Computer Networks CH: 01

ISP: Internet service Provider

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Lecture NO. 1

① Information Generating Systems
② communication Techs!
responsible for transferring data from 1 point to another

ICT

collection of devices, routers, links

↑

•) Internet → network of networks / network of connected devices

↓ components ~~of networks~~

hosts, packet switches, communication links

•) protocols → mechanisms or strategies to share info with others.

•) network edge → from where the info is generated

•) Layered Architecture:

L1
L2
L3
L4
L5

Divide communication in layers. The architecture is 5 layered. Each layer is providing some service.

•) Access network is used to access the internet wirelessly or through cables or ISP's.

•) packet transmission delay = time needed to transmit L-bit packet into link = $\frac{L\ (\text{bits})}{R\ (\text{bits/sec})}$ → speed

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Lecture NO. 2

- Wireless Ratio — Half Duplex (2-way comm but not a same time)
  - Simplex Duplex (1-way comm)
  - Full Duplex (2-way comm simultaneously)

- Devices communicate through physical media.

- Layered Internet Protocol Stack: (modular approach)

application	L1	·) have a modular approach
transport	L2	·) "data" given to L1 is also referred as "message".
network	L3	
link	L4	
physical	L5	transfers datagram

(segment does not open the msg. just do some processing what is source, destination, which router (route/path) is used.)

transmits data

·) Data generated in network layer is called Datagram

·) As a whole, it will be called as frame.

·) Header is appended in message

·) Receiver will discard all the things and then will get the message. After receiving all the steps will be done in reversed order (removing headers)

user is active → he/she has data to transmit

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Lecture NO. 3

Network core (Internet) → network of ISP's (uses packet switching)

→ router receives data and find a suitable link to forward the data towards destination. (store & forward)

→ circuit switching: allocate fix resources for users.
↳ term from telecommunication system.

resource
/ \
time frequency

Bandwidth: range of frequencies: transmission rate

- Frequency Division Multiplexing: (FDM)
  e.g we have to transmit data with 4 people in time span to but in frequency domain. The frequency is already allocated.
- Time Division Multiplexing (TDM):
  Share in time domain (channel KO). when it's your turn, you can use all the frequencies.

Ex: Prob a user is active = 0.1 = p
NO. of user = 35 = N
NO. of active users = X

$$P(X>10) = 1 - P(X \le 10) = 1 - \sum_{x=0}^{10} \binom{35}{x} p^x (1-p)^{35-x}$$
$$= 0.0004 \text{ (Risk Factor)}$$

→ speed of access network is always greator than the core network.

→ queuing delay is always random.

~~4th Week~~ 4th Week : Monday
(Lecture 7)

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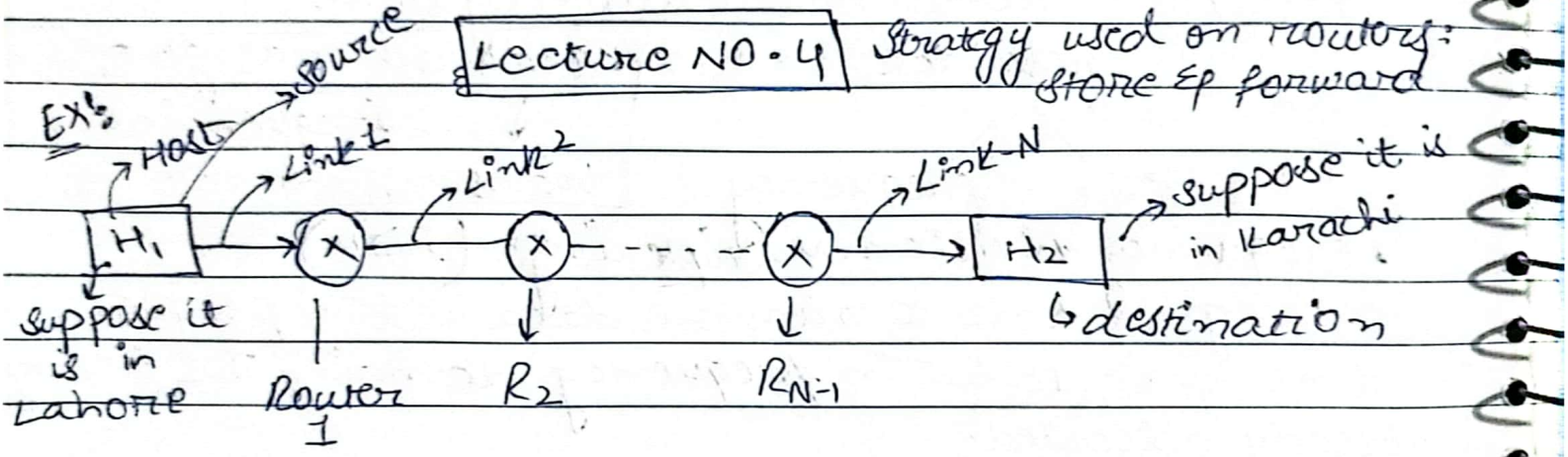
→ queuing delay is coming on router not on host.
→ transmission delay depends on transmission rate.

→ Traffic intensity = $\frac{\text{arrival rate of bits}}{\text{service rate of bits}}$
↳ can never be -ive

Lecture NO. 4 Strategy used on routers: store & forward



NO. of Links = N
NO. of Routers = N-1
NO. of Packets = P
Size of each packet = L-bits
Consider d_{trans} only

Transmission rate of each link = R-bps
↳ bits/sec

$d_{end\text{-}to\text{-}end}$ = ?

Sol:
1st packet arrives at destination at time = $\frac{N \times L}{R}$

2nd packet " " " " = $\frac{N \times L}{R} + \frac{L}{R} = \frac{(N+1)L}{R}$

3rd " " " " = $\frac{N \times L}{R} + \frac{2L}{R} = \frac{(N+2)L}{R}$

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Pth packet " " " $= (N+P-1)\frac{L}{R}$

d end-to-end $= (N+P-1)(L/R)$

Ex2:

$R = 1.536$ Mbps $= 1.536 \times 10^6$ File size $= 640$ Kb $= 640 \times 10^3$

$r = 64$ Kb/s $= 64 \times 10^3$

No. of users = ? $T = ?$

No. of users $= \frac{1.536 \times 10^6}{64 \times 10^3} = 24$

time $= 0.5$ s (to acquire link (later randomly) → connection setup.)

$T = d = \frac{640 \times 10^3}{64 \times 10^3} = 10$ sec $+ 0.5$

$= 10.5$ sec

→ Throughput: Rate at which bits are being sent from sender to receiver (→ end-to-end.)

→ per connection end-to-end throughput:

$\min(R_c, R_s, R/10)$

(CH:01 → completed)

CH: 02

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Lecture NO: 5

Application Layer → is not doing any physical communication

Peer-to-Peer Architecture: → client/Server architecture has centeralized server.

↳ NO centeralized server. it is distributed.

e.g torrents, bluetooth

- complex as compared to server/client but has it's own advantages.
- each layer assigns identifiers

→ Sockets:

↳ processes send/receives message to/from sockets.

→ proprietary protocal

↳ some of the things are private and some of them are public.

→ data has 2 types of traffic — real time / non real time

→ HTTP assume that it's msg will be transferred reliably by tcp also looks at the flow of data.

HTTP: Hyper Text Transfer Protocol

• Browser also has a cache
(Read DNS topic before Next class)

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Lecture NO·7

HTTP/3 → used to provide security
HTTPS → security

• Security can be provided by any layer. Every layer has it's own mechanisms.

→ Domain Name System : (DNS)
• Host name is one of the address assigned to a machine
• A machine can have several addresses.
• In application layer (top), the address is host name.
• To map host name to IP address, we use DNS. (translation)
• DNS is not centeralized.
• consists of heirarchical distribution.
• Two types of queries (iterative & recursive) → several servers
• several DNS servers like local, root, TLD

approach: iterative query — forwading query, forwarding addres

• recursive : forwarding till the end to get IP address & then roll back.

∵ average is only taken when there are multiple quantities

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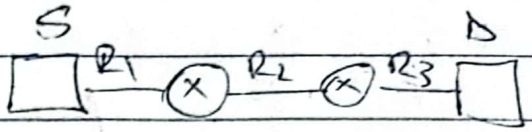
Lecture No 8

Quiz-1 Solution



$R_1 = R_2 = R_3 = 2.5 \times 10^6$ bps

$S_1 = 5000$ km

$S_2 = 4000$ km

$S_3 = 1000$ km

$L = 1500 \times 8$ bits

$V = 2.5 \times 10^8$ m/s

$d_{proc} = 0.003$ sec

dend-to-end = ?

$$d_{end\text{-}to\text{-}end} = 3 \times \frac{L}{R} + (2 \times d_{proc}) + d_{prop_1} + d_{prop_2} + d_{prop_3}$$

$$= 3 \times \frac{1500 \times 8}{2.5 \times 10^6} + 0.003 + \frac{1}{2.5 \times 10^8} (5000 + 4000 + 1000) \times 10^3$$

$= 0.0604$ sec

$= 60.4$ msec

•) If not store-and-

P27 (CH:01):

$R = 500$ Mbps $= 500 \times 10^6$ bps

$S = 20{,}000$ km $= 20{,}000 \times 10^3$ m

$L = 800{,}000$ bits

Max no. of bits in the link $= R \times d_{prop}$

$$= 500 \times 10^6 \times \frac{S}{V}$$

$$= \frac{500 \times 10^6 \times 20{,}000 \times 10^3}{2.5 \times 10^8} = 40 \text{ Mb}$$

: transmission Rate ∝ 1/duration

* SMTP is the protocol used for e-mails.
  (Simple Mail Transfer Protocol.

Bit width = $\frac{20,000 \times 10^3}{40 \times 106}$ = 0.5m

→ dprop = $\frac{S \rightarrow \text{Link Length}}{V \rightarrow \text{speed.}}$, Rx dprop = NO. of bits in S meters.

CH:02

- 2 types of physical address — IP address, MAC address
- TLD doesn't store the address of host.
- ttl (time to live)

Mids Syllabus : CH:01 + CH:02

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Lecture NO.9

- cookie no is used to identify user/client if your info is not being shared.
- HTTP → Stateless
  - ↳ server does not maintain/keep the history of user's action. does not maintain the state of the user.

- We can optimize recommendations using cookies
  - ↓
  - Drawbacks: privacy, security

- [redacted]

CH:02 (completed)

CH:03 Transport Layer

- Application Layer handovers data to lower layer i.e transport layer.

- Transport layer provides a logical comunication end-to-end connection b/w different application processes running on different hosts.

- Multiplexing → have to send data from several paths/networks/links to a single destination / channel.

- TCP is complex as compared to UDP. The choice

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b/w them is made according to the requirements.

- Multiplexing / De-multiplexing → same concept used in FDM & TDM.

- address of process identified by port number, address of host identified by IP address.

- socket have it's own unique port number. Uniqueness of port number is in the machine only. A machine has it's own IP address.

- UDP → User Datagram Protocol.

- Implementation of transport layer is fixed.