COMP3331/9331 T3 Mid-semester Exam Answers

Question 1

a) Load Balancing, directing client to nearby replica, customized content based on geographic location of client. (**1 mark**)

b) SMTP is a push protocol, whereas receiving e-mail requires "pull" semantics. IMAP, POP, and HTTP are typically used for a client to retrieve e-mail. (**1 mark**)

c) By "prefetching" the name-to-address mapping, the local DNS server can hide the DNS look-up delay, improving the performance experienced by the end user. However, prefetching introduces extra DNS queries and network load to look up name-to-address mappings that may never be needed, any change in mapping after the pre-fetching is not tracked, requires more storage as well. (**1 mark**)

d) Yes, the e-mail traffic can still have an effect. If no VoIP packets are present, the router starts transmitting an e-mail packet. A VoIP packet that arrives while the e-mail packet is in flight must wait for the ongoing transmission to complete, introducing delay related to the size of the e-mail packet. Limiting the maximum size of packets can help reduce the effect. (**1 mark**)

Question 2

a) For a 10K bit packet, the transmission time over a 20 Mbps links is .0005 secs, over a 30Mbps link is 0.000333 secs, and over a 100 Mbps link is .0001 secs. The total transmission time end-to-end is thus .0009333 secs. The total propagation delay is 60 ms. Therefore, the total end-end delay is .0609333 secs. (**1.5 mark**)

b) The link between routers is the bottleneck link, allowing 30 Mbps to be delivered to the two servers combined. There are three clients so the maximum rate for each client is 30/3 = 10 Mbps (**1.25 mark**)

c) The maximum rate at which the host can generate remote logging messages is 20 Mbps or 2K logging messages per second. Local messages can be generated at the same rate, so the overall rate is 40 Mbps or 4K logging messages per second. (**1.25 mark**)

Question 3 (1 mark for each)

a) Delay to fetch index page = RTT (for TCP connection) + RTT (for downloading the first few bits of the index page) + 10Kbytes/10Mbps = 100 ms + 100 ms + 80/10 ms = 208ms.

   Delay to fetch one single embedded object = RTT + RTT + 100 Kbytes/10Mbps = 100ms + 100ms + 80ms = 280ms.

   Total delay = 208 + 20 (280) = 5808 ms = 5.8 seconds.

b) Delay to fetch index page is the same = 208ms.
   Delay to fetch 4 objects in parallel over the 4 parallel TCP connections = RTT + RTT + 100Kbytes/2.5 Mbps = 100ms + 100ms + 320ms = 520ms
   Delay to fetch 20 objects (4 at a time in parallel) = 5 x 520ms = 2600ms
   Total delay = 208ms + 2600ms = 2808ms = 2.808 seconds

c) Delay to fetch index page is the same = 208ms
   20 requests are sent back-to-back and the responses (objects) are received back-to-back
   Delay for the 20 objects = RTT + 20 x 100Kbytes/10Mbps = 100 + 20 x 80 = 1.7 seconds
   Total= 1.908 seconds

d) Delay to fetch index page is the same = 208ms
   Time to setup 2 parallel TCP connections = RTT = 100ms
   Time to fetch 20 objects over these 2 TCP connections, 2 at a time = 10 x (RTT + 100Kbytes/5Mbps) = 10 x (100 + 160) = 10 x 260 = 2600ms
   Total delay = 208 + 100 + 2600 = 2908 ms = 2.908 seconds

Question 4

a) There is not enough information to tell, since both GBN and SR will individually ACK each of the first two messages as they are received correctly. (**0.75 mark**)

b) This must be SR, since packet 3 is ACKed even though packet 2 was lost. GBN use cumulative ACKs and so would not generate an ACK 3 if packet 2 was missing. (**0.75 mark**)

c) Sender window is [0, 1, 2, 3] while receiver window is [2, 3, 4, 5] (**0.5 mark** for each window)

d) Possible events are as follows:

   - If the next event is ACK0 received, then the sender will advance the window and send pkt 4. (**0.5 mark**)
   - If the next event is ACK1 received (ACK 0 is lost), then the sender will note that pkt1 has been ACKed but will not advance the window and will not send anything. (**0.25 mark**)
   - If the next event is ACK3 received (ACK 0 and ACK 1 are lost), then the sender will note that pkt3 has been ACKed but will not advance the window and will not send anything. (**0.25 mark**)
   - If ACK0, ACK1 and ACK3 are lost, then the next event will be a timeout and since no ACKs have been received, the sender will resend pkt0, pkt1, pkt2 and pkt3. (**0.5 mark**)
   - There are many other possibilities as well, marks are to be awarded appropriately

Question 5

Undergraduate Version

Let us refer to the packet received by host A (from host B) as *first*

The validity test for the response packet is based on the following two conditions:

- Sequence # >= 5001
- (Sequence # + Payload size) <= (Acknowledgement$_{first}$ + Window size$_{first}$) = (5001 + 4000) = 9001.

Based on the above conditions, the answers for the four packets are as follows: (**1 mark each**)

1) TCP Header Fields – Sequence: 5001, Acknowledgement: 1053, TCP Payload: 2000 bytes

Valid. The two condition above are met.

2) TCP Header Fields – Sequence: 1053, Acknowledgement: 5001, TCP Payload: 2000 bytes

Not Valid. The first condition above is not met.

3) TCP Header Fields – Sequence: 6001, Acknowledgement: 1053, TCP Payload: 4000 bytes

Not Valid. The second condition above is not met.

4) TCP Header Fields – Sequence: 8001, Acknowledgement: 1053, TCP Payload: 1000 bytes

Valid. Both conditions above are met.

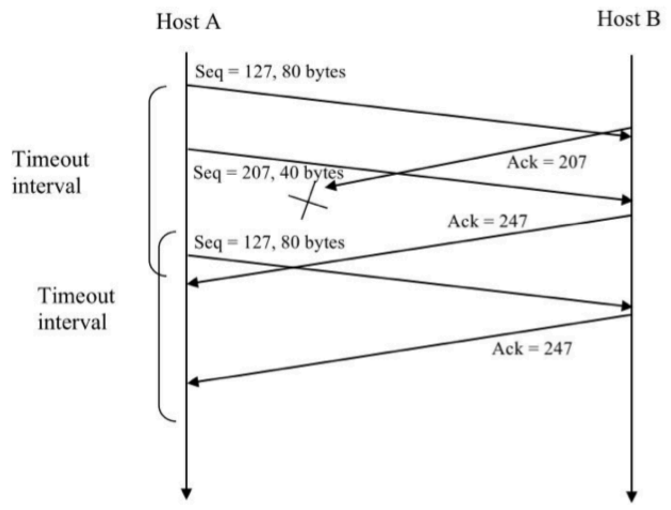
Postgraduate Version

(a) The sequence number is 207, the source port number is 302, and the destination port number is 80. (**1 mark**)

(b) The acknowledgement number is 207, the source port number is 80, and the destination port number is 302. (**1 mark**)

(c) The acknowledgement number is 127. Even if the second packet arrives before the first transmitted packet, TCP uses cumulative ACKs and has received everything in order till byte 126. (**1 mark**)

(d) **1 mark**


Host A
Host B
Seq = 127, 80 bytes
Timeout interval
Seq = 207, 40 bytes
Ack = 207
Ack = 247
Seq = 127, 80 bytes
Timeout interval
Ack = 247