Birla Institute of Technology & Science, Pilani
Department of CS & IS
EA C451 Internetworking Technologies

Max. Time: 90 min. **Mid Term Test** **Max. Marks: 70**

Instructions

1. Start the answer to each question on a fresh page
2. Write your assumptions and reasoning clearly for complete credit.
3. Make an index on the back side of the first page of the answer booklet.

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1. Suppose TCP operates over a 1-Gbps link.
   a) Assuming TCP could utilize the full bandwidth continuously, how long would it take the sequence numbers to wrap around completely?
   b) Suppose an added 32-bit timestamp field increments 1000 times during the wraparound time you found above. How long would it take for the timestamp to wrap around? **(5 + 5)**

   Ans:

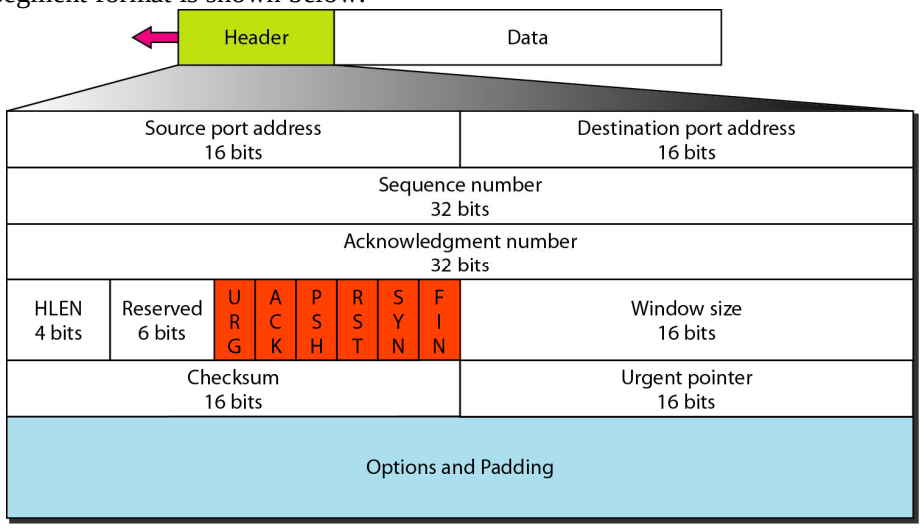
   a) This is 125MB/sec; the sequence numbers wrap around when we send 2^{32} B = 4 GB. This would take 4GB/(125MB/sec) = 32 seconds.
   b) Incrementing every 32 ms, it would take about $32 \times 4 \times 10^9$ms, or about four years, for the timestamp field to wrap.

2. Draw the TCP segment format. Modify the policies for interpreting the mechanisms in the TCP header to provide the following service at the transport layer.
   a. best effort, unreliable message delivery with no congestion control – similar to UDP
   b. best effort, unreliable and in-sequence message delivery with no congestion control – similar to RTP on top of UDP.
   c. best effort, unreliable byte delivery with congestion control – similar to DCCP.

   Clearly explain the new policies and provide at least one example for each case. **(2+4+4+4)**

   Ans:

   The TCP segment format is shown below.



   a) Type of Service (ToS) required: best-effort, unreliable possibly out-of-order message delivery

      Invalidated mechanisms: Sequence number, ACK, Window size, Urgent Pointer, All flags

      Invalidated policies: Handshaking, Window flow control, Nagle's algorithm, Timeout algorithms, AIMD

New policies: each segment is identified by one sequence number
each segment contains one message
the segments are not byte oriented

NOTE: The flow control aspect of the protocol has not been mentioned, but UDP itself does not have the flow control. If by chance you chose flow control, then the ACK mechanism is required.

b) Type of Service (ToS) required: best effort, unreliable and in-sequence message delivery with no congestion control

Invalidated mechanisms: ACK, Window size, Urgent Pointer, All flags

Invalidated policies: Handshaking, Window flow control, Nagle's algorithm,
Timeout algorithms, AIMD

New policies: each segment is identified by one sequence number
each segment contains one message
the segments are not byte oriented
Segments are always delivered in order

c) Type of Service (ToS) required: best effort, unreliable byte delivery with congestion control with possibly out-of-order delivery

Invalidated mechanisms: ACK, Window size, Urgent Pointer, All flags

Invalidated policies: Handshaking, Window flow control, Nagle's algorithm

New policies: each byte is identified by one sequence number
the segments are byte oriented
Segments are always delivered in order

NOTE: The flow control aspect of the protocol has not been mentioned, but UDP itself does not have the flow control. If by chance you chose flow control, then the ACK mechanism is required.

3. Suppose within your Web browser you click on a link to obtain a Web page. The IP address for the associated URL is not cached in your local host, so a DNS lookup is necessary to obtain the IP address. Suppose that n DNS servers are visited before your host receives the IP address from DNS; the successive visits incur an RTT of RTT_1, RTT_2,. . ., RTT_n. Further suppose that the web page associated with the link contains exactly one object, consisting of a small amount of HTML text. Let RTT_0 denote the RTT between the local host and the server containing the object. Assuming zero transmission time of the object, how much time elapses from when the client clicks on the link until the client receives the object? **(7)**

Ans:

The total amount of time to get the IP address is

$$RTT_1 + RTT_2 + \ldots + RTT_n$$

Once the IP address is known, RTT_0elapses to set up the TCP connection and another RTT_0elapses to request and receive the small object. The total response time is

$$2RTT_0 + RTT_1 + RTT_2 + \ldots + RTT_n$$

4. "**ARP is a threat to security**". Do you agree or disagree with this statement. Support your answer with a proper example/use case scenario. **(4)**

   Ans.

   "ARP is a threat to security". The statement is true. This is because when address translation takes place, an intruder can always revert back the packet by inserting a false MAC address. The router has no means (if ARP is used in its basic form) to check the intrusion.

5. Suppose that a router interconnects three subnets: S1, S2, and S3 via three links I1, I2, and I3. Host-A is connected to S1 and Host B is connected to S3. All the three subnets are Ethernet networks. With respect to it, answer the following questions:
   a) Suppose all the interfaces in each of the three subnets are required to have the prefix 223.1.17/24. Also suppose that subnet 1 is required to support up to 125 interfaces, subnet 2 and 3 are each required to support up to 60 interfaces. Give a valid IP address to the three links (I1, I2, and I3) in the following table (Draw this table in your answer sheet):

Link	Valid IP address	Specify third and fourth octet of IP address in binary
I1	223.1.17.1	
I2	223.1.17.65	
I3	223.1.17.129	

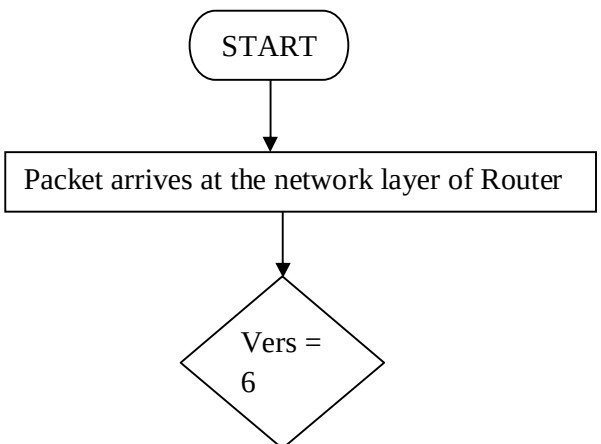
   b) If datagrams are limited to 1500 bytes (including header) between Host-A and Host-B and header is limited to 20 bytes, how many datagrams would be required to send an MP3 consisting of 4 million bytes. **(15+5)**

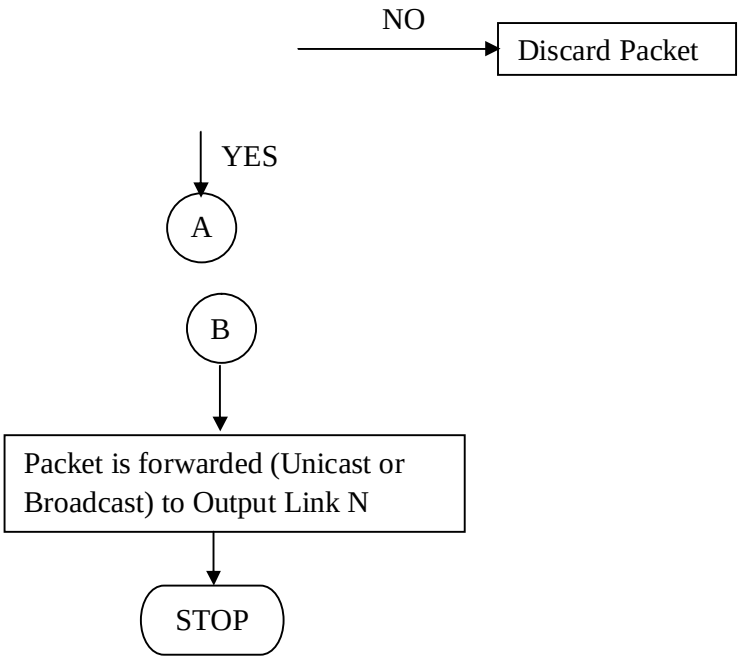
   Ans

   Each datagram can carry 1480 bytes of user data. So number of datagrams required = 4000000/1480 = 2702.7 ≈ 2703 datagrams.

6. You are well aware with the router architecture and the meaning of the fields of packet structure of IPv4 and IPv6. With respect to it, answer the following parts:
   a. Suppose you have to design network layer software which is to be embedded in a router, so that router can smoothly function. You very well know that before designing software, you should have flow chart with you, which depicts the flow of control.

   Given the following incomplete flow chart, complete it for IPv6. Basically you have to show how and when the fields of IP header are used to make decisions, which fields are modified etc. In other words, show the steps how the packet is handled/transformed and how it is forwarded from the network layer of Input port to the network layer of output port. You can assume here that the router is already loaded with forwarding tables. Give a clearly visible and neat flow chart (between the connectors A and B only), and don't make it messy. **(15)**





Ans. In this answer basically you were suppose to write how and when the fields of IPv6 packet header are used by the router.