

CHAPTER 01:

COMPUTER NETWORKS & INTERNET.

1.1 WHAT IS INTERNET?

Internet consist of 24 ^{components} ~~things~~
Host, Links, Routers, Protocols.

① HOST: Devices that are on the internet. Any network connected device. Hosts = End Systems

Eg: Computer, Smartphones, Tablets, Routers, ^{running network apps.}

② LINKS: ^{Land} Packet Switches

• Connects 2 hosts together, wire or wireless

Eg: fibre, copper, radio, satellite

• Transmission rate: Bandwidth.

③ Routers: • Networking device that forwards data packets
b/w CN. (chunk of data)

④ PROTOCOLS: • Not Hardware, it's a software
Protocols, rules.

• Set of rules/procedure for transmitting data
b/w electronic devices.

• Eg: ^{Transmission control} TCP, IP, HTTP, Skype, 802.11

Packet Switch: It takes packet arriving on one of its incoming
communication link & forward that packet on one of its outgoing
com "

Packet Switch: " Eg: Router, link layer switch.

link layer used in Access Network
Router used in network core.

- IP protocol specifies format of packet sent & received among ^{router} ^{round} ^{end}

INTERNET

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- Networks of Networks
- Inter connected ISPs
- Internet Standards

RFC: Request for comments

IETF: Internet Engg Task force.

Infrastructure that provides service to the app

Web, VoIP, email, games, e-commerce, social Net
Communication Services
- reliable data.

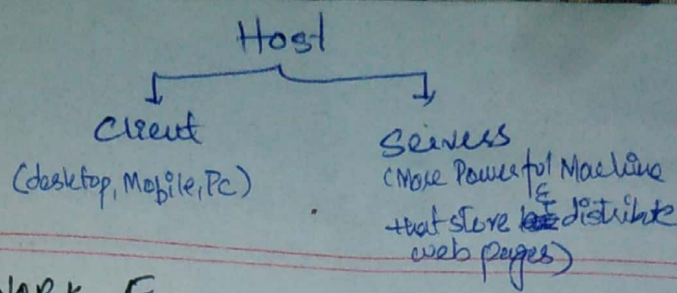
WHAT IS PROTOCOL?

Protocol defines format, order of Messages
Sent and received among network entities and
Actions taken on message transmission.

2 important Protocols are

- ① Internet Protocol (IP): Specifies format of packets that are sent/receive among routers & end systems
- ② Transmission Control Protocol (TCP)

• The Internet Principal Protocol are collectively known as TCP/IP



1.2 NETWORK EDGE:

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- Network Edge: computers are at edge (end) of Network.
 - hosts: clients and servers (hosts = end system)
 - Servers often in data centres.
- Access Networks / Physical Media
 - wired, wireless communication links
 - Routers
- Network Core
 - interconnected routers
 - Network of Network.
- Routers is known as Edge Routers
- To connect end system to edge router
 - Residential access Nets
 - Institutional " Networks (School, Company)
 - Mobile Access Networks - (3G, 4G)
- Network Edge:
 - 2 Models:
 - ① Client/Server Model
 - ② Peer-to-Peer Model. (every body is client & server, Anybody can talk to anyone)

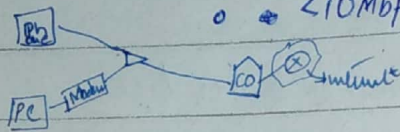
data transfer
 client \rightarrow server \Rightarrow uploading/upstream
 server \rightarrow client \Rightarrow downloading/downstream

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Access Network:

① DIGITAL SUBSCRIBER LINE (DSL)

- Use existing telephone line to central office (DSLAM)
- data over DSL phone line goes to internet
- voice over DSL phone line goes to telephone net.
- < 1 Mbps upstream transmission rate
- < 10 Mbps downstream

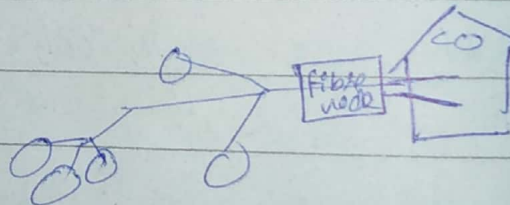


Asymmetric
 b/c up/downstream are diff

② CABLE NETWORK

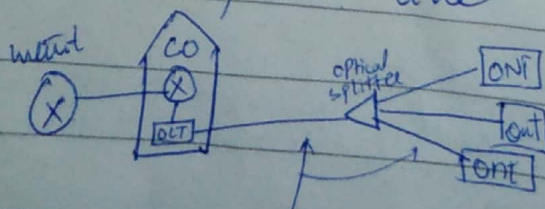
- Do not use telephone infrastructure
- speed up to 30 Mbps downstream
- 2 Mbps upstream
- Asymmetric
- Shared Access

HFC
 (hybrid fiber
 coax)



③ FIBRE TO THE HOME (FTTH)

- Provide optical fibre path from CO directly to user
- Active Optical Networks (AONs)
- Passive " " (PONs)
- Optical Network Terminator (ONT)
- optical line " (OLT)



- Provides speeds in Gbps

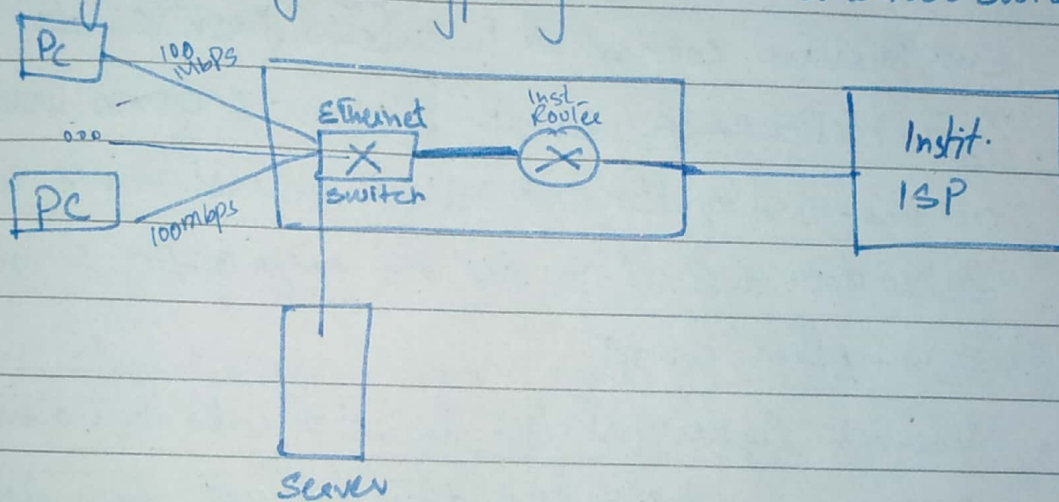
- Modem Connects to Internet
- Router Connects devices to Wi-Fi



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1) ETHERNET & WIFI :-

- In University, Corporate and home, a LANs used to connect end system to the edge router.
- There are many type of LAN technology.
- 10Mbps, 100Mbps, 1-10 Gbps Transmission Rate.
- Today, End System typically connect to Ethernet switches



• Wireless LAN

- within Building
- 11, 54, 450 Mbps Trans-rate (WIFI)

- Wide Area Wireless Access

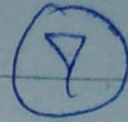
- Provided by Telco (cellular) operator
- 10Kms
- B/W 1-10 Mbps
- 3G, 4G: LTE

LTE = Long Term Evolution.

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- System App said to be Hybrid distributed app
Since they involve multiple end-sys - They do not run in packet switch in network ~~at~~ that exchange data with each other.
- Internet app run on end sys. They do not run in packet switch in network core
- End system connected to internet provide ~~the~~
Socket Interface: that specifies how program running on one end system ask internet infrastructure to deliver data to specific destination program ~~pt~~ running on another end sys.
- Internet Socket Interface is set of rules that a sending program must follow so that the internet can deliver data to destination prog.
- Eg: Sending letter to someone we need to write
Address, Name etc
↳ This is ISI

PHYSICAL MEDIA.



- Bits travel from one end system through series of links and routers to another end system.
- The Bit propagates b/w transmitter-receiver pairs across a Physical Medium.

Types of Physical Media

- Twisted pair copper wire
- Coaxial cable
- Multimode fibre optic cable
- Physical Media has 2 categories
- ① GUIDED MEDIA: waves are guided along solid medium such as twisted pair, Coaxial Cable.
- ② UNGUIDED MEDIA: waves propagate in atmosphere and outer space. Such as wireless LAN.

TWISTED PAIR COPPER WIRE:

- Consist of 2 insulated copper wire arranged in ^{spiral} ~~spiral~~ pattern.
- These wire twisted together to reduce the electrical interference from similar pairs close by.

Category 5: 100mbps } TP (Twisted Pair)
" 6: 10 Gbps }

⑧

- Unshield Twisted Pair: used within Building i.e LAN.

Data rates 10mbps - 10Gbps

▷ Data rates can be achieved depend on thickness of wire and distance b/w transmitter & receiver

COAXIAL CABLE: Two concentric copper conductor
Bi-directional with special insulation
and shielding.
it can achieve high data transmission rates

1.3 THE NETWORK CORE:

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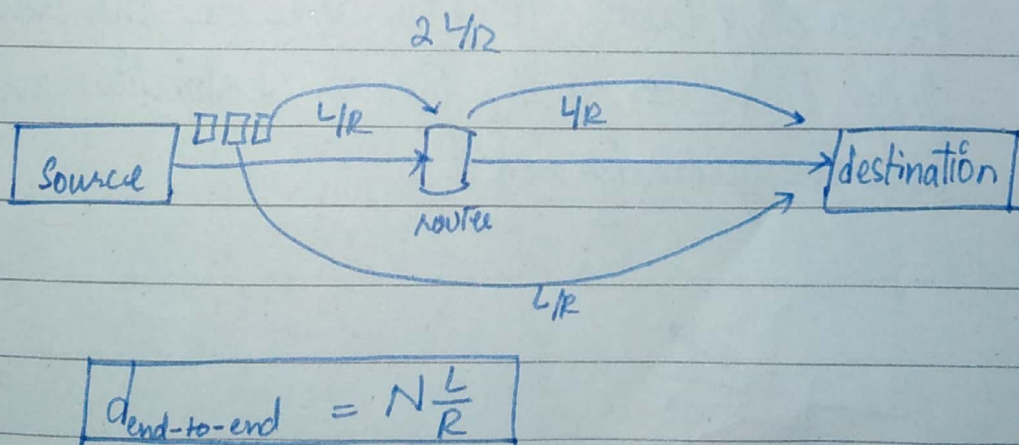
2 ways to move data through network of links & switches:

• PACKET SWITCHING:

- long message broken into smaller message ^{called} PACKETS:
- Between source & destination, each packet travel through communication link and Packet Switches
- if transmission rate is R bits/s & L packets are sent then
Time to transmit packet is L/R sec

- STORE & FORWARD TRANSMISSION:

Packet switch must receive the entire packet before it can begin to transmit the first bit of the packet onto the outbound link



- QUEUING DELAYS AND PACKET LOSS.

if an arriving packet need to transmit onto a link but finds the link busy with transmission of another packet the packet must wait in output buffer/queue. Hence packet suffer output buffer queuing delays

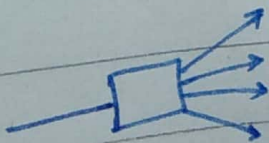
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If an arriving Packet finds that the buffers completely full with other packet waiting for transmission, Packet loss will occur, hence either the arriving packet or the already arrived packet will be dropped.

- FORWARDING TABLES & ROUTING PROTOCOLS.

- Forwarding Table maps the destination address to that router's outbound links. When the packet arrives at a router, the router examines the address and searches in forwarding table, to find outbound link. The packet then directs to outbound link.

- Routing Protocols: are used to automatically set the forwarding tables. It determines the shortest path from each ~~router~~ router to each destination and uses the optimizing results.

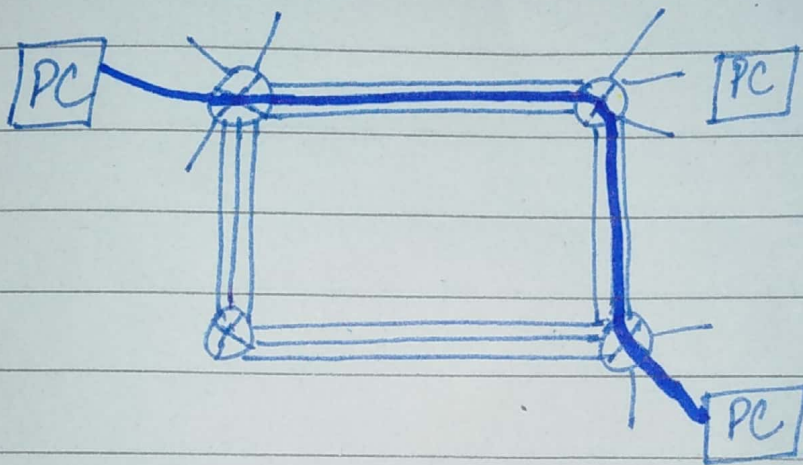


CIRCUIT SWITCHING.

The process need along a path to provide for communication between the end system are reserved for duration of communication session

In packet switches, these resources are not reserved.

Example: Telephone Network.



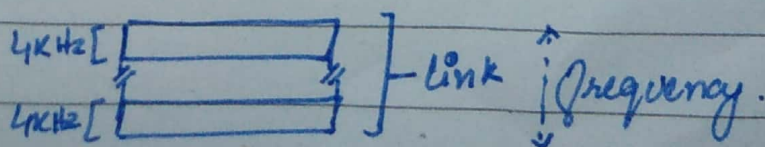
MULTIPLEXING IN CIRCUIT-SWITCHED NETWORK.

Circuit in a link is implemented with either Frequency Division Multiplexing (FDM) or Time Division Multiplexing (TDM)

FDM: frequency spectrum of a link is divided up among the connections established across the link.

Width of band is called Bandwidth

Radio station uses FDM.



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TDM: For a TDM link, time is divided into frames of fixed ~~solution~~ duration and each frame is divided into a fixed number of time slots.

