6/5/22

Indian Institute of Engineering Science and Technology, Shibpur
B.Tech. (CST) 6th Semester End-Term Examination, May 2022
Subject: Data Communication and Computer Networks (CS - 3202)

Time: 2 hours **Full Marks:50**

Answer *Q1* and *any three* from the rest
(Write *all parts* of the same question *together*. Start every question in a new page)

1. Answer the following (in brief) [14]
   a) For *n* devices in a network, what is the number of cable links required for a mesh, ring, bus, and star topology? [4]
   b) In an internet, we change the LAN technology to a new one. Which layers in the TCP/IP protocol suite need to be changed? [2]
   c) End-to-end connectivity is provided from host-to-host in: (a) the network layer (b) the transport layer (c) the session layer (d) it is a combined functionality of the network and the data link layer [1]
   d) Name one inter-AS and one intra-AS routing protocols. [2]
   e) Why do HTTP, FTP, SMTP, and POP3 run on top of TCP rather than on UDP? [2]
   f) Name the layers where the following devices are functional: (i) router, (ii) repeater, (iii) hub, (iv) switch, (v) bridge, (vi) gateway. [3]

2. a) Why does the network layer fragment IP datagrams? Which fields in the IP datagram header are used for reassembly? [2+2]
   b) Let a datagram (packet id: 777) of size 1024 bytes has to pass through two different networks (*N1* and *N2*) whose MTUs are 600 and 400 bytes respectively, to reach the destination (see Fig. 1). Specify the IP datagram fields (`length`, `offset`, `flag`) related to fragmentation: (i) while passing through the network whose MTU is 600 and (ii) while passing through the network whose MTU is 400. [8]

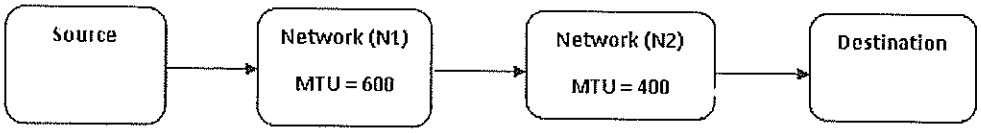

Fig. 1: Maximum Transfer Unit (MTU)

3. a) Consider the network shown in Fig.2. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from `A` to all network nodes. Show how the algorithm works by computing the following Table where `N'` is the subset of nodes visited till now, `D(v)` is the cost of the least-cost path from the source node to any destination `v`, and `p(v)` is the previous node (neighbor of `v`) along the current least cost path from the source to `v`.
   b) Draw the final shortest path tree (SPT) after the execution of the algorithm. [8 + 4]

Step	N'	D(B), p(B)	D(C), p(C)	D(D), p(D)	D(E), p(E)	D(F), p(F)	D(G), p(G)

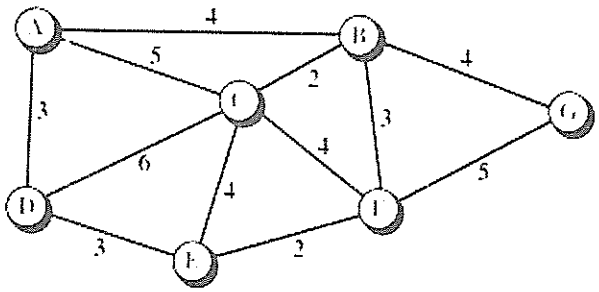

Fig.2: Example Network

4. a) What are the two problems typical of IEEE 802.11 wireless LANs? Draw and explain how does WLANs tackle these problems using control frames. [4 + 4]
   b) What is the total delay (latency) for a frame of size 5 million bits that is being sent on a link with 10 routers each having a queuing time of 2 μs and a processing time of 1 μs. The length of the link is 2000 Km. The speed of light inside the link is 2×10^8 m/s. The link has a bandwidth of 5 Mbps. Which component of the total delay is dominant? Which one is negligible? [4]

5. a) Explain the "loop problem" in switched network with help of an example. [4]
   b) The four switches (S1, S2, S3, S4) connect three LANs as follows:
      i. S1 connects LAN1 and LAN3
      ii. S2 connects LAN1 and LAN2
      iii. S3 connects LAN2 and LAN3
      iv. S4 connects LAN1, LAN2 and LAN3

   Draw the above network system. Find the spanning tree and show the forwarding and blocking ports (use S1 as root bridge). [3 + 5]