Systems and Networking II – Prof. Bartolini - February 8, 2024

True/false questions. +1 for correct answer, -1 for wrong answer, 0 no answer – pass with 7/10.

1. The propagation delay between two nodes depends on the bandwidth of the link. [T/F]
2. With NAT, multiple private IP addresses are translated into a unique public address. [T/F]
3. Session management is explicitly supported by HTTP. [T/F]
4. FDMA ensures maximum fairness in link utilization. [T/F]
5. Congestion control is not implemented in TCP Tahoe [T/F]
6. Prefix routing always ensures the selection of the shortest path. [T/F]
7. The value of the field Source Address in a frame header changes when traversing a router. [T/F]
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9. DHCP messages are encapsulated in TCP [T/F].
10. A distance vector routing algorithm may cause routing cycles [T/F].

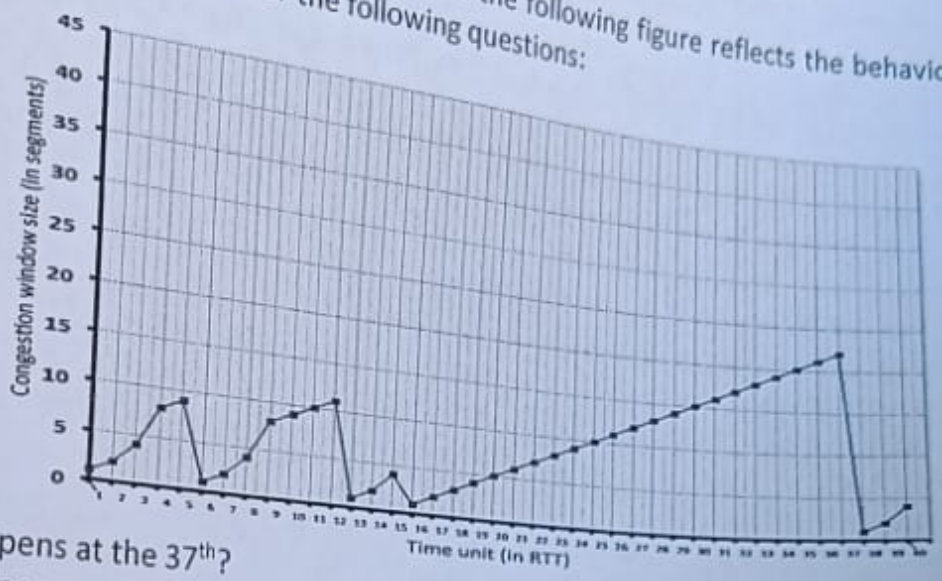
Exercises

1. Given the following routing table entries:
   192.168.2.0/24 -> Next hop: Router A
   192.168.0.0/16 -> Next hop: Router B
   10.0.0.0/8 -> Next hop: Router C
   172.16.0.0/16 -> Next hop: Router D
   Default route (0.0.0.0/0) -> Next hop: Router E
   Analyze the following IP addresses and determine the next hop router for each address using the longest prefix matching:
   IP Address 192.168.1.50
   IP Address 192.168.1.150
   IP Address 10.10.10.10
   IP Address 172.16.10.20
   IP Address 20.20.20.20
   For each IP address, write down the most specific route (prefix) matched in the routing table and the corresponding next-hop router.
   Explain why each IP address matches a specific route based on the longest prefix match.
   (6 points)

2. Consider the Cyclic Redundancy Check (CRC) algorithm. Suppose that the 5-bit generator (G) is 11011, that the data payload (D) is 10000011, and that r = 4. Provide the CRC checksum for the given data payload using the polynomial division method. Show each step of the polynomial division process, including calculating the remainder. Finally, show the transmitted message.
   (6 points)

3. A TCP server has just sent an ACK referring to sequence number 2001. Assume buffering at the server. Explain the actions that the server will take following the given events, including buffering, interactions with the upper layer protocol, and messages being sent:
   a) The server receives a 1000-byte segment with sequence number 5001.
   b) Following the event in a) the server receives a 1000-byte segment with seq. number 2001.
   c) Following the event in b) the server receives a 1000-byte segment with seq.number 4001.
   d) Following the event in c) the server receives a 1000-byte segment with seq.number 3001.
   (6 points)

4. Assuming that TCP Reno is being used and that the following figure reflects the behavior of the congestion window size. Answer the following questions:



a) What happens at the 37th?
b) What happens at the 9th transmission round?
c) When is the 26th segment sent?

(6 points)

5. Consider two hosts, A and B, connected by a single link of rate *R* bps. Suppose the two hosts are separated by *m* meters, and the propagation speed is *s* meters/sec. Host A is to send a packet of size *L* bits to Host B.
   a. Ignoring processing and queuing delays, obtain an expression for the end-to-end delay.
   b. Suppose Host A begins to transmit the packet at time $t = 0$. At time $t = d_{trans}$, where is the last bit of the packet? Explain your answer.
   c. Suppose d_{prop} is greater than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet? Explain your answer.
   d. Suppose d_{prop} is less than d_{trans}. At time $t = d_{trans}$, where is the first bit of the packet? Explain your answer.
   e. Suppose $s = 3 \times 10^8$ meters/sec, L = 1200 bytes, and R = 1 Mbps. Find the distance *m* so that d_{prop} equals d_{trans}.

(6 points)

6. A network using CSMA/CD has a bandwidth of 5Mbps. If the maximum propagation time is 102,4 μs, what is the minimum size of the frame?

(3 points)