

2. Networking Fundamentals

what Is Network?

The Environment created by devices in a digital world which allow nodes to share resource is called computer network.

- **ARPANET:** In 1969 internet was started by a Advanced Research Projects Agency Network (ARPANET) in **USA**. by connecting 3 university network.

Client : a device which access a service made available by a server.

Server : a device which provide service to client.

Software component of a network

Operating system:- system like windows, MacOS, or Linux have built in network capabilities.

network driver:- These are software program that control the network hardware and provide an interface for the operating system to interact with it.

Networking protocols:- These are set of rules that given how data is transferred on a network.

Switching Techniques

Switching is the mechanism for moving information between network.

- When we send the data before data reach to destination address data have to travel through various communication channels like switch , nodes, router , switching terminal ,server etc.

3 Type of Switching

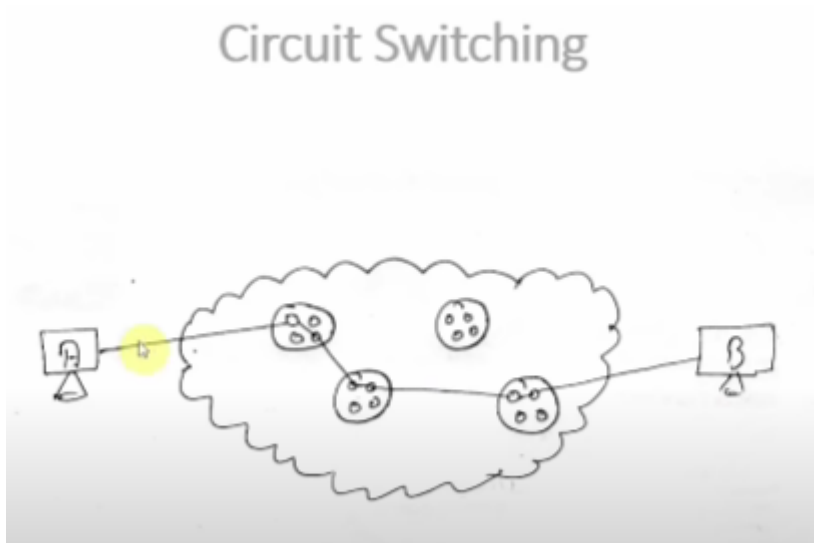
1 . Circuit switching: When 2 nodes communicate with each other over a dedicated communication path is called circuit switching.

- There is a need of pre-specified route from which data will travels and no other data is permitted.
- In Circuit Switching a dedicated channel (or circuit) is set up for a single connection between the sender and recipient during the communication session.
- the channel is reserved between the users till the connection is active.

Mostly used in **Telephone**.

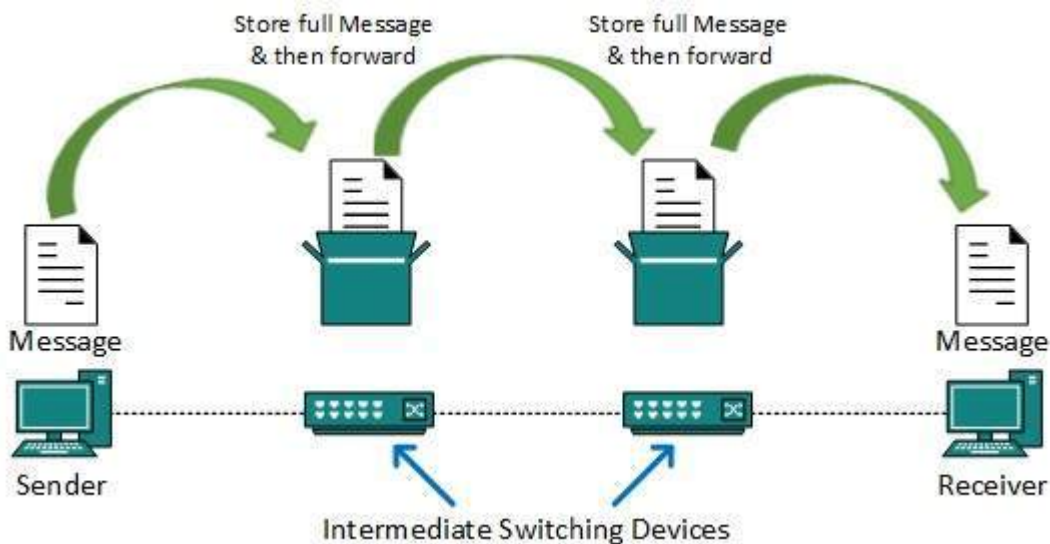
Circuits can be permanent or temporary. Applications which use circuit switching may have to go through three phases:

- Establish a circuit
- Transfer the data
- Disconnect the circuit



Message switching: In message switching, the whole message is treated as a data unit and is switching / transferred in its entirety.

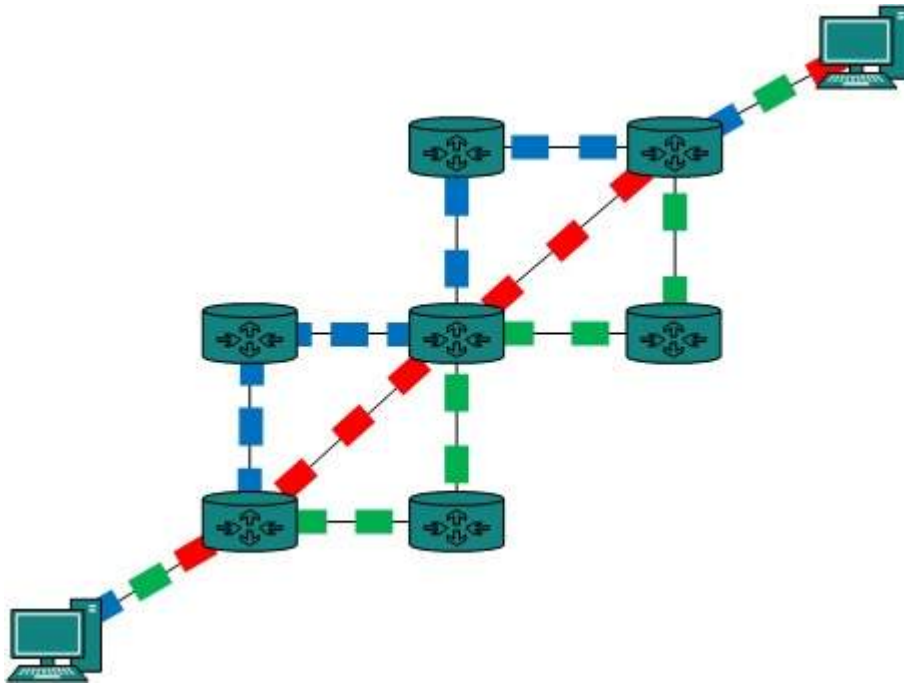
- Every switch in transit path needs enough storage to accommodate entire message.
- Because of store-and-forward technique and waits included until resources are available, message switching is very slow.
- Message switching was not a solution for streaming media and real-time applications.



Packet Switching : The entire message is broken down into smaller chunks called packets. The switching information is added in the

header of each packet and transmitted independently.

It is easier for intermediate networking devices to store small size packets and they do not take much resources either on carrier path or in the internal memory of switches.



Here's a table comparing the advantages and disadvantages of Circuit Switching, Message Switching, and Packet Switching:

Switching Type	Advantages	Disadvantages
Circuit Switching	- Guaranteed bandwidth	- Inefficient resource use during idle periods
	- Low latency once connected	- Scalability issues with many simultaneous connections
	- Predictable performance	- Setup time required to establish connections
	- Simple communication model	- Fixed capacity, not adaptable to demand changes
Message Switching	- No dedicated path, efficient resource use	- Higher latency due to storage and forwarding delays
	- Scalable, handles many messages	- Message size limitations can affect performance
	- Flexible, messages stored and forwarded as needed	- More complex handling and management

Switching Type	Advantages	Disadvantages
Packet Switching	- Efficient resource use, dynamic bandwidth allocation	- Variable latency depending on network congestion
	- Highly scalable for large volumes of data	- Overhead from packet headers
	- Robust error handling for individual packets	- Packet loss can occur in congested networks
	- Ideal for diverse data types (voice, video, etc.)	- Requires more complex routing algorithms

Type Of Network:

1. **PAN (Personal network)** : up to 10m and minimal devices are connected like phone and headset.
2. **LAN (Local Area Network)** : connects computers and devices within a limited area, like a home or office.
3. **MAN (Metropolitan Area Network)** : is a network that connects multiple LANs within a specific geographic area, like a city or a large campus.
4. **WAN (Wide Area Network)** : is a telecommunications network that extends over a large geographical area, connecting multiple LANs and MANs, often using public or private networks.
5. **CAN (Campus area network)** : It smaller then MAN and larger than LAN. This computer network can contain several LANs. Usually, the computer networks of universities, institutions, or private companies are given as an example of this computer network.

Network Topologies :

Network Topologies describe the arrangement of different elements in a network, such as physical or logical layout of nodes, links and connecting line.

1. **Physical topology** refers to the actual physical layout of devices and cables in a network, showing how they are interconnected in real space.
2. **Logical topology**, on the other hand, describes how data flows through the network, regardless of the physical arrangement, focusing on the way devices communicate and share information.
3. **Star Topology**: All devices connect to a central hub or switch, making it easy to manage and troubleshoot.

4. **Ring Topology:** Devices are connected in a circular fashion, where each device connects to two others, and data travels in one direction.
5. **Mesh Topology:** Every device is connected to multiple other devices, enhancing redundancy and reliability.
 - **Full Mesh:** Every device connects to every other device.
 - **Partial Mesh:** Some devices connect to all, while others connect only to a few.
6. **Bus Topology:** All devices share a single communication line, with data transmitted in both directions along the bus.
7. **Point-to-Point:** A direct connection between two devices, offering a simple and dedicated link.
8. **Tree Topology:** A hierarchical structure combining star and bus topologies, with multiple star networks connected to a central bus.

Internet backbones connections

Internet backbone:- A set of high speed network that carry internet traffic. These network are provided by companies such as AT & T, GTE and IBM.

Internet service provider (ISP)

A company that provides other companies or individuals with access to internet.

Note:- There are various technologies available that you can use to connect a home computers to the internet

A phone modem:- converts a computer data into a analog audio signal for transfer over a telephone line, and then a model at the destination convert it back again into data.

A digital subscriber line(DSL):- uses regular copper line to transfer digital data to and from the phone company's central office.

A cabel model:- use the same line that your cable tv signal come in into transfer the data back one forth.

Number Systems

Decimal Number System

- Uses 10 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
- Example:

- ($1828 = 1 \times 1000 + 8 \times 100 + 2 \times 10 + 8 \times 1$)
- ($1828 = 1 \times 10^3 + 8 \times 10^2 + 2 \times 10^1 + 8 \times 10^0$)

Hexadecimal Number System

- Uses 16 digits: 0-9 and A-F (where A=10, B=11, C=12, D=13, E=14, F=15).
- Example: Decimal 16 = Hexadecimal 10.

DEC.	HEX.	DEC.	HEX.	DEC.	HEX.	DEC.	HEX.
0	0	8	8	16	10	24	18
1	1	9	9	17	11	25	19
2	2	10	A	18	12	26	1A
3	3	11	B	19	13	27	1B
4	4	12	C	20	14	28	1C
5	5	13	D	21	15	29	1D
6	6	14	E	22	16	30	1E
7	7	15	F	23	17	31	1F

IP. to binary

In binary base is 2

192.168.1.22

192 = 11000000

$1 \times 128 + 1 \times 64 + 0 \times 32 + 0 \times 16 + 0 \times 8 + 0 \times 4 + 0 \times 2 + 0 \times 1 = 128 + 64 = 192$

sub $192 - 128 = 64$, $64 - 64 = 0$ so $128 + 64 = 192$

168 = 10101000

$1 \times 128 + 0 \times 64 + 1 \times 32 + 0 \times 16 + 1 \times 8 + 0 \times 4 + 0 \times 2 + 0 \times 1 = 128 + 32 + 8 = 168$

$168 - 128 = 40$, 64 is so big so we skip it, $40 - 32 = 8$, 16 is big skipped, $8 - 8 = 0$

1 = 00000001

$0 \times 128 + 0 \times 64 + 0 \times 32 + 0 \times 16 + 0 \times 8 + 0 \times 4 + 0 \times 2 + 1 \times 1 = 1 = 1$

22 =

$0 \times 128 + 0 \times 64 + 0 \times 32 + 1 \times 16 + 0 \times 8 + 1 \times 4 + 1 \times 2 + 0 \times 1 = 16 + 4 + 2 = 22$

binary to no.

10001111

$1 \times 128 + 0 \times 64 + 0 \times 32 + 0 \times 16 + 1 \times 8 + 1 \times 4 + 1 \times 2 + 0 \times 1 = 128 + 8 + 4 + 2 + 1 = 143$

IPv4 BIT COUNTING SYSTEM

128 64 32 16 8 4 2 1

192.168.1.1

11000000.10101000.00000001.00000001

1.1.0.0.0.0.0.0

$128+64+0+0+0+0+0+0=$ **192**

1.0.1.0.1.0.0.0

$128+0+32+0+8+0+0+0=$ **168**

0.0.0.0.0.0.0.1

$0+0+0+0+0+0+0+1=$ **1**

0.0.0.0.0.0.0.1

$0+0+0+0+0+0+0+0=$ **1**

