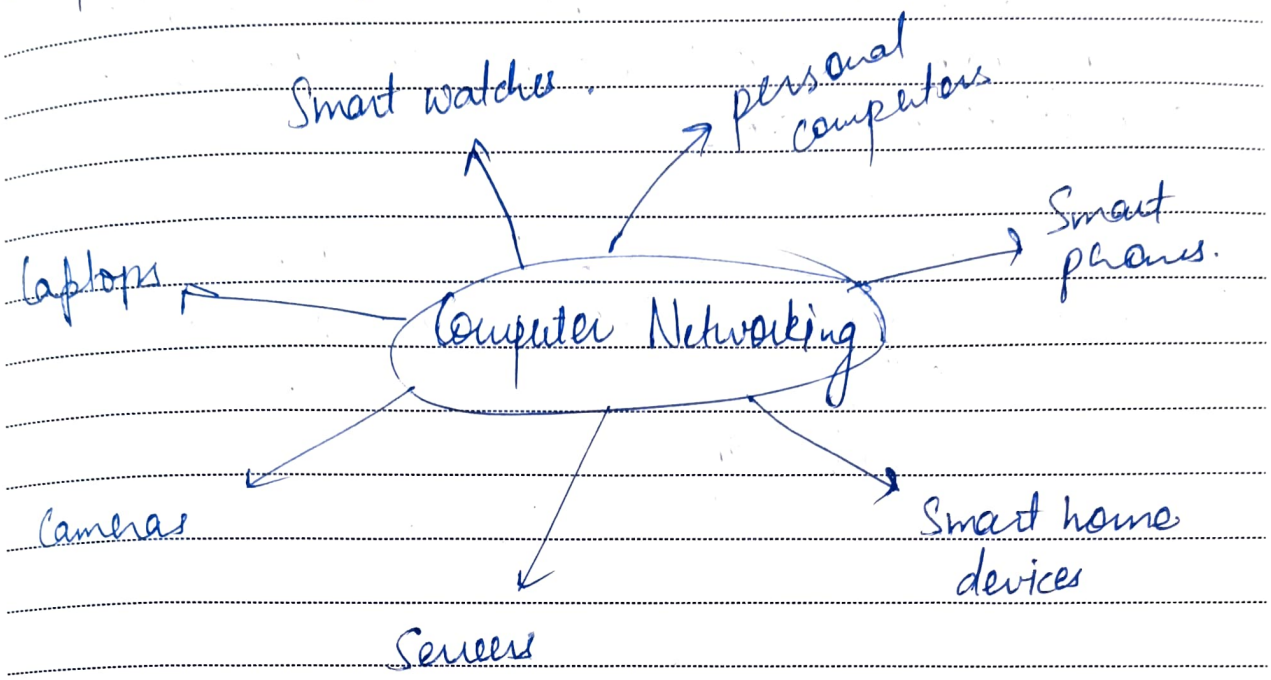
MODULE-I

(Computer Networks) Network and communication.

Computer Networking and Network protocols.



Network protocols:- The set of standardised rules that computer needs to follow to communicate with another device is called "Network Protocols".

Computer Networking:- It basically means how computers/devices/machines communicate with each other.

Internet :-

- is a computer network that connects billions of devices throughout the world.

* In networking the devices like laptops, PC's, smartphones etc are called "end devices", "end systems" or "Hosts".

FTTH = Fibre to the home

FTTN = Fibre to the Node.

ISP = Internet service provider.

* These devices are connected via different mediums
  - Wired, - Wireless.

* These end devices are connected to each other via "Network devices" such as switches, routers and wireless routers.

Network :- collection of end devices, network devices and communication links is called Network.

Network

Access Network	Core Network
It is a network that gives the user access of the telecommunication services. out of different parts or we can say that it is a network that physically connects the end systems to the distant end system.	It is the network that connects the different access networks together but also it connects different ISP's together. It also connects the networks of different countries.
Eg Home network, enterprise network Mobile network (4G|5G|6G), optical Network (FTTH| FTTN) copper network.	Eg :- Global ISPs, Content provided network, data center network

Content provider network -

Data centre network -

→ Access network usually connects the local or regional internet service provider.

INTERNET => Network of Networks !!

→ Sending and recieving the messages is done as the host / end devices take an application message and breaks into the packets. These packets are sent via communication links and network devices to the other hosts / servers.

→ We cannot send as many packets as we want because the communication links have a limited capacity

Link capacity / Transmission rate / Link Bandwidth :-

↳ The capacity of the communication links is known as the link capacity or transmission rate or link bandwidth.

↳ Depending on the link capacity, we can only send a limited no. of packets in that link for a given period of time.

Packet transmission delay :- Since any given link has the capacity and specific rate (analogous to speed) that a packet can traverse, packets experience a delay in going from PointA to PointB in that link. This is called packet transmission delay.

How are packets lost?

$\Rightarrow$ Time needed to transmit $= \frac{L}{R}$

$L \rightarrow$ size of the packet

$R \rightarrow$ bandwidth / link capacity

PACKET SWITCHING

→ We use the concept of PACKET SWITCHING to send the packets from one place to another.

→ In packet switching network, packets are forwarded from one router to the next across links on path from source to destination.

Routing Algorithm → Local forwarding table
↳ header value
↳ output link

→ In the routing algorithm, we have a local forwarding table which every router has,

→ In the local forwarding table, there are 2 contents i.e header value and the output link.

→ In the packet, ~~it is~~ the header value is pre-specified with the output link (destination) and this connection goes on.

FORWARDING → LOCAL action: move arriving packets from router's input link to appropriate link of the router output.

ROUTING → GLOBAL action: determines the source-destination paths taken by the packets.

2 Methods of packet switching } why this is done?
- ↳ store and forwards
- ↳ queuing.

CIRCUIT SWITCHING

- → In circuit switching, end to end resources are reserved for a "call" between source & destination.
- → Dedicated resources: no sharing
- → Circuit segment is idle if not used by call (no sharing)
- → Commonly used in traditional telephone networks

PACKET SWITCHING	CIRCUIT SWITCHING
→ Resource sharing	→ Dedicated resources.
→ No call setup is needed.	→ Quality of service guaranteed.
→ Protocols needed for reliable data transfer, congestion control	→ Not scalable at all
→ Can achieve circuit switching behaviors with special mechanisms.	

LAYERED ARCHITECTURE

Advantages

- To discuss a well defined, specific part of a large and complex system.
- Easy to identify and discuss the relationship of system's pieces.
- Modularisation eases maintenance.

1.3 TCP/IP

Network layered Model

- We use a layered approach to build an architecture for computers to communicate for computer networking.

There are two main layered model developed for computer networking.

Network layered Model

- Transmission control protocol / Internet Protocol (TCP/IP) — Five layered model
- Open systems interconnection / International organization for standardisation (OSI/ISO) reference model — 7 layered Model.

TCP / IP layers

Application layer
Transport layer
Network layer
Data link layer
Physical layer.

OSI / ISO reference model

Application layer
Presentation layer.
Session layer
Transport layer
Network layer
Data link layer
Physical layer.

UDP = User datagram protocol

TCP/IP protocol stack

Layer Name	Protocol	Protocol data unit	Addressing
Application	HTTP, SMTP, DNS	Message	N/A
Transport	TCP, UDP	Segment	Port Numbers
Network	IP	Datagram	IP address
Data link	WiFi, Ethernet	Frames	MAC address
Physical	Wireless, cables	Bits	N/A

Physical layer → Networking cables, wireless devices and all.

Physical layer is all about cabelling, connectors and signals & how signals are sent over the communication links.

Data link layer is responsible for defining a unique protocols for ~~defining~~ interpreting the signals from physical layer.

~~Which~~ Q- Will the output link of every layer will be same or different?

Data link layer is responsible for connecting the multiple layers.

Data link layer delivers the data across a single link.

Network layer delivers the data b/w 2 individual computers/devices. Responsible from getting data from 1 device to the other.

Transport layer

UDP is responsible for getting ensured that the data is sent on the right application that is running on that nodes.

Transport layer delivers the data to the correct applications run in a device.

Application layer is responsible for certain application

Servicing, Layering and Encapsulation

Application	Application exchanges messages		Application
Transport	Transport-layer transfers from 1 process to another		Transport
Network			Network
Link	Transfers datagram from device to neighbouring device		Link
Physical			Physical
SOURCE			DESTINATION

Q→ Does application layer has a header or not?

Transport-layer protocol encapsulates application layer message, with transport layer header H_t to create a transport-layer segment.

H_t used by transport layer protocol to implement its service.

Network layer protocol transfers transport-layer segment from one device to another devices. Network layer protocol encapsulates transport-layer segment $[H_t | M]$ with the network layer header H_n to create a network-layer datagram.
H_n used by the network layer protocol to implement its services.

Link layer protocol encapsulates network datagram $[H_n | H_t | M]$, with link-layer H_l to create a link-layer fram.

Link layer protocol transfers datagram $[H_n | H_t | M]$ from device to ~~neigh~~ neighbouring device.

Q→ What is the use of link layer switch?

Source side → encapsulation happens
Destination side → decapsulation happens

End to End packet transfer

Link layer switch and router do not have all the 5 layers of TCP/IP protocol. They have just Link layer and Physical layer and for router it includes Network layer with link & physical layer

→ IETF = Internet Engineering Task force has developed internet standards.

→ RFC's = Request for comments → These are the documents that contain the detail of the standardised protocols are called RFC's.

→ 3GPP = 3rd Generation partnership project.

→ IEEE 802 defines the Ethernet & wireless WIFI standards and 3GPP defines the standards for 4G & 5G wireless networks.