PES UNIVERSITY

BENGALURU - 560085

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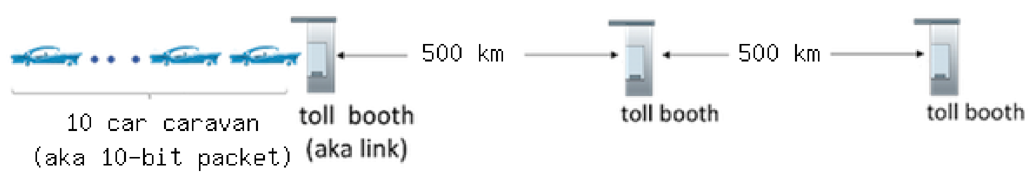
UE18CS301

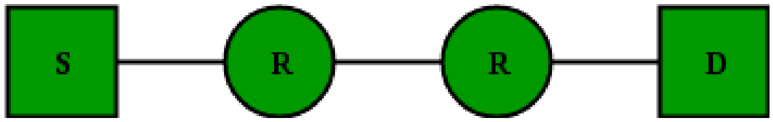
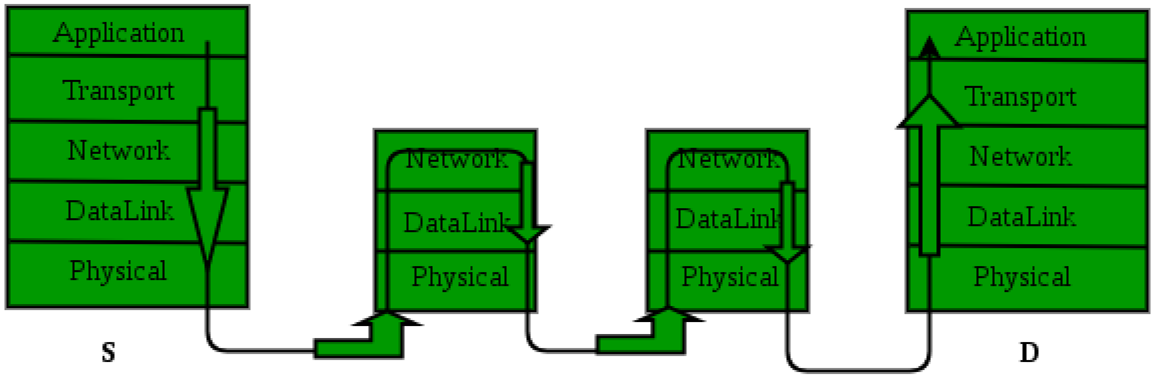
October 2020: IN-SEMESTER ASSESSMENT (ISA)
B.Tech (CSE) – V SEMESTER

UE18CS301 – COMPUTER NETWORKS

Scheme

1.	a)	**Consider the figure below, which draws the analogy between store-and-forward link transmission and propagation of bits in packet along a link, and cars in a caravan being serviced at a toll booth and then driving along a road to the next toll booth.**  **Suppose the caravan has 10 cars, and that the toll booth services a car (that is, transmits) at a rate of one car per 5 seconds. Once receiving serving, a car proceeds to the next toll booth, which is 500 kilometers away at a rate of 20 kilometers per second. Also assume that whenever the first car of the caravan arrives at a toll booth, it must wait at the entrance to the toll booth until all of the other cars in its caravan have arrived, and lined up behind it before being serviced at the toll booth. (That is, the entire caravan must be stored at the toll booth before the first car in the caravan can pay its toll and begin driving towards the next toll booth).** **1) Once the first car leaves the toll booth, how long does it take until it arrives at the next toll booth?** **2) Once the last car leaves the toll booth, how long does it take until it arrives at the next toll booth?** **3) Once the first car leaves the toll booth, how long does it take until it enters service at the next toll booth?** **4) Are there ever two cars in service at the same time, one at the first toll booth and one at the second toll booth?** **5) Are there ever zero cars in service at the same time, i.e., the caravan of cars has finished at the first toll booth but not yet arrived at the second toll booth?**	5

		1) It takes 25 seconds to travel to the next toll booth (500 km / 20 km/s) 2) Just like in the previous question, it takes 25 seconds, regardless of the car 3) It takes 70 seconds until the first car gets serviced at the next toll booth (10-1 cars * 5 seconds per car + 500 km / 20 km/s) 4) No, because cars can't get service at the next tollbooth until all cars have arrived 5) Yes, one notable example is when the last car in the caravan is serviced but is still travelling to the next toll booth; all other cars have to wait until it arrives, thus no cars are being serviced	
	b)	**List six access technologies. Classify each one as home access, enterprise access, or wide-area wireless access.**	**3**
		1. Dial-up modem over telephone line – home; 2. DSL over telephone line – home or small office; 3. Cable to HFC – home; 4. 100 Mbps switched Ethernet – enterprise; 5. Wifi (802.11) – home and enterprise; 6. 3G and 4G – wide-area wireless	
	c)	**Consider sending a packet from a source host to a destination host over a fixed route. List the delay components in the end-to-end delay. Which of these delays are constant and which are variable?**	**2**
		The delay components are processing delays, transmission delays, propagation delays, and queuing delays. All of these delays are fixed, except for the queuing delays, which are variable. The processing delay, transmission delay, and propagation delay are constant.	
2.	**a)**	**Suppose you would like to urgently deliver 40 terabytes data from Bangalore to Chennai. You have available a 100 Mbps dedicated link for data transfer. Would you prefer to transmit the data via this link or instead use BlueDart courier overnight delivery? Explain.**	**3**
		40 terabytes = $40 * 10^{12} * 8$ bits. So, if using the dedicated link, it will take $40 * 10^{12} * 8 / (100 * 10^{6})$ = 3200000 seconds = 37 days. But with BlueDart overnight delivery, you can guarantee the data arrives in one day.	
	b)	**Suppose Host A wants to send a large file to Host B. The path from Host A to Host B has three links, of rates R_1 = 500 kbps, R_2 = 2 Mbps, and R_3 = 1 Mbps.** **1. Assuming no other traffic in the network, what is the throughput for the file transfer?** **2. Suppose the file is 4 million bytes. Dividing the file size by the throughput, roughly how long will it take to transfer the file to Host B?** **3. Repeat (1) and (2), but now with R_2 reduced to 100 kbps.**	**5**
		1. The throughput for the file transfer= min $\{R_1, R_2, R_3\}$ =500 kbps. 2. File size = 4 million bytes = 32000000 bits, from (1), throughput for the file transfer = 500 kbps = 500000 bps. 32000000 bits/500000 bps = 64 seconds 3. 100 kbps, 320 seconds	

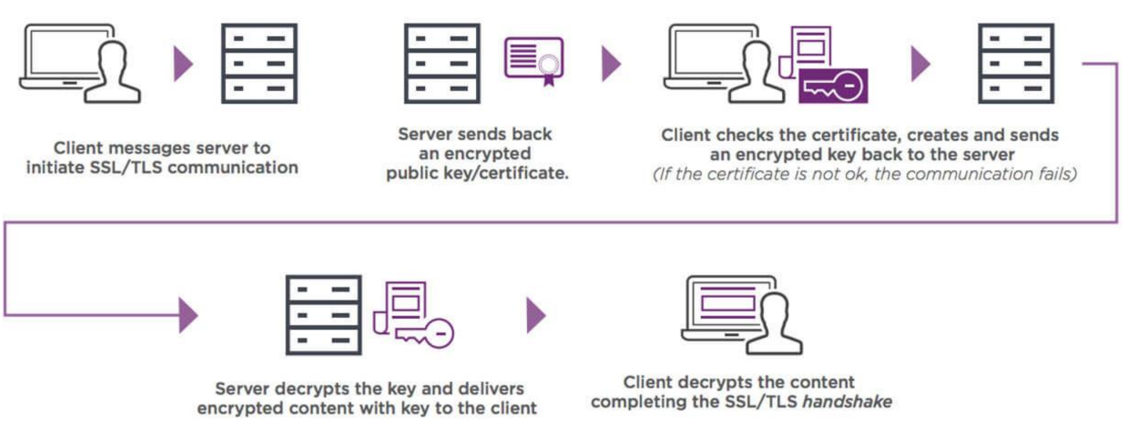
<table>
<tr><td></td><td>c)</td><td>Assume that source S and destination D are connected through two intermediate routers labelled R. Determine how many times each packet has to visit the network layer and the data link layer during a transmission from S to D.

</td><td>2</td></tr>
<tr><td></td><td></td><td>Network layer – 4 times and Data link layer – 6 times

</td><td></td></tr>
<tr><td rowspan="2">3.</td><td>a)</td><td>Assume that you have a base HTML file with 30 embedded images. These images and base file are small enough to fit in one TCP segment. How many RTT are required to retrieve base file & images under the following conditions:
Non-persistent connection with no parallel TCP connections
Persistent connection without pipelining
Persistent connection with pipelining
(Assume RTT dominates all other time)</td><td>6</td></tr>
<tr><td></td><td>2 RTT is the initial required connection, one for TCP connection and one for HTML base file.

Total time = 2RTT + transmit time

Non-persistent connection with no parallel connections:
✓ 2 RTT for the base file
✓ 2 * (30 RTT) for 30 embedded images
✓ Total time = 2 RTT + 60 RTT = 62 RTT

Persistent connection without pipelining:
✓ 2 RTT for the base file
✓ 30 * (1 RTT) for 30 embedded images
✓ Total time = 2 RTT + 30 RTT = 32 RTT

Persistent connection with pipelining:
✓ 2 RTT for the base file
✓ 1 RTT for all 30 embedded images
✓ Total time = 2 RTT + 1 RTT = 3 RTT</td><td></td></tr>
</table>

	b)	**Suppose Bob joins a BitTorrent torrent, but he does not want to upload any data to any other peers (so called free-riding). Bob claims that he can receive a complete copy of the file that is shared by the swarm. Is Bob's claim possible? Why or why not?**	**2**
		Yes. His claim is possible, as long as there are enough peers staying in the swarm for a long enough time, Bob can always receive data through optimistic unchoking by other peers.	
	c)	**List at least four different applications that are naturally suitable for P2P architectures.**	**2**
		• File Distribution • Instant Messaging • Video Streaming • Distributed Computing	
4.	**a)**	**Explain how HTTPS (SSL) works to keep your e-commerce transactions secure?**	**5**
		Step 1: Browser requests secure pages (HTTPS) from a server. Step 2: Server sends its public key with its SSL certificate (digitally signed by a third party – CA). Step 3: On receipt of certificate, browser verifies issuer's digital signature. (green padlock key) Step 4: Browser creates a symmetric key (shared key), keeps one and gives a copy to server. Encrypts it using server's public key. Step 5: On receipt of encrypted secret key, server decrypts it using its private key and gets browser's secret symmetric key.  	
	b)	**The transport layer protocols used for real time multimedia, file transfer, DNS and email, respectively are:**	**1**
		UDP, TCP, UDP and TCP	

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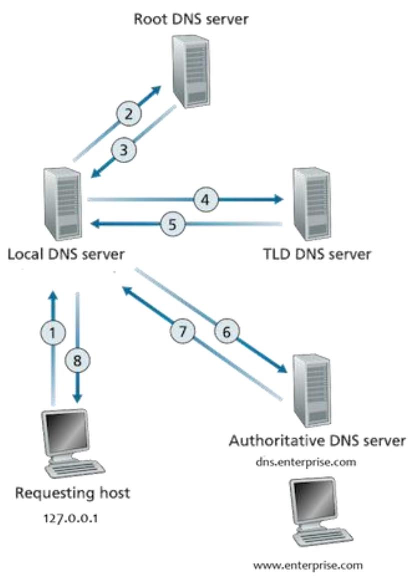
<td></td>
<td>c)</td>
<td>Imagine that you are trying to visit www.enterprise.com, but you don't remember the IP address the web-server is running on.

Assume the following records are on the TLD DNS server:
• (www.enterprise.com, dns.enterprise.com, NS)
• (dns.enterprise.com, 146.54.138.29, A)

Assume the following records are on the enterprise.com DNS server:
• (www.enterprise.com, east1.enterprise.com, CNAME)
• (east1.enterprise.com, 142.81.17.206, A)
• (www.enterprise.com, mail.enterprise.com, MX)
• (mail.enterprise.com, 247.29.64.130, A)


1. How many types of Resource Records (RR) are there?
2. In the example given in the problem, what is the address of the DNS server for enterprise.com?
3. When you make the request for www.enterprise.com, your local DNS requests the IP on your behalf. When it contacts the TLD server, how many answers (RR) are returned?
4. Assume that the enterprise.com website is actually hosted on east1.enterprise.com, what type of record is needed for this?</td>
<td>4</td>
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<tr>
<td></td>
<td></td>
<td>1. There are 4 types of RR's: A, CNAME, NS, and MX.
2. The Authoritative DNS server for www.enterprise.com is dns.enterprise.com
3. There are 2 records returned; a NS record, and an A record for the DNS server.
4. In this case, a CNAME record is needed.</td>
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<tr>
<td></td>
<td>a)</td>
<td>When does a TCP sender perform a fast retransmission? Why?</td>
<td>3</td>
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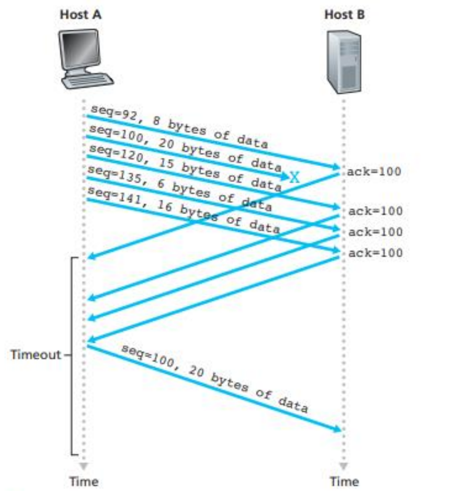
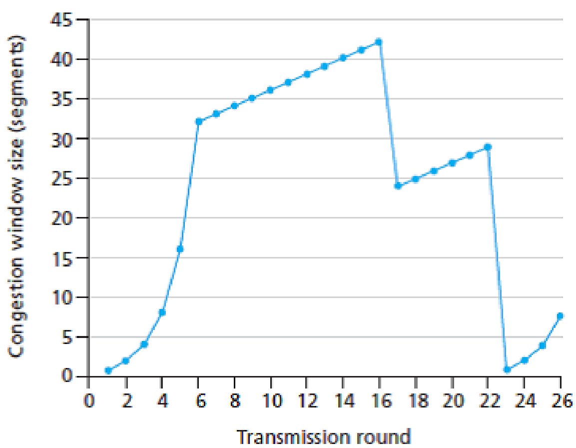
<tr><td rowspan="5">5.</td><td></td><td>If sender receives 3 additional ACKs for same data (“triple duplicate ACKs”), resend unACKed segment with smallest seq #.


7 ♦ Fast retransmit: retransmitting the missing segment before the segment's timer expires</td><td></td></tr>
<tr><td>b)</td><td>Station A needs to send a message consisting of 11 packets to station B using a sliding window (window size 3) and Go-Back-N error control strategy. All packets are ready and immediately available for transmission. If every 6th packet that A transmits gets lost (but no ACKs from B ever get lost), then what is the number of packets that A will transmit for sending the message to B?</td><td>4</td></tr>
<tr><td></td><td>In Go-Back-N, if we don’t receive acknowledgement for a packet, whole window of that packet is sent again. As a packet is received window is slided.
Here, window size is 3. Initially window will contain 1,2,3 then as acknowledgement of 1 is received window slides so 4 is transmitted.
Now, when 4th packet’s acknowledgement is received 7th packet is sent and when 5th packet’s acknowledgement is received 8th packet is sent.
Now, as acknowledgement of 6 is not received so the window of 6 i.e. 6,7,8 packets are retransmitted.
Now the 6th packet from there is 9, so 9,10 will be retransmitted.
The serial transmissions of packets: 1 2 3 4 5 6 7 8 6 7 8 9 10 11 9 10 11.
Hence total 17 transmissions are needed.
Packets in bold in the above were failed transmissions. Hence their window (underlined) was resent.</td><td></td></tr>
<tr><td>c)</td><td>UDP and TCP use 1s complement for their checksums. Suppose you have the following three 8-bit bytes: 01010011, 01100110, 01110100. How does the receiver detect errors?</td><td>3</td></tr>
</table>

		0 1 0 1 0 0 1 1 0 1 1 0 0 1 1 0 1 0 1 1 1 0 0 1 1 0 1 1 1 0 0 1 0 1 1 1 0 1 0 0 0 0 1 0 1 1 0 1 1 0 0 1 0 1 1 1 0 One's complement = 1 1 0 1 0 0 0 1 To detect errors, the receiver adds the four words (the three original words and the checksum). If the sum contains a zero, the receiver knows there has been an error.	
6.	a)	**Consider figure showing TCP window size as a function of time. Assuming TCP Reno is the protocol experiencing the behavior shown below, answer the following questions. In all cases, you should provide a short discussion justifying your answer.**  **1) Identify the intervals of time when TCP slow start is operating.** **2) Identify the intervals of time when TCP congestion avoidance is operating.** **3) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?** **4) After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?** **5) Suppose TCP Tahoe is used (instead of TCP Reno), and assume that triple duplicate ACKs are received at the 16th round. What are the ssthresh and the congestion window size at the 19th round?** **6) During what transmission round is the 70th segment sent?**	6

		1) TCP slowstart is operating in the intervals [1,6] and [23,26] 2) TCP congestion avoidance is operating in the intervals [6,16] and [17,22] 3) After the 16th transmission round, packet loss is recognized by a triple duplicate ACK. If there was a timeout, the congestion window size would have dropped to 1. 4) After the 22nd transmission round, segment loss is detected due to timeout, and hence the congestion window size is set to 1. 5) threshold is 21, and congestion window size is 1. 6) During the 1st transmission round, packet 1 is sent; packet 2-3 are sent in the 2nd transmission round; packets 4-7 are sent in the 3rd transmission round; packets 8-15 are sent in the 4th transmission round; packets 16-31 are sent in the 5th transmission round; packets 32-63 are sent in the 6th transmission round; packets 64 – 96 are sent in the 7th transmission round. Thus packet 70 is sent in the 7th transmission round.	
	b)	**Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110.** **1) How much data is in the first segment?** **2) Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?**	**2**
		1) 20 bytes 2) ack number = 90	
	c)	**Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B, each send a UDP segment to Host C with destination port number 6789. Will both of these segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?**	**2**
		Yes, both segments will be directed to the same socket. For each received segment, at the socket interface, the operating system will provide the process with the IP addresses to determine the origins of the individual segments.	