1 OSI T/F

1.1 Question

The Open Systems Interconnection model started with seven layers, but we use only five layers in practice today. As a result, we cannot reap the benefits of session and presentation layers.

( ) True (x) False

2 Sending Small Messages

2.1 Question

Two endpoints (A and B) in a voice-over-IP session are connected by a path of 4 routers. All links are running at 10 Mb/s, and the hosts are separated by 3000 km. All packets are of size 1500 Bytes. Assume the bit propagation speed is 2×10^8 m/s. Assume 1 Mb/s = 10^6 bits/s. Show calculations for each of the following questions.

1. What is the minimum round trip time (RTT), assuming there is no queueing and processing delay?
2. For this part only let us assume that one router on the path has a steady queue occupancy of 5 packets. What is the end-to-end delay (one way, not round trip) in this case?
3. Now let us assume the maximum queue occupancy for every router queues is 5 packets. What is the maximum end-to-end delay (one way, not round trip)?
4. Finally, let us assume that there are no queueing delays, but one of the routers inspects every packet toward B, and it adds 10 milliseconds processing delay. What is the minimum RTT?

2.2 Answer

1. RTT = 2*(propagation + transmission * 5 hops); propagation = 3000km/2x10^8= 15 ms; transmission = 1500 Bytes / 10 Mbps = 1.2 ms; So, RTT = 2*(15+1.2*5) = 2 * 21 = 42 ms.
2. Avg. queueing delay = 5 * 1.2 = 6 ms (i.e., 5 * time to transmit each packet) so, end-to-end delay = 6 + 21 = 27 ms
3. End-to-end delay = 6 * 4 + 21 = 45 ms
4. RTT = 42 + 10 = 52 ms (processing delay is added once because it only exists in one direction)

3 Caching

3.1 Question

Caching is useful for web pages that contain only static content.

( ) True (x) False

4 Browsing the Web

4.1 Question

You visit the following URL using your web browser: `http://www.cs.USC.edu`

This the CS home page. To know more about our faculty, you type the following URL into your web browser: `http://www.cs.USC.edu/directory/faculty/`

You close the tab after a minute of browsing the page. Assuming that • your DNS resolver is located it 192.12.80.214, • your browser and DNS has caching enabled, • DNS always uses UDP, and • the HTML response returns 200 OK with a web page, • the HTML request and response each fit in a single segment, and • the web page requires loading no additional resources,

List below the series of packet exchanges that will occur for your host to receive only the second web page. Include all packets – control and data – from relevant protocols.

4.2 Answer

1. From: My Machine, To: Server, SYN
2. From: Server, To: My Machine, SYN+ACK
3. From: My Machine, To: Server, ACK + HTTP GET
4. From: Server, To: My Machine, GET Response
5. From: My Machine, To: Server, ACK
6. From: My Machine, To: Server, FIN
7. From: Server, To: My Machine, FIN+ACK
8. From: My Machine, To: Server, ACK

5 DNS Round-Robin

5.1 Question

A CDN usually uses DNS to direct clients to replicas in a round-robin fashion. Despite the use of round-robin, certain replicas can become more heavily loaded than others. The root cause behind this imbalance is not taking client latencies from the CDN servers into account.

( ) True (x) False

6 Watching Videos

6.1 Question

You want to watch a video that is 640 MB in size from your home. The video can be watched in only one quality setting in the video player of your browser: at 16 MB/s rate. Your browser will be receiving the video via a proxy, and your machine is connected to the proxy by an infinite capacity link. The video itself is stored as 1 MB fragments in 3 CDN servers that the proxy knows about. The video is fully replicated across all CDN servers. The bandwidth between the proxy and the CDN servers are 2 MB/s, 3 MB/s, and 5 MB/s.

1. How long the video must be buffered so that you can watch the video without any interruption once the video starts playing?
2. As soon as you finish watching, your roommate watch the same video from her own laptop. However, she does not experience any buffering at all! What is the likely cause?
3. You then go to the department and show your best friend the same video from the same browser you watched the video on. Unlike your roommate, your friend experience the same buffering as you did earlier. Why?
4. The next day, you try to watch the same video again connecting to the same proxy. You end up waiting as long as the video takes to play – even longer than the day before! What could have gone wrong?

6.2 Answer

1. Video duration = 640/16 = 40 s; Download time = 640/x s; buffer for (640/x-40) s; x = 10 Mb/s in the best case (proxy can use all servers in parallel to increase throughput!). So, buffer for 24 sec.
2. Proxy Caching
3. Different proxy, or video removed from browser cache
4. Link bandwidth changes or server failed.