Introduction to Computer networks

1. Networking is everywhere.
2. Networks support the way we learn.
3. Networks support the way we communicate.
4. Networks support the way we work.
5. Networks support the way we play.

Syllabus

1. Fundamentals
2. Data Link Layer
3. Network Layer
4. Transport Layer
5. Application Layer
6. Network Security

Definition - Computer Network

A Computer network is a set of **nodes** connected by **communication links.**

**Node:** A node can be a computer, printer or any other device capable of sending/receiving data generated by other nodes in the network.

**Example:** Computer, Server, Printer, Security camera, many more (Switches, Bridges, Routers etc.)

**Communication links:** A communication link can be **wired link** or **wireless link.**

The link carries the information.

Find out the end nodes (end devices) and intermediary nodes depicted in the scenario and place them rightly.

**End Devices:** The source or the destination in the communication are called as nodes.

**Intermediary Devices:** The Devices which forwards the data from one side to another side is called intermediary Devices.

|  |  |
| --- | --- |
| END DEVICES | INTERMEDIARY NODES |
| PC | Router |
| Printer | Wireless Router |
| Server | Cell Tower |
| Tablet | Modem |
| Smart Phone | Internet Cloud |

Basic Characteristics of computer network

* Fault Tolerance
* Scalability
* Quality of Service (QOS)
* Security

1. Fault Tolerance

The ability to:

* Continue working despite failures
* Ensure no loss of service

Ex: if you have a computer network and if had problem inside the computer network but still computer network should work with no loss of service

1. Scalability

The ability to:

* Grow based on the needs
* Have good performance after growth

Ex: if there are 10 computers in a network and if again 10 computers added to the network this network should work as like the same after adding the 10 computers

1. Quality of Service (QOS)

The ability to:

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

Ex: if a router receives 2 data at a time and this router should know which data should process first.

1. Security

The ability to prevent:

* Unauthorized access
* Misuse
* Forgery

The ability to provide:

* Confidentiality
* Integrity
* Availability

Data Communication:

* Data Communications are the exchange of data between two nodes via some of link (transmission medium) such as a cable.

Two nodes are going exchange data is called Data Communication.

Data Flow:

* Data flow means the data is going to flow from one node to another node.

There are 3 types of flows:

1. Simplex
2. Half Duplex
3. Full Duplex
4. Data Flow – Simplex

Communication is always unidirectional

One device can transmit, and another device will receive.

EX: Keyboard: the keyboard will give data to CPU whereas CPU is not going to give any data to the Keyboard.

EX: traditional Monitors (no touch monitors): whatever the data is there in the CPU that is going to be given to the monitor and monitor is not going to give any information to the CPU.

1. Data Flow – Half Duplex

Communication is in both directions but not at same time.

If one device is sending, the another can only receive, and vice versa.

EX: Walkie-Talkies.

1. Data Flow – Duplex or Full Duplex

Communication is in both directions simultaneously.

Device can send and receive at the same time.

EX: Telephone line.

Protocols

* All Communication schemes will have the following things in common:

1. Source or sender
2. Destination or receiver
3. Channel or media

* Rules or protocols govern all methods of communication.
* Protocol = Rule.
* It is a set rules that govern data communication.
* Protocol Determines:

1. What is communicated?
2. How is it communicated?
3. When is it communicated?

Protocols – Human Communication

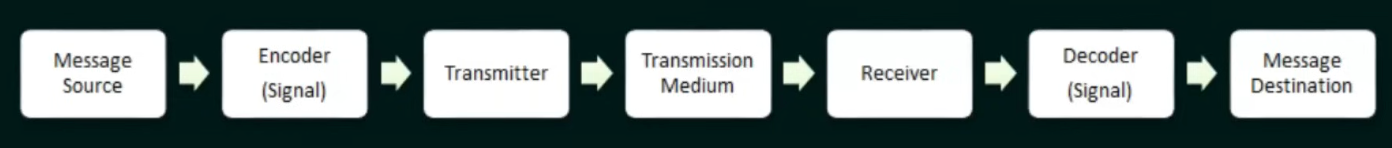
* Protocols are necessary for human communication and include:

1. An identified sender and receiver
2. Common language and grammar
3. Speed and timing of delivery
4. Confirm or acknowledgment requirements

Protocols – Network Communication

* Protocols used in network communications also define:

1. Message encoding
2. Message formatting and encapsulation
3. Message timing
4. Message size
5. Message delivery options
6. Message Encoding:



1. Message Formatting and Encapsulation

Agreed format. (Both sender and receiver must mutually agree upon certain formats)

Encapsulate the information to identify the sender and the receiver rightly.

1. Message timing

Flow control

Response timeout

1. Message Size

Human break long messages into smaller sentences.

Long messages must also be broken into smaller pieces to travel across a network.

1. Message Delivery Options

* Unicast (one sender and one receiver)
* Multicast (if senders send the data to set of receivers, not all)
* Broadcast ( the sender send the data to all the participants in the network.)

Components of a computer network

1. Nodes
2. Media
3. Services
4. **Nodes**

End nodes (end devices).

End nodes are the nodes starting point in the communication or the end point in the communication.

Intermediary nodes.

* **End Nodes (devices)**

Computers

Network printers

VoIP Phones

Telepresence endpoint

Security cameras

Mobile handheld devices (smart phones, tablets, PDAs (personal digital Assistance), Wireless debit/credit card reader, barcode scanner)

**Intermediary nodes**

Switches

Bridges

Wireless Access point

Hubs

Routers

Repeaters

Security Devices (Firewall)

Cell Tower

1. Media

Wired Medium (guided medium)

Wireless Medium (unguided Medium)

Ex: ethernet straight – through cable

A blue wire on a black background

AI-generated content may be incorrect.

The data will carry in terms of electrical signals.

Ethernet crossover cable

Fiber optic cable

Close-up of a cable

AI-generated content may be incorrect.

In fiber optic cable, the data is going to be carried in the form of light waves.

Coaxial cable

A close-up of a cable

AI-generated content may be incorrect.

USB cable

Wireless media

* Infrared (Ex: short range communication – TV remote control)
* Radio (Ex: Bluetooth, Wi-fi)
* Microwaves (Ex: cellular System)
* Satellite (Ex: Long range communication – GPS)

1. Services
2. E-mail
3. Storage services
4. File sharing
5. Instant messaging
6. Online game
7. Voice over IP
8. Video telephony
9. World Wide Web

Classification of computer networks

1. Local Area network (LAN)
2. Metropolitan Area Network (MAN)
3. Wide Area Network (WAN)
4. Local Area Network (LAN)

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.

LAN – Devices

* Wired LAN (Ex: Ethernet – Hub, Switch)
* Wireless LAN (Ex: Wi-fi)

1. Metropolitan Area Network (MAN)

A metropolitan area network (MAN) is a computer network that interconnects users with computer resources in a geographic region of the size of a metropolitan area (city).

MAN – Devices

* Switches/Hub
* Routers/Bridges

1. Wide Area Network (WAN)

A wide area network (WAN) is a **telecommunications network** that extends over a **large geographical area** for the primary purpose of computer networking.

WAN – Devices

End devices and intermediary devices

Storage Area Network (SAN)

Cloud Computing

It is the on-demand availability of computer system resources, especially data storage and computing power, without active management by the user.