Assignment Submission

Name: Rayan Shabir

Roll No: BITF20M535

Subject: Computer Networks

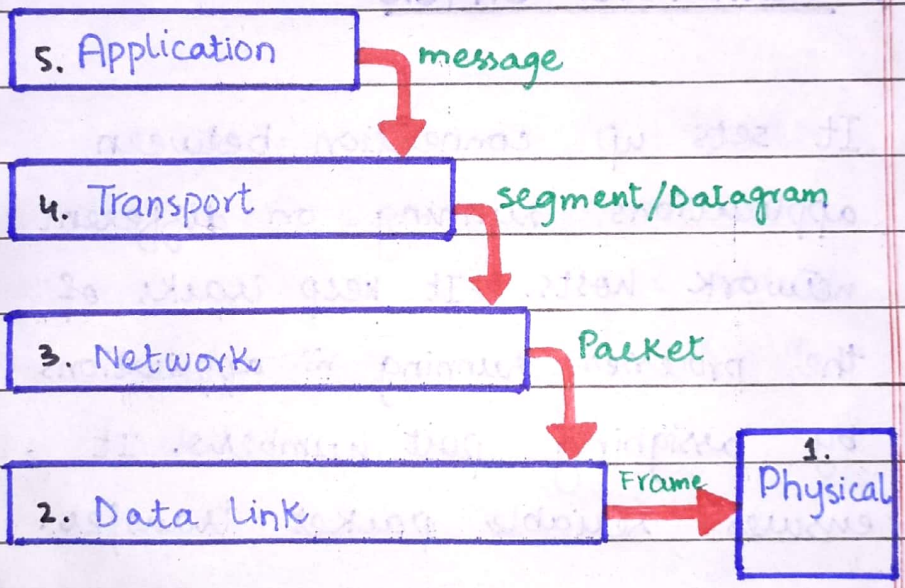
Class: IT Morning

Date: _____ Day: _____

Q NO1:

INTERNET ARCHITECTURE

DIAGRAM:



★ APPLICATION LAYER:

It is a layer which contains those applications that require standard internet/network connection. These applications use Transport layer to send requests to connect themselves with remote host networks.

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Protocols:

- HTTP (Hypertext Transfer Protocol)
- SMTP (simple Mail Transfer Protocol)

★ TRANSPORT LAYER:

It sets up connection between applications running on different network hosts. It keep tracks of the processes running in applications by assigning port numbers. It ensures reliable packet transfer.

Protocols:

- TCP (Transmission Control Protocol)
- UDP (User Datagram Protocol)

★ NETWORK LAYER:

It is responsible for creation of packets that move across networks.

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Protocols:

- IP (Internet Protocol)
- ARP (Address Resolution Protocol)

★ DATA LINK LAYER:

It creates frames which enfolds packets and moves across the network host. It uses MAC address to identify source and destination of packets.

Protocols:

- Token ring
- PPP (point to point protocol)
- Ethernet

★ PHYSICAL LAYER:

It encodes/decodes the bits of data in frames and select the

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hardware that drives and receives signals on the network.

Protocols:

- IEEE 802.11
- USB 3.0 (Universal Serial Bus)
- Bluetooth

Q NO3:

(A)

(a) Coaxial cable
(b) Ethernet cable
(c) Optic Fiber

(B)

Coaxial cable and Ethernet cable are made of copper.

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Q NO4:

PROTOCOL:

A Protocol is a set of rules or procedures which are used for transmission of data and for communication between electronic devices (such as computers). It is a format in which messages are transformed between sender and receiver.

LIST OF PROTOCOLS & THEIR USES:

Name of Protocol	Uses
(1) Transmission control Protocol (TCP)	→ used for communication over a network host. → divides messages into a series of packets

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	to send from source to destination.
(2) Internet Protocol (IP)	→ IPs are assigned to devices which help packets route through different nodes and reach the destination.
(3) Post office Protocol (POP)	→ used for receiving incoming Emails.
(4) File Transfer Protocol (FTP)	→ allows user to transfer files from one machine to other machines. Files could be programs, text files, documents, multimedia, etc.

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Q NO9:

AVERAGE THROUGHPUT

Throughput refers to the rate at which packets of data are transmitted over a communication channel. To measure the total amount of time in which packets transferred, difference between the timestamps bet first and last packet sent, are taken.

Formula:

Suppose, packets of 'R' bits are transmitted to a host network in total time 'T'.

The average throughput will be calculated as:

$$\text{Average Throughput} = \frac{R \text{ (bits)}}{T \text{ (sec)}}$$

Unit: bps (bits per second)

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Q NO7:

NETWORK LATENCY

Definition:

- The time taken by a data packet to be transmitted from its source to destination, is called Network Latency. In technical words, we say the round trip time **(RTT)** from browser to server.
- The desired value of network latency is approximate to zero '0'.

Causes:

The causes of network latency are:

1) low space in memory

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2) Presence of multiple routers
3) Poorly optimized backend database

How to MEASURE?

Latency can be measured in:

1. Round Trip Time (RTT)
2. Time to first byte (TTFB)

RTT:

RTT means measurement of time taken when a client sends a request to server and server gives response to client.

TTFB:

TTFB means measurement of time taken when a client

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sends a request to server and server gives first byte of data to client.

Factors:

A number of factors that contribute to network latency are:

* Propagation Delay
* Routing and Switching
* Queuing and Buffering

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Q NO2:

CIRCUIT SWITCHING Vs. PACKET SWITCHING

CIRCUIT SWITCHING	PACKET SWITCHING
• data unit knows the entire path (address) by source	• data unit knows only final destination decided by routers.
• more reliable	• less reliable.
• data processed at source system only.	• data processed at all intermediate nodes.
• more wastage of resources.	• less wastage of resources.
• not a store and forward technique.	• Store and forward technique.
• Examples: → Optical Mesh → Analog Telephone	• Examples: → school web sewers

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Suitable Situation for Circuit Switching:

Circuit switching is favourable in situations where connection is required for continous long period of time, such as long distance communication.

Why Internet use Packet Switching?

It is because packet switching is efficient enough to find its destination using routers when packets links are lost. Also, it provide less wastage of bandwidth.

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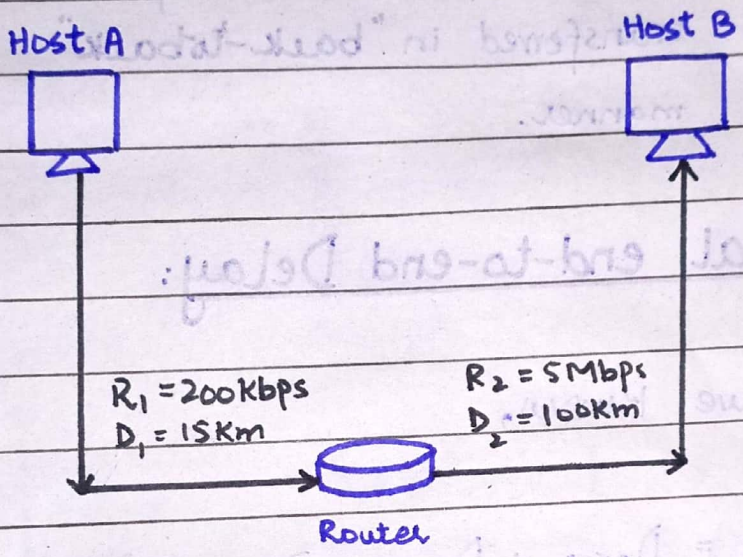
NUMERICALS

Q NO10:



Given Data:

Propagation speed = s = 3×10^8 m/sec

Processing delay = D_{proc} = 20 m/sec

Queuing delay = D_{queue} = 25 m/sec

(a) When one packet sent;

File size = L = 1500 bytes

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Average throughput = 200Kbps

↳ Here we have assumed that packets are being transferred in "back-to-back" manner.

Total end-to-end Delay:

As we know,

$$D_{Total} = D_{prop} + D_{trans} + D_{proc} + D_{queue}$$

- First, we'll calculate: Dprop:

$$D_1 prop = \frac{d_1}{s} = \frac{15 \times 10^3}{3 \times 10^8} = 5 \times 10^{-5} \text{ m/sec}$$

$$D_2 prop = \frac{d_2}{s} = \frac{100 \times 10^3}{3 \times 10^8} = 3.33 \times 10^{-4}$$

$$D_{Total} prop = \frac{d_1}{s} + \frac{d_2}{s}$$

$$= 5 \times 10^{-5} + 3.33 \times 10^{-4}$$

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$$D_{total\ prop} = 3.83 \times 10^{-4}\ m/sec$$

- Now, we'll calculate D_{trans}:

$$D_{Trans} = \frac{L}{R}$$

$$= \frac{1500}{200 \times 10^3}$$

$$D_{Trans} = 7.5 \times 10^{-3}\ sec$$

- Put values to calculate D_{total}:

$$D_{Total} = 3.83 \times 10^{-4} + 7.5 \times 10^{-3} + 20 \times 10^{-3} + 25 \times 10^{-3}$$

$$D_{Total} = 0.052883$$

Throughput:

$$Throughput = \frac{L}{D_{Total}}$$

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$$\text{Throughput} = \frac{1500}{0.052883}$$

$$\boxed{\text{Throughput} = 28364.50277 \text{ bps}}$$

(b) When four packets are sent;

File size = L = 1500 × 4 = 6000 bytes

Total end-to-end Delay:

$$D_{total} = D_{prop} + D_{trans} + D_{proc} + D_{queue}$$

$$D_{Trans} = \frac{L}{R_1} = \frac{6000}{200 \times 10^3}$$

$$\boxed{D_{Trans} = 0.03}$$

We have already calculated Dprop in part (a).
Put in D_{Total}.

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$$D_{Total} = 3.83 \times 10^{-4} + 0.03 + 20 \times 10^{-3} + 25 \times 10^{-3}$$

$$\boxed{D_{Total} = 0.075383}$$

Throughput:

$$\text{Throughput} = \frac{L}{D_{Total}}$$

$$= \frac{6000}{0.075383}$$

$$\boxed{\text{Throughput} = 79593.54 \text{ bps}}$$

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Q No 8:

Given Data:

Service Time = 10 ms (sum of queue time and procesing time)

Packet size = L = 2000 bits

Propagation delay = D_{prop} = 150 ms

Latency = D_{Total} = 200 ms

Minimum capacity = R = ?

Solution:

As we have formula:

$$D_{Total} = D_{prop} + D_{Trans} + (D_{proc} + D_{queue})$$

$$D_{total} = d_{prop} + \frac{L}{R} + \text{service time}$$

$$200 = 150 + \frac{2000}{R} + 10$$

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$$200 = 160 + \frac{2000}{R}$$

$$40 = \frac{2000}{R}$$

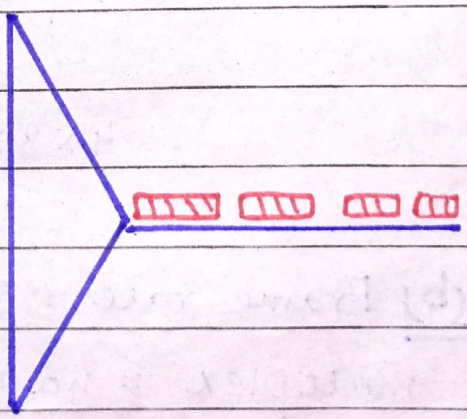
$$R = \frac{2000}{40}$$

$$\boxed{R = 50\text{ ms}}$$

So, minimum capacity of link connecting two hosts is 50 ms.

Q No5:

1. 1 2 3 4 5 6 7 8
2. 1 2 3 4 5 6 7 8
3. 1 2 3 4 5 6 7 8
⋮ ⋮
8. 1 2 3 4 5 6 7 8



(a) Frame rate = 4 F/s

multiplex = ?

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Frame rate = $\frac{\text{no. of channels}}{\text{multiplex}}$

multiplex = $\frac{\text{no. of channel}}{\text{Frame rate}} = \frac{8}{4}$

multiplex = 2

- data rate of single TDM channel = no. of frame x single slot size

= 4 x 8 = 32 bits/sec.

- data rate of TDM line = no. of slots x single slot size

= 4 x 8 x 8 = 256 bits/sec

(b) Frame rate = 8 F/s

multiplex = $\frac{\text{no. of channel}}{\text{Frame rate}} = \frac{8}{8} = 1$

- data rate of single TDM channel = 8 x 8 = 64 bits/sec

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- data rate of TDM line = 8×8×8
  = 512 bits/sec

(c)

Frame rate = 4000 F/s

multiplex = $\frac{8}{4000}$ = 2×10^{-3}

- data of single TDM channel =
  4000 × 8
  = 32000 bits/sec

- data rate of TDM line = 4000×8×8
  = 256000
  bits/sec

(d) Frame rate = 4000 F/s

Data rate in TDM line = 8×8×4000
= 256000 bits/sec

Data size = 6000 kB
= 6000×1000×8 = 48000000
bits

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Time required = $\frac{48000000}{256000}$

= 187.5 sec

= 187.5/60 min

Time = 3.125 mins

QNO6:

Link rate / multiplex = 1.68 Mbps

= 1.68×10^6 bps

Individual session rate = 28 Kbps

= 28×10^3 bps

Total no. of sessions = $\frac{1.68 \times 10^6}{28 \times 10^3}$

Total no. of sessions = 60 Links can carry.

L = 3 MB = (3×10^6 B x 8) bits

Dtotal = ?

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SOLUTION:

$D_{Total} = D_{prop} + D_{Trans} + D_{proc} + D_{queue}$

Neglecting D_{prop}, D_{proc} & D_{queue}

So,

$$D_{Total} = D_{Trans}$$

$$D_{Total} = \frac{L}{R}$$

$$= \frac{3 \times 10^6 \times 8}{28 \times 10^3} = \frac{24000000}{28 \times 10^3}$$

$$= 857.14 \text{ s}$$

But, it also takes 150 ms before establishing circuit.

So,

$$D_{Total} = 857.14 + 150 \times 10^{-3}$$

$$\boxed{D_{Total} = 857.29 \text{ s}}$$