CS 31204: Computer Networks

Spring 2024

Full Marks: 20 **Class Test 2, April 4, 2024** **Time: 50 minutes**

NAME: **ROLL NO.:**

1. Consider the network 203.26.20.0/23 with a total of 512 IP addresses. It is first broken into 2 subnets of 256 addresses. The second subnet is then again broken into two subnets of 128 addresses each. Machines are then allocated IP's in each subnet starting from the smallest address possible with no gap. What is the IP address assigned to the 7^{th} machine in each of the three subnets? Fill in the blanks, no explanation is needed. (3)

   (i) *203.26.20.7* (ii) *203.26.21.7* (iii) *203.26.21.135*

   Grading Remarks: 1 mark each. 0.5 each given if counted from 0 instead of 1 in all three

2. Consider a IP datagram of size 2176 bytes (without header) and id 1000 to be sent over a link with MTU of 585 bytes. Show all fragmentation related fields only in each of the IP fragments sent. Assume that no IP options are present. No explanation is needed. (3)

   All fields are shown in this order: <Id, Fragmentation Offset, More Fragment, Don't Fragment>
   Packet 1 = <1000, 0, 1, 0>
   Packet 2 = <1000, 70, 1, 0>
   Packet 3 = <1000, 140, 1, 0>
   Packet 4 = <1000, 210, 0, 0>

   Grading remarks: 0.5 for Id field, 1 mark for offset field, 1 mark for MF field, 0.5 mark for DF field. All marks are binary, either full correct or 0.
   Some of you got 0, 73, 146, 219 in offset field. Still 0 for that part. You forgot that MTU includes IP header and so you first need to remove 20 bytes.

3. When is a routing protocol said to be robust? One sentence only. (1)

   A routing protocol is said to be robust of it can automatically recover from changes in topology in a network.

   Grading remarks: 1 mark as long as the idea of automatic recovery from changes is there clearly, 0 otherwise

4. What is the use of sequence numbers in a LSA packet in Link State routing? One sentence only. (1)

   Sequence numbers are used in LSA packets to detect stale/old/obsolete/duplicate packets that should be discarded.

   Grading remarks: 1 mark as long as detection of duplicate or old packets are there clearly, 0 otherwise

5. Suppose that a IP routing protocol behaves as follows: if there are two equal cost (no. of hops) routes to a destination IP network, it stores both routes in the routing table, and while forwarding packets to that destination network based on the destination IP in packets, it uses the two routes in a round-robin fashion (1^{st} packet in 1^{st} route, 2^{nd} packet in 2^{nd} route, 3^{rd} packet in 1^{st} route, 4^{th} packet in 2^{nd} route, and so on) for better load balancing. Is there any drawback to this? 1-2 sentence only. (2)

   This may cause packets of the same TCP connection above the IP layer to arrive out of order at the destination due to different delays in the two paths. This may cause unnecessary buffering of out of order packets and generation of duplicate ACKs.

   *Grading remarks: 1.5 marks if **both** TCP and out-of-order are there (not mentioning TCP is not correct as IP packets can arrive out of order anyway), 0.5 marks for additionally saying something about why out of order is a problem. No marks for stating what is good about it. 1.5 mark given if you mentioned RTT estimation problem at TCP layer as long as you explained why it will be so (at least 1 sentence).*

6. Mention a specific scenario when an OSPF Database Description message is useful. (1)

   OSPF Database Description messages can be used to proactively sync the routing table of a router from its neighboring routers when the router powers up without waiting for the information to come after one update period.

   Grading remarks: 1 or 0 depending on the scenario mentioned

7. Suppose that the size of the send buffer in a TCP connection is 4000 bytes. A user makes 3 send() calls, each with 1000 bytes of data, every 100 milliseconds (first call made at t=0). Round trip time is exactly 250 milliseconds. MSS size is 1500 bytes, Initial Sequence No. sent in SYN segment is 1200. There is no timeout, and for simplicity, assume that there is no cumulative ACK. There is no data sent in the other direction. List all TCP data segments sent. For each segment, list the time at which it is sent, the amount of data in it, and the value of the sequence no. field. No explanation is needed. (4)

   Three segments will be sent following Nagle's algorithm.

   Segment 1: sent at t = 0, data size 1000 bytes, seq. no. 1201 (1st segment sent anyway)
   Segment 2: sent at t = 200, data size 1500 bytes, seq. no. 2201 (exceeds MSS, so MSS size sent)
   Segment 3: sent at t = 250, data size 500 bytes, seq. no. 3701 (ACK for 1st segment comes back)

   Grading remarks: 1 mark for saying 3 segments (binary), 1 mark for each of the three segments (binary). 1 mark deduced from total if started from 1200 instead of 1201 but otherwise fully correct.
   Explanations given beside each above is just for your benefit, no marks on it as no explanation was needed.
   Note that since there is no cumulative ACK, the ACK for the first segment will come back after 1 RTT. Some of you assumed an ack timer on receiver side to still wait for data, that changes time for segment 3, given partial marks.

8. Consider TCP congestion control with ss_thresh = 15, RTT = 100 milliseconds. Frame transmission time is negligible compared to RTT, there is no timeout or cumulative ACK, and updates are made to congestion window only once each RTT (at the end of the RTT, as per the current window size before updation to determine which phase it is in). If the MSS is the default 536 bytes, how much time will be taken to transmit 40 KB (1 KB = 1024 bytes) of data? Ignore the effect of everything else (such as receiver window size, Nagle's algorithm etc.) other than congestion control. Assume that the whole data is available for sending at the beginning only. Show your calculations. (4)

   # of MSS needed = (40 x 1024)/536 = 77
   In slow start phase, starting from t = 0, 1 MSS will be transmitted in RTT 1, 2 MSS in RTT 2, 4 MSS in RTT 3, 8 MSS in RTT 4, and 16 MSS in RTT 5, for a total of 31 MSS of data in 5 RTTs.
   Now when the ACKs come back for the 16 MSS sent, it is found that current window before updation (=16) is > ss_threshold, so congestion avoidance phase is entered. Note that it won't be entered after 8 as 8 < 15 so it will still double it to 16.
   In congestion avoidance phase, congestion window will increase by 1 every RTT. So will transmit 17 MSS in first RTT, 18 MSS in 2nd RTT, and the remaining 11 MSS in the 3rd RTT.

   Thus, total time needed = 8 RTTs = 800 milliseconds (counting till ACKs received which means transmission is over)

   Grading remarks: 1 mark for final answer, 0.5 marks for # of MSS sent (as seen from answer), 1 mark for correct increase in slow start phase, 0.5 marks for correct time to transition to congestion avoidance, 1 marks for correct increase in congestion avoidance. 700 milliseconds also given credit as long as calculation is correct.
   0 given if only final answer is written with no/hardly any calculations shown even if final answer is correct.

9. What is your best guess of % classes attended by you ☺? Tick the correct/best-guess answer. (1
   Grading remarks: 1 mark given as long as you answered exactly one ☺