CS31006: Computer Networks

Long Test 2

April 12, 2022

Duration: 1 Hour 15 minutes (60 minutes for answering questions + 15 minutes for submission)

Total marks: 60

Answer ALL questions

All your answers MUST BE HANDWRITTEN on paper. Scan all papers with your answer in a SINGLE pdf and upload in the course page in Moodle in the appropriate link. The size of the final pdf must be less than 10MB.

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1. (a) Suppose that an organization gets the IP network 144.16.192.0/23. It wants to break it up into 1 subnet of size 256 addresses, 1 subnet of size 128 addresses, and 2 subnets of size 64 addresses. Call the subnets Subnet 1 to Subnet 4 respectively. For each subnet, show the subnet address using / notation. Show briefly your calculations to get the addresses (no marks without this). (6)

   (b) Consider a router with 4 network interfaces (all Ethernet) named eth0, eth1, eth2, and eth3. The MAC addresses of the next hops (in the order of first entry to last entry) are m1, m2, m3, m4 respectively. The routing table of the router has the following entries:

Destination	Next Hop	Cost	Interface
144.16.203.0/24	144.16.203.2	10	eth0
144.16.203.64/26	144.16.203.69	20	eth1
144.16.203.160/27	144.16.203.170	5	eth2
0.0.0.0/0	144.16.230.7	10	eth3

   Suppose that an IP packet comes with destination IP 144.16.203.88. For the packet to be forwarded to the next hop, show (i) which entries in the routing table, if any, is/are matched for the destination IP (show your calculations), (i) the next hop chosen, with 1 line explanation of why it is chosen, and (iii) all the Ethernet frames sent by the router (show only the destination MAC field and Type field in the Ethernet header (exact protocol type values not needed, can just write names)), with one line description of the purpose of each frame. No marks will be given without the calculations/explanations/descriptions asked. Do not make any other assumptions not given in the problem. (12)

2. Suppose that data is to be transmitted in an IP based network from the node A (IP address 160.110.10.20) to the node C (IP address 208.50.50.60). There is only one router B (with two network interfaces, one with IP address 160.110.10.2 on A's subnet and the other with IP address 208.50.50.2 on C's subnet) on the route between A and C. The link from A to B

has an MTU of 1200 bytes, and the link from B to C has an MTU of 800 bytes. Each node knows only the MTU of the next link. The IP layer in A wants to send 2200 bytes of data (not including header) to C. Clearly show all header fields (**except** Version, Checksum, Type of Service, and Protocol) of all IP packets **received at C** for this transfer. **Show ONLY a single table**, with the rows representing the relevant header fields (name them with the field names), and the columns representing the packets received at C (name them with the packet no. in order). Just show the header field values of the packets, **no explanation/calculation is needed to be shown**. Assume that at A, identification field for IP starts with the last 4 digits of your roll no, default TTL is (20 + (last 2 digits of your roll no.)%10), and there are no IP options sent. Also assume that no packets are lost and all packets arrive in order. (12)

3. (a) List clearly the actions taken by TCP when an acknowledgement for a segment is received. (5)

   (b) Consider that an application using TCP periodically generates (makes a send() call) 200 bytes of data every 1 second for 6 seconds, generating the first 200 bytes at t = 0 and the last 200 bytes at t = 5. The MSS is 550 bytes, and the RTT is 2.7 seconds. Assume that processing times are negligible and there is no loss/timeout. For all TCP segments that are sent from the sender to the receiver, show the time the segment is sent and its size (in bytes, not including header). Give justifications for your answer. For each of the times t=0, 1,2,3,4,5, if no segment is sent, your justification should clearly state why no segment is sent even though data has been generated by the user. No marks will be given without proper justification. (10)

4. (a) For the 3-duplicate ack scheme, is it better to choose a larger value than 3 (say 10) or smaller value (say 2) to trigger fast retransmit and fast recovery? Justify briefly. (5)

   (b) Consider a TCP connection using cumulative acknowledgements in which a sender A is sending data to a receiver B. The initial sequence no. of A communicated during connection establishment is 13210. Suppose that A has sent 4 segments with 1120, 950, 1250, and 800 bytes of data respectively, and B has received all of them. A now sends another 4 segments S1, S2, S3, S4 with 875, 900, 1050, and 1250 bytes of data respectively, at times t = 1, 2, 3, 4 seconds respectively. One way delay for a segment or an ack to be received is 1 second. Timeout is set at 3 seconds. S1, S2, and S4 are received in this order by B, but S3 is lost. S3 is retransmitted after timeout and is received by B correctly this time. Show all acknowledgement messages sent by B with the time at which they are sent from B and the sequence number in them. For each ack, justify why it is sent with those values. Assume that processing delay is negligible, no other segments or acks are lost, and any other types of timeouts (i.e. other than retransmission timeout) used in the system is very large. No marks will be given without proper justification. (10)