

National University of Computer & Emerging Sciences, Karachi

Spring-2022, FAST School of Computing

Final Examination

June 7, 2022, 8:30 am – 11:30 am

Course Code: CS3001	Course Name: Computer Networks
Instructor Name: Dr. Farrukh Salim, Dr. Aqsa Aslam, Mr. Shoaib Raza and Ms. Eman Shahid	
Student Roll No: 19k-9999	Section: 41

Instructions:

- Return the question paper. Do not write anything on question paper, except your Roll # & Section #.
- Read each question completely before answering it. There are 10 questions and 4 pages.
- In case of any ambiguity, you may make assumptions. However, your assumptions should not contradict any statement in the question paper.
- All the answers must be solved according to the sequence given in the question paper.
- This paper is subjective. Write the answers only on answer sheet.

Time: 180 minutes.

Max Points: 100

Question 1: CLO-01

[2x5=10 points]

- Network Congestion is one of the top most research topics in Computer Networks. Is there a better way than Additive Increase Multiplicative Decrease (AIMD) to "probe" for usable bandwidth?
- With the help of Window timing diagram, explain the phenomenon of TCP Fast Re-transmit.

Question 2: CLO-01

[2x5=10 points]

- How a link-state routing protocol works differently from a distance vector protocol? Explain this difference using a comparison chart.
- Consider the network graph shown in figure 1 with nodes A to F. Apply Dijkstra's algorithm to find the least cost path from Node A to all other nodes.

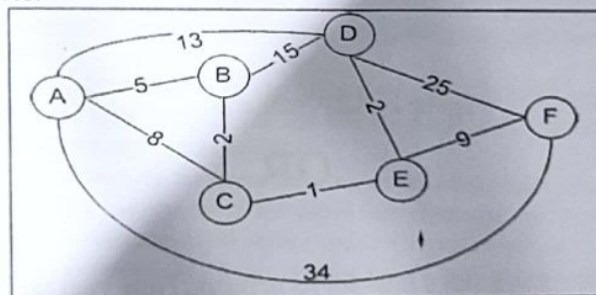


Figure 1: A network graph

Question 3: CLO-01

[2x5=10 points]

- Imagine that a sender uses RDT 3.0 with stop-and-wait. This sender sends packets of length 10 KB over a link of 1 Mbps. The average round trip time RTT is equal to 250ms.
- Calculate the channel utilization and then explain the result.
- How the channel utilization may be increased?

Question 4: CLO-01

[5x2=10 points]

- Write the difference, in maximum 30 words each (answer will not be marked after 30 words)
 - (In Forwarding table computing/learning) process at switches versus routers
 - intra-AS routing versus intra-domain routing
 - Time-to-Live field of IPv4 Header versus Hop-Limit field of IPv6 Header.
 - Flow control mechanism in link layer versus flow control in transport layer
 - Connectionless link versus Unreliable link

Question 5: CLO-01
In TCP connection management, a three-way handshake is used to establish a TCP connection. With the help of a sequence diagram, describe in detail the three-way handshake process and TCP connection termination process. Your description should include the details of actual sequence and acknowledgement number. [2x5=10 points]

[4x2.5=10 points]

Question 6: CLO-02
Consider the LAN scenario in figure 2 and answer the following:

- Which protocol is used to resolve IP to MAC addresses?
- Which broadcast address is used in an ARP request frame?
- PC-A has sent a frame addressed to PC-B. What will the switch SW1 do with the frame if address of PC-B is not present in the MAC address table of SW1?
- PC-C is trying to send a packet to a PC-D on a remote LAN segment, but there are currently no mappings in its ARP cache. How will the PC-C obtain a destination MAC address?

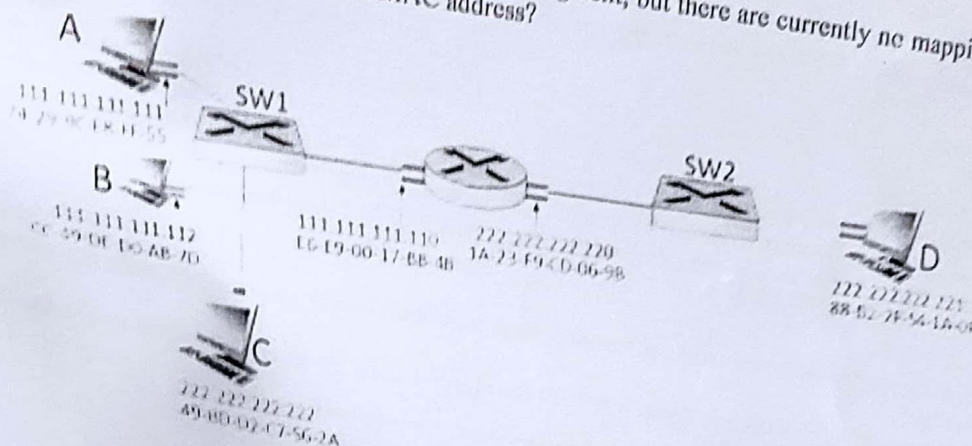


Figure 2: ARP Scenario

OR

Question 6: CLO-02
A University uses the address block of 192.168.9.0/24 for its network. Now your task is to assign IP addresses to the different department's LAN as shown in network figure 3. The network has the following addressing requirements. [5x2=10 points]

- The Computer Science (CS) department LAN-1 will require 50 host IP addresses.
- The Computer Science (CS) department LAN-2 will require 120 host IP addresses.
- The Electrical (EE) department LAN-1 will require 10 host IP addresses.
- The Electrical (EE) department LAN-2 require 18 host IP addresses.
- The Head Quarter (HQ) LAN-1 will require 28 host IP addresses.

Determine the following.

- Number of Bits Borrowed
- Total Number of Subnets
- Total Number of Host Addresses
- Number of Usable Addresses
- Custom Subnet Mask & Subnet Range (Network & Broadcast address)

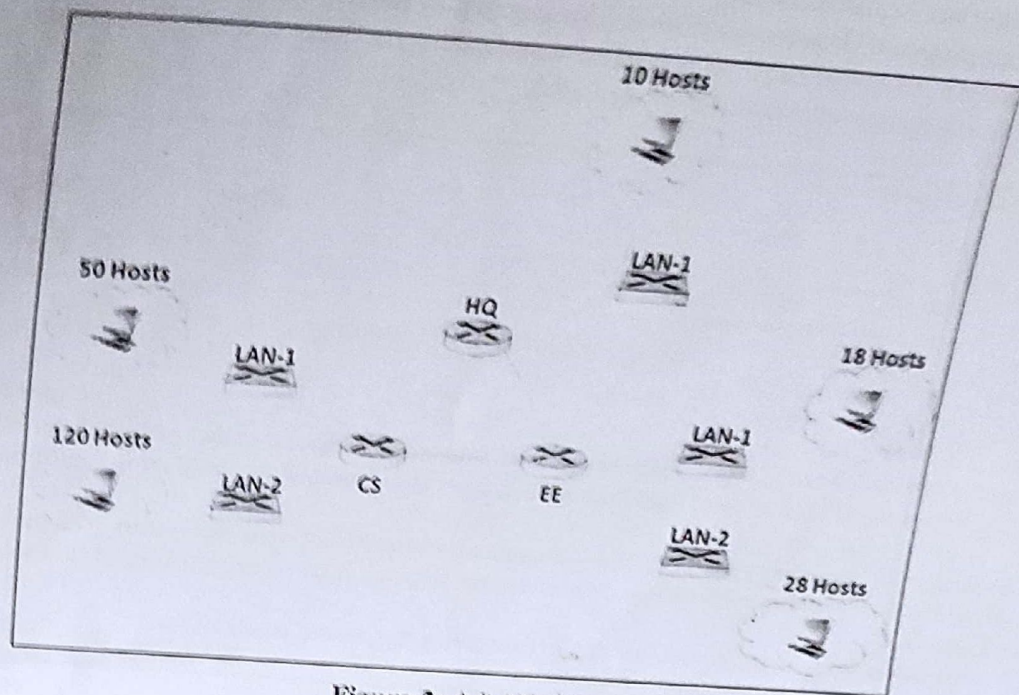


Figure 3: A LAN subnet

Question 7: CLO-03

[5x2=10 points]

Suppose that the Alice as a client wants to retrieve the www.google.com home page but has no information about the www.google.com web server IP address:

- Describe the process of the Alice client obtaining the IP address for the hostname www.google.com under the assumption that it is not cached at the local DNS server and that the local DNS server has not cached an entry for the www.google.com DNS server. (Describe this for the non-recursive case)
- After Alice, a second client Bob (connect to the same network as the first client Alice) also wants to obtain the IP address for www.google.com. Describe the process of the client Bob obtaining the IP address in this case.
- Assume that the round-trip time between local DNS server and DNS root server is 3RTT, between local DNS server and DNS TLD server is 2RTT, and between the clients and the local DNS server is RTT. How long does it take for Alice to obtain the IP address for www.google.com? How long for the Bob?
- How many types of Resource Records (RR) are there?
- What would be the type for the Resource Record that contains the hostname of the mail server?

Question 8: CLO-03

[10 points]

How the Dijkstra's link state routing can be used in an SDN controller scenario. Explain using the help of a detailed diagram that takes into consideration following points:

- The Dijkstra's algorithm is executed as a separate application, outside of the packet switches (3).
- Packet switches send link updates to the SDN controller and not to each other.
- A controller's functionality can be broadly organized into three layers
 - Name each layer
 - Name different components of an SDN controller within each layer
- The two APIs used for communicating between (1) application plane and control plane and (2) control plane and data plane
- The sequence of operations (number them) between different SDN modules/planes, to implement Dijkstra.

Question 9: CLO-03

- Why IP fragmentation was implemented in IPv4?
- ISPs are slowly changing their IP networks to IPv6. This means they have to interconnect between groups running IPv4 with other groups running IPv6. Suppose a scenario shown in figure 4, where IPv6 packets move through an IPv4 tunnel. How is this tunnel practically implemented?

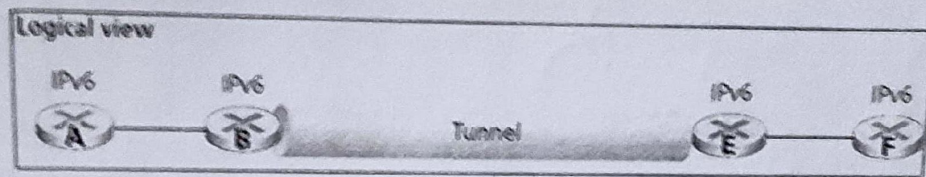


Figure 4: IP Tunneling

Question 10: CLO-03

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For the network shown in Figure 5, suppose that the desired forwarding behavior is that packets from h5 or h6 are to be forwarded from s3 to s1, and then from s1 to s2 (thus completely avoiding the use of the link between s3 and s2).

- Write down the flow table entry for s3, so that datagram sent from h5 or h6 are forwarded to s1 over interface 4.
- Write down the flow table entry for s1, so that datagram arriving at port 1 of s1, from s3, are forwarded to outgoing interface 4.
- Finally write down the flow table entry for s2, for forwarding to required destinations.

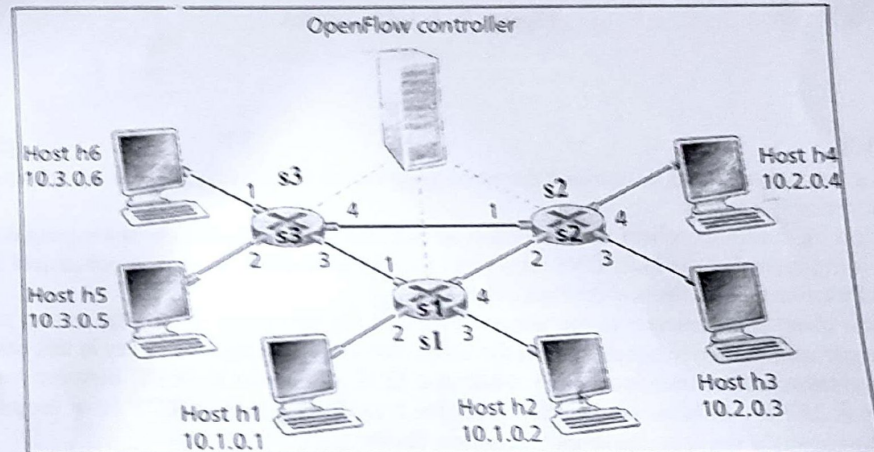


Figure 5. An SDN network, consisting of 3 OpenFlow Switches, 6 Hosts and an OpenFlow Controller

——Thank You——