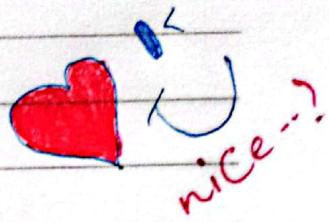




اللهم إله العالمين
سُرْعَةً مُّسْرَعَةً

Lecture "1"

→ What's The internet ?



• billions of connected computing devices running network Apps.

• These devices connected with each other by :-

→ Communication Links :-

* wireless :- ↗ wifi, mobile 4G-LTE ...

* wired :- ↗ fiber, copper ...

→ Transmission rate : (Bandwidth) (bps)

• ↗ maximum data rate which can be sent throughout link

All of above are connected with ^(Devices) :-

* Packet Switches :- routers - switches

* Protocols :-

• a group of rules that control sending, receiving messages

Like :- TCP, IP, HTTP, 802.11 ...

⇒ internet standard :-

- ❖ **RFC** :- Request For Comments .
 - ❖ **IETF** : Internet Engineering Task Force .

⇒ internet services :-

- Provides Services to Apps like :-
Web - **Games** - **email** ... etc
 - Provides Programming interface to Apps

Protocols define "format", "order" of messages sent & received and "actions" taken on msgs transmission.

human protocols

network protocols

* for humans

* for machines

* Talks with people

* Tcp Connection request

and other
protocols

* network edge :-

- Hosts "end systems" :- clients & servers
- Servers :-
 {often} in data center.

→ Access networks and physical media

Awesome..



* Ways to Connect Systems to edge router :-

- residential access nets.
- institutional access networks
"school, Company".
- mobile Access networks.

* Digital Subscriber Line (DSL) :-

* Use existing telephone line

- Data over DSL goes to (internet)
- Voice " " " (Telephone net)

- 2.5 Mbps upstream transmission rate
- 24 Mbps downstream transmission rate

⇒ **cable network :-**

frequency division multiplexing :-

different channels transmitted in different frequency bands.

⇒ **HFC** :- Hybrid fiber Coaxial

- 30 Mbps downstream transmission rate
- 2 Mbps upstream

{**Ethernet**} :-

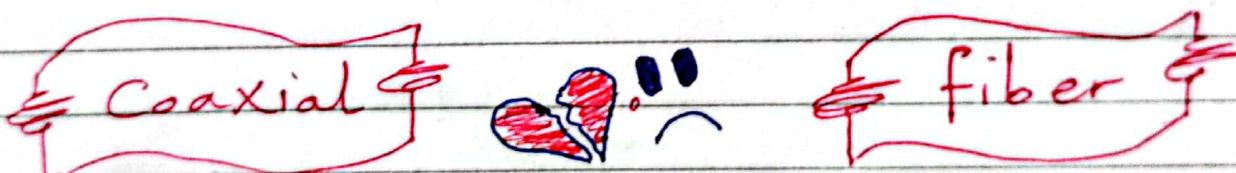
used in Companies, universities --- etc

transmission rates :-

10 Mbps, 100 Mbps, 1 Gbps, 10 Gbps

⇒ physical media :-

- ❖ Physical link :- What lies between transmitter and receiver.
- ❖ Guided media :- Signal propagate in solid media → fiber, coax etc
- ❖ unguided media :- Signal propagate freely radio - etc
- ❖ Twisted pair (TP) :- two insulated Copper wires
- ❖ Category 5 :- 100 Mbps, 1 Gbps Ethernet
- ❖ Category 6 :- 10 Gbps



- ❖ 2 concentric copper conductors
- * bidirectional
- * broadband

- ❖ glass fiber carrying light pulses
- * high-speed
- * low-error rate

* radio :-

⇒ signal carried in electromagnetic spectrum "no wire"

⇒ bidirectional

* radio Link types:-

⇒ radio Link types

⇒ LAN

⇒ wide area

⇒ satellite

⇒ network core :-

⇒ mesh of interconnected routers

* Packet switching :-

⇒ Hosts : break application-layer messages into (packets)

⇒ forward packets :- from one router to next across links on path from source to destination.

* each packet transmitted at → full link capacity

* if arrival rate to link exceeds transmission rate of link :-

* packets will queue, wait to be transmitted on link

* packets can be dropped if memory fills up.

* packet switching : allows more users to use network.

⇒ network core functions
2 functions

- **routing** :- determines source-destination route taken by packets
- **forwarding** : move packets from router's input to appropriate router output.

* **internet structure** :-

- End systems connect to internet via access "ISPs":
↳ **internet service provider**.
- Access ISPs in turn must be interconnected. So that any 2 hosts can send packets to each-
- resulting network of networks is **too complex**

⇒ delay and loss occur :-

∴ d_{proc} : nodal processing

* check bit error and determine output link . . . typically < msec

∴ d_{queue} : queuing delay

* time waiting at output link for transmission that depends (depends on) on congestion level of router.

* packet Loss :-

∴ has finite capacity

∴ Lost packet may be retransmitted by previous node by source end system or not at all.

* throughput :- rate at which bits transferred between sender and receiver.

∴ instantaneous :-

rate at given point in time

∴ average :-

rate over longer period of time.

"Protocols"

- * **Layers** :- each Layer implement a services :-
 - via its own internal layer actions
 - relying on services provided by **Layer below**

(internet protocol stack)

1- **application** :-
support network apps HTTP, FTP, ...

2- **transport** :-
process to process data transfer
TCP, UDP ..

3- **network** :-
routing of datagrams from Source to destination IP, routing protocols

4- **Link** :-
data transfer between network elements
Ethernet, 802.11 ...

5- **physical** :-
movement of bits through the wires.

ISO/OSI reference model

7 Layers

* presentation :-

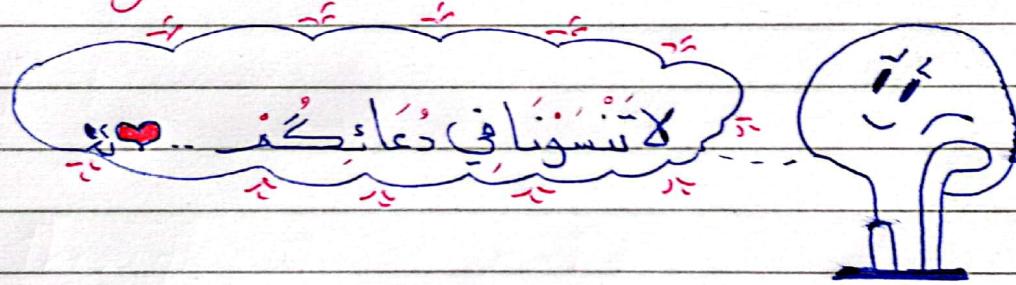
encryption, compression--

allow apps to interpret data.

* session :-

synchronization, checkpointing
recovery data exchange.

internet stack doesn't have these layers: presentation, session



Encapsulation : $\xrightarrow[\text{at}]{\text{Done}}$ Link and physical Layer

physical & Data link layer

Data \rightarrow (frames)

network Layer :-

Data \rightarrow (packets)

or data gram