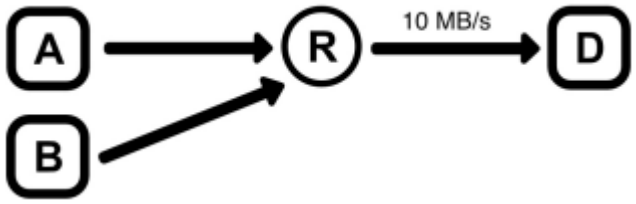
BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Department of Computer Science & Information Systems
Second Semester 2022-2023
COMPUTER NETWORKS (CS F303)
Comprehensive Examination (REGULAR)

Date of Exam: 08-05-2023 (FN) **PART-B (OPEN BOOK)** **MM: 39** **Duration: 1.5 Hrs.**

Note: Write your answers in the main answer sheet. Attempt subparts of questions in sequence, one after the other.

Q.1 Consider the topology where two hosts, A and B, send packets to D through router R. The bottleneck link in the path from R to D runs at 10MB/s (i.e., 10 Megabytes per second). The RTTs from A to D and B to D are 100 ms. Assume that both A and B can communicate with R instantaneously and at an arbitrarily large rate. Assume that each packet has a length of 1250 bytes and the buffer on router R can hold 200 packets. **[1+1+1+3+2+1+2+2=13M]**



a) What is the bandwidth-delay product in Megabytes (MB)?

b) How many packets can the network hold (on the wire plus in R)?

Suppose that at time t = 0, host A has a congestion window of 999 packets, B has a congestion window of 0, and R's buffer is empty. You should assume that packet drops are always experienced by the flow with more packets in flight. You should assume that each flow updates its congestion window after each RTT, decreasing it if any packet was dropped and increasing it otherwise.

Assume that each flow is governed by AIMD, in which the congestion window grows by being incremented by one and shrinks by being halved (rounding down).

c) At which value of t will the number of outstanding packets exceed the network's capacity? Give your answer in RTTs, not seconds.

d) At which value of t will the number of outstanding packets next exceed the network's capacity? Give your answer in RTTs, not seconds. What are the congestion windows in the RTT after this? Give your answer in packets.

Suppose that instead of AIMD, we are using an AIAD protocol. In this case, every drop decreases the congestion window by 5 packets (to a minimum of 1 packet) instead of halving the congestion window. The increment value remains the same as in AIMD (incremented by one).

e) What are the congestion windows of both hosts at t = 300 RTTs for AIAD? Give your answer in packets.

f) How do the number of dropped packets in AIMD and AIAD compare?

g) Does AIAD eventually converge to a fair allocation between flows? Explain.

h) On the real internet, the smaller flow can have its packets dropped too. Suppose that the flow to experience the drop was chosen randomly with a 50% probability. Explain the effect of AIAD on fairness in this new model.

Q.2 The details of an IPv4 address block assigned by an ISP to your research lab are as follows:
Original network address: 142.150.0.0/16 (represents the superblock of the IP address from which the block for your lab is provided.)
Base address: 142.150.235.0
Network mask: 255.255.255.224
Broadcast address: 142.150.235.31
Reserved Router address: 142.150.235.1
Answer the following questions for the above-mentioned IPv4 address block. **[1+1+1+1+1+1+4=10M]**

a) What is the address of the assigned subnetwork, and what is the extended network prefix?

b) Which IP addresses can you use to configure the computers in your lab?

c) How do you configure your computer's IP address, default gateway, and subnet mask?

d) How many bits of the host number are used to designate the subnet of your lab?

e) What is the role of the "reserved router address"? Why is this information important?

f) Do you need to set up a router in your lab?

g) Suppose you wanted to subdivide the assigned address block into 3 smaller subnetworks. Out of these subnetworks, one subnetwork must be of 16 IP addresses, and the remaining two must be of equal size. What are the network addresses and range of IP addresses of these 3 subnetworks? How many hosts can you configure for each subnetwork?

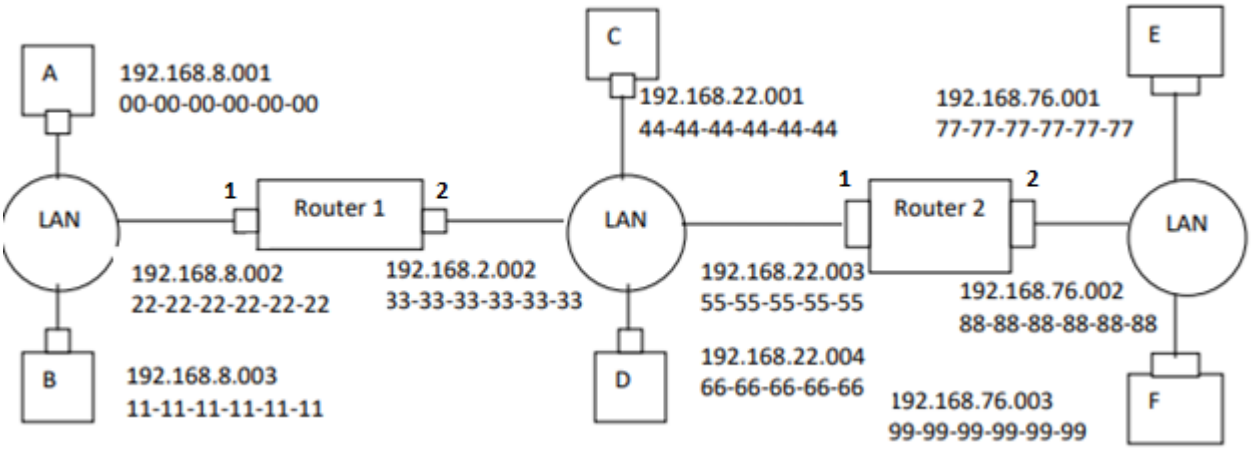
Q.3 Consider the following network. It contains six hosts (A through E) and two Routers. Corresponding IP and MAC addresses are shown for each interface. **[6+6+2+2=16M]**

a) Host E wants to send an IP datagram to host B. Write all the steps required for the packet to be sent to B in sequence and specify all necessary information at each step. Assume that the forwarding tables of all switches already have entries for all MAC addresses and that all hosts and routers already know each other's MAC addresses.

b) Write the forwarding table entries maintained at Router 1. Assume the forwarding table consists of three pieces of information, i.e., Subnet Address, Subnet Mask, and Interface number. Assume the left interface of both routers is 1 and the right interface is 2, as shown in the network figure.

c) Can hosts A and E have the same IP address? Can they have the same MAC address? Justify.

d) Can hosts A and B have the same IP address? Can they have the same MAC address? Justify.



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