

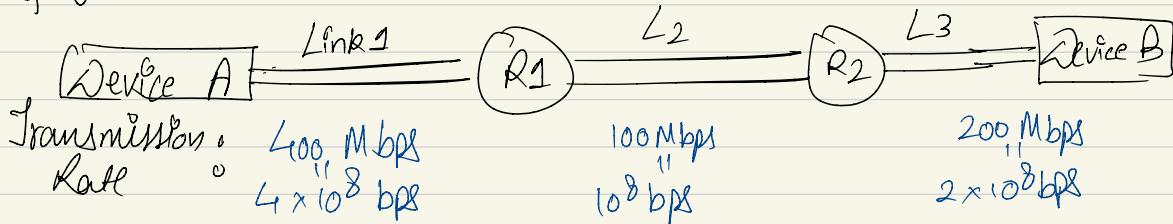
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Assignment - 1



Q2



* Size of message A want to send = $100 \text{ KB} = 10^5 \text{ bytes}$

* Propagation and processing delay = 0

* For Each packet, Meta-data = 100 bytes.

To reduce the time taken to deliver the msg, we can reduce the time delay. Propagation & processing delays are zero, so we need to reduce transmission delay.

$$\text{Transmission delay} = \frac{\text{Packet Size}}{\text{Transmission Rate}}$$

Let us take different cases

Note \rightarrow on same link two packets cannot travel.

a) 1 Packet

$$* \text{Packet Size} = 100 \times 10^3 + 100 \text{ bytes} = 100 \times 1001 \times 8 \text{ bits}$$

$$\text{Total delay} = t_{L1} + t_{L2} + t_{L3}$$

$$\begin{aligned}
 &= \frac{100 \times 100 \times 8}{400 \times 10^6} + \frac{100 \times 100 \times 8}{100 \times 10^6} + \frac{100 \times 100 \times 8}{200 \times 10^6} \\
 &= \boxed{14.016 \text{ ms}}
 \end{aligned}$$

b) 10 packets
 We will send 2nd packet only when 1st packet reaches at the end of L1.

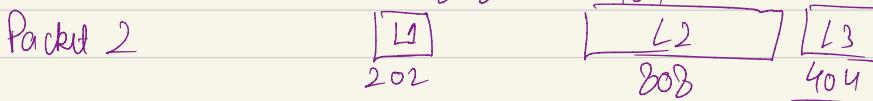
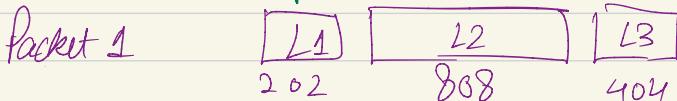
$$\text{* Packet Size} = 100 + \frac{10^5}{10} = 10100 \times 8 \text{ bits}$$

$$(T.D)_{L1} = \frac{10100 \times 8}{400 \times 10^6} = 202 \text{ ms}$$

$$(T.D)_{L2} = \frac{10100 \times 8}{100 \times 10^6} = 808 \text{ ms}$$

$$(T.D)_{L3} = 404 \text{ ms.}$$

Let us see what happens with 3 packets, then we can generalize it for n packets.



$$\therefore \text{Total time} = 202 + 404 + \underbrace{(3 \times 808)}$$

Replace with n.

$$\therefore \text{for } 10 \text{ packets} = 202 + 404 \times 10 \times 208 = [8686 \text{ ms}]$$

c) 50 packets

$$* \text{Packet Size} = 100 + \frac{10^3}{50} = 2100 \times 8 \text{ bits}$$

$$\text{Delays} \Rightarrow L_1 = \frac{2100 \times 8}{2100 \times 10^6} = 42 \mu\text{s}$$

$$L_2 = 16 \mu\text{s}$$

$$L_3 = 8 \mu\text{s}$$

$$T_{\text{idle}} = 42 + 84 + 50 \times 16 \mu\text{s} = [8526 \mu\text{s}]$$

d) 100 packets

$$* \text{Packet Size} = 100 + \frac{100 \times 10^3}{100} = 1100 \times 8 \text{ bits}$$

$$\text{Delays} \Rightarrow L_1 = \frac{1100 \times 8}{400 \times 10^6} = 22 \mu\text{s}$$

$$L_2 = 8 \mu\text{s}$$

$$L_3 = 4 \mu\text{s}$$

$$T_{\text{idle}} : 22 + 44 + 100 \times 88 = [8866 \mu\text{s}]$$

(Delay)

\therefore Minimum Time is for 50 packets

$$\therefore [A] = 50 \text{ packets}$$

Q3

- * Length of $L_2 = 10 \text{ Kms} = 10^4 \text{ mts} = L$
- * Transmission Rate = $100 \text{ Gbps} = 10^n \text{ bps} = T \cdot R$
- * Propagation Speed = $\frac{2}{3} c = 2 \times 10^8 \text{ m/s} = S$

a) Propagation Delay = $\frac{L}{S} = \frac{10^4}{2 \times 10^8} \Rightarrow 50 \mu\text{s}$.

b)

We need to find max^m bits on L_2 when first bit reaches R_2 from R_1 .

- * Time taken to reach R_2 from $R_1 = \frac{L}{S} \text{ sec}$
- * Bits released in $(\frac{L}{S}) \text{ sec} = (T \cdot R) \times (\frac{L}{S}) \text{ bits}$

∴ Max^m bits on $L_2 = (T \cdot R) \times \left(\frac{L}{S}\right) = 10^n \times 50 \times 10^{-6}$
All 1st bit reaches R_2 from R_1 . $= 5 \text{ Mb}$

- c)
- * In 1 sec bit released = $T \cdot R$

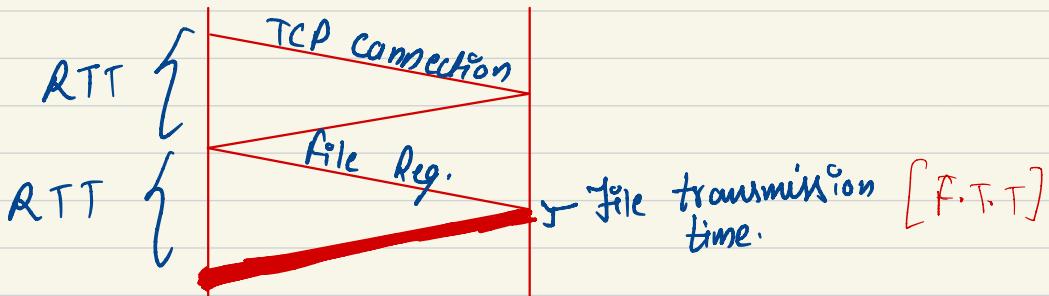
- * In 1 sec distance covered = S

- * length of 1 b.d = $\frac{S}{R} = \frac{2 \times 10^8}{10^n} = 2 \text{ mm}$

Q4

- * RTT between client & server = 10 ms
- * Size of web page = 1 Kb
- * Number of objects = 10
- * Size of each object = 100 Kb

a) Non-Persistent [A TCP connection is established for every request]



$$\text{HTTP response time for locating web-page} = \left(2 \text{RTT} + \text{file transmission time of HTML files} \right)$$

$$\text{HTTP response time for 10 objects} = 10 \left(2 \text{RTT} + (\text{F.T.T})_{\text{object}} \right)$$

$$\text{Total HTTP response time} = 22 \text{RTT} + (\text{F.T.T})_{\text{HTML}} + 10(\text{F.T.T})_{\text{object}}$$

Assumption \Rightarrow Neglecting FTT in comparison to RTT.

$$\text{Total HTTP response time} = 22 \text{RTT} = 0.22 \text{ sec.}$$

b) Persistent [Single TCP connection]

$$\begin{aligned}
 \text{Total HTTP response time} &= \underbrace{\text{RTT}}_{\text{TCP}} + \underbrace{\text{RTT} + (\text{FTT})_{\text{HTML}}}_{\text{HTML}} + \underbrace{10(\text{RTT} + (\text{FTT})_{\text{obj}})}_{10 \text{ objects}} \\
 &= 12 \text{ RTT} + \left[(\text{FTT})_{\text{HTML}} + 10(\text{FTT})_{\text{obj}} \right] \\
 &= 12 \text{ RTT} \quad [\text{By Assumption}] \\
 &= 0.12 \text{ sec}
 \end{aligned}$$

c) Persistent + Pipelined [All data are transferred in chunks in continuous stream]

$$\begin{aligned}
 \text{Total HTTP response time} &= \underbrace{\text{RTT}}_{\text{to fetch web page}} + \underbrace{\text{RTT} + (\text{FTT})_{\text{HTML}}}_{\substack{\text{HTML} + 10 \text{ objects} \\ \text{In pipelined way (chunks)}}} + \underbrace{\text{RTT} + (\text{FTT})_{10 \text{ objects}}}_{\text{to fetch 10 objects at once}} \\
 &= 3 \text{ RTT} \quad [\text{By Assumption}] \\
 &= 0.03 \text{ sec.}
 \end{aligned}$$

Note : If we consider $t = \text{file transmission time for 1 KB of data}$.
 $(\text{FTT})_{\text{HTML}} + (\text{FTT})_{10 \text{ objects}} \Rightarrow (1 \text{ KB} + 10 \times 100 \text{ KB}) \times t = 100t$
 If t is not negligible, add $100t$ in final ans.

Q5.

a) 5 different protocols that I found.

1) ARP [Address Resolution Protocol]

* RFC no. = RFC 826

* Layer of operation = Data link layer

* Most of the applications use logical address (IP) to send/receive messages but actual communication happens over physical address. (from layer 2 [Data link])

* The function of ARP is to translate IP address to physical addresses.

2) TLS v1.2 [Transport Layer security v1.2]

* RFC no. = RFC 5246

* Layer of operation = Application Layer

TLS v1.2 used by endpoint devices & applications to authenticate and encrypt data securely when transferred over a network.

3) QUIC [Quick UDP internet connection]

* RFC no. = RFC 9000

* Layer of operation = Transport Layer

* This protocol improves performance of connection-oriented web applications using TCP protocol.

* Based on UDP & employs multiplexing.

4) TLS v1.3

* RFC no. = RFC

* Layer of operation = Transport Layer

* A major revision to the TLS protocol that is intended to provide better security & improve performance.

5) MDNS [multicast DNS]

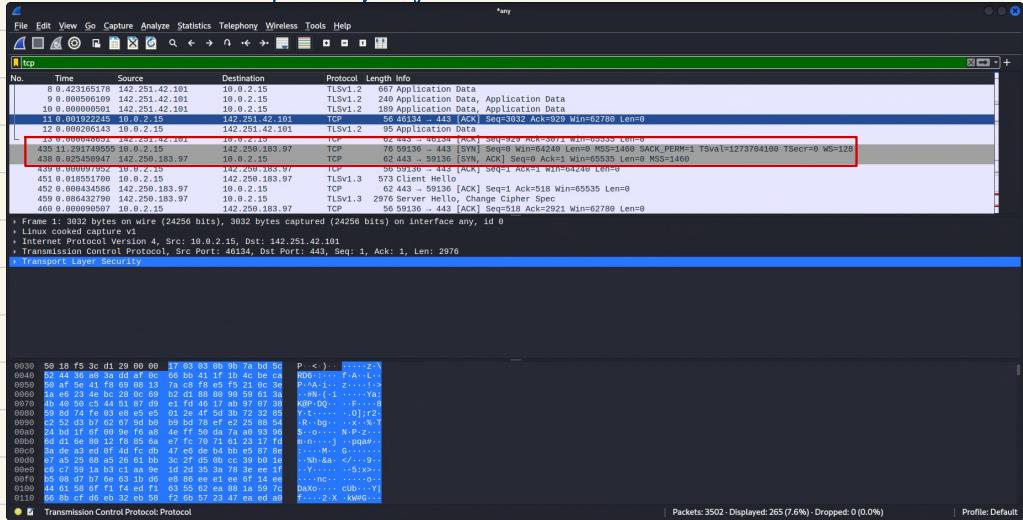
* RFC no. = RFC 6762

* Layer of operation = Data link layer

It resolves hostname to IP address in small networks that do not include a local name server.

b) + I Started playing a song on youtube to identify TCP handshakes on whoishark.

- * I filter out TCP connections from all packet catches
 - * View \rightarrow time display format \rightarrow Seconds Since Previous Displayed packet
 - * This setting helps/gives time elapsed in a TCP handshake



How we can identify this as a TCP handshake, because source is destination & destination

$$\text{Time} = 0.02545094 = \text{RTT}$$

Sim, for other TCP handshake

Frame: 3032 bytes on wire (24256 bits), 3032 bytes captured (24256 bits) on interface any, id 0

Linux cooked capture v1

Internet Protocol Version 4, Src: 10.0.2.15, Dst: 142.251.42.101

Transmission Control Protocol, Src Port: 46134, Dst Port: 443, Seq: 1, Ack: 1, Len: 2976

Transport Layer Security

Packets: 3502 - Displayed: 265 (7.6%) - Dropped: 0 (0.0%) | Profile: Default

$$RTT = 0.027181685$$

c)

Cookies when loading ims.

The screenshot shows the Network tab of the Chrome DevTools. A single cookie entry is highlighted:

Name	Value	Domain	Path	Expires / Max-Age	Size	HttpOnly	Secure	SameSite	SameParty	Partition ...	Priority
_ga	GA1.3.520009116.1613152094	jign.ac.in	/	2023-09-13T08:14:54.000Z	29						Medium

Below the table, a message says "Select a cookie to preview its value". The sidebar on the left lists various sections: Application (Manifest, Service Workers, Storage), Cache (Cache Storage, Back/Forward cache), and Background Services (Background fetch, Background Sync, Notifications, Payment Handler, Periodic Background Sync, Push Messaging, Reporting API). At the bottom, there's a "Console" tab with a "What's New" section and a "Highlights from the Chrome 105 update" section.

Characteristics -

- * It shows the domain which is `itlggn.ac.in`
- * Name of cookie
- * Expiry date = `2023-09-13`
- * Size of cookie = `29`
- * Path of directory = `/1`

Cookies when login as a student.

The screenshot shows the Chrome DevTools interface with the Network tab selected. On the left, the Student Portal sidebar is visible, showing navigation links like Request Status, Academics, Activities, Courses, Feedback, Financial Details, and Services. The main area displays a table of cookies:

Name	Value	Domain	Path	Expires / Max-Age	Size	HttpOnly	Secure	SameSite	SameParty	Partition ...	Priority
RequestToken	fb316fkz3ptymbfmm3k	lms.itlggn...	/	Session	36	✓	Lax				Medium
_ga	GA1.3.520009116.1631520894	itlggn.ac.in	/	2023-09-13T08:14:54.000Z	29						Medium

A tooltip at the bottom center says "Select a cookie to preview its value".

Characteristics -

- * Same domain [obv.]
- * It has different name & value
- * Same path
- * It is a session cookie which means it'll expire after we logout [session case].
- * Size is 36 & it is HttpOnly.