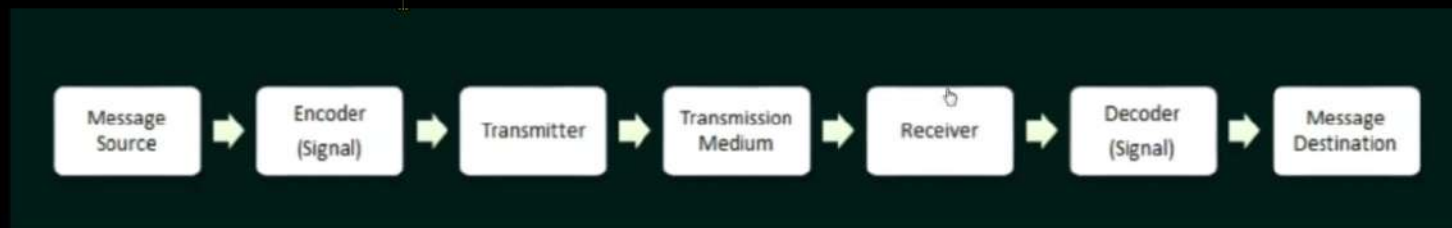
Protocols in network communication:

Protocols used in network communications also define:

- ☐ Message encoding
- ☐ Message formatting and encapsulation
- ☐ Message timing
- ☐ Message size
- ☐ Message delivery options

These are also called elements of the protocol.

★ Message encoding:



The sender encodes the data, i.e : Convert the data to signals or waves depending upon the transmission medium, then through the transmission medium, the transmitter sends the data to the receiver who decodes it, i.e : Convert the signals or waves back to data to understand it and in this way the message is received by the destination.

★ Message formatting and encapsulation:

Both sender and receiver must mutually agree upon a common format. e.g: Both should use common language or maybe the file type based on extension with which both the sender and receiver are comfortable with.

Similarly we have to encapsulate the information to identify the sender and receiver rightly.

★ Message timing:

Message timing deals with flow control and response timeout.

- Flow Control:

Lets say the sender is sending the data too fast that the receiver is unable to handle such speed so the entire communcation here is useless, so it is the responsibility of the protocol to provide flow control, i.e : speed matching mechanism.

- Response Timeout:

acknowledgement

Secondly, if the sender is sending some data, the receiver has to acknowledge that data. When the acknowledgement is send back to the sender, he can understand that the receiver has received the data. If the is not received, the sender has to wait for a certain period of time after which it has to retransmit the data again to ensure guaranteed delivery and it is the responsibility of the protocol to tell the sender that how much time you should wait for an acknowledgement

★ Message size:

Humans break long messages into smaller parts or sentences to make the communcation effective. Likewise, long messages must also be broken into smaller pieces to travel across a network. e.g : If the data to be sent is big and the communcation channel is small, the source should break his message into smaller message into the size which the communication link can handle.

★ Message delivery options:

There are three different types of delivery options:

- Unicast:

If the sender is sending data to only one destination in the network, it is called unicasting.

- Multicast:

If the sender sends the data to set of receivers but not all in the network, it is called multicasting.

- Broadcast:

If the sender sends the data to all the participants in the network, then it is called broadcasting.

These are also called elements of the protocol.