COMP3234/CSIS0234 Computer and Communication Networks

Problem Set Assignment Three
Total 7 points

Due date: 17:00 May 3, 2016

<u>Answer all questions. Hand-in the assignment via the Moodle System.</u>

Question 1 (1.5 points) (This question is related to ILO2b – "be able to comprehend and explain the principles behind IP technology and IP addressing" and ILO5 – "be able to plan for IP networks and properly assign IP addresses to interfaces in given networks.")

Suppose Organization XYZ has 4 internal subnets (LAN1, LAN2, LAN3, & LAN4) and uses one router R to connect all subnets. Given the following information:

- LAN1 has the subnet address 123.1.1.0/25.
- LAN2 has the subnet address 123.1.2.0/23.
- LAN3 has the subnet address 123.1.4.0/24.
- LAN4 has the subnet address 123.1.1.192/26.
- Router R has IP addresses
    - 123.1.1.40 assigned to interface e2,
    - 123.1.2.23 assigned to interface e3,
    - 123.1.4.85 assigned to interface e4
    - 123.1.1.200 assigned to interface e5,
    - 117.45.61.78 assigned to interface e1 that connects Router R to the Internet, and has 117.45.61.1 as its nexthop router.

a) (0.8) For each subnet, how many IP addresses are available to allocate to host machines in that subnet (exclude the IP address that has been allocated to the router)? Show your calculation.

b) (0.3) Give the forwarding table for the host machine with IP number 123.1.1.1 (which is assigned to interface e0 of that host). (Each entry of the forwarding table contains three fields: "Destination address/mask", "Nexthop", and "Interface".)

c) (0.4) Give the forwarding table for the router R.

Question 2 (1 point) (This question is related to ILO2b – "be able to comprehend and explain the principles behind IP technology and IP addressing" and ILO5 – "be able to plan for IP networks and properly assign IP addresses to interfaces in given networks.")

An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to customers as follows:

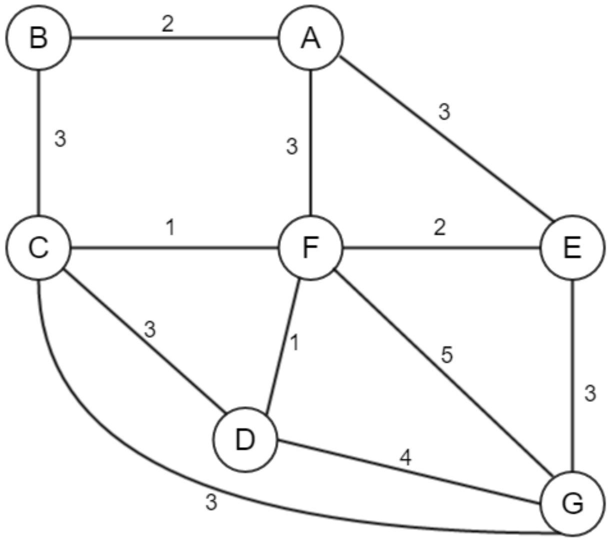
1. The first group has 100 medium-size businesses; each needs at least 200 addresses.
2. The second group has 120 small businesses; each needs at least 50 addresses.
3. The third group has 500 tiny businesses; each needs at least 10 addresses.
4. The fourth group has 1500 households; each needs at least 4 addresses.

Assume the ISP allocates address blocks contiguously, i.e., it does not allow "holes" (unallocated addresses) between subblocks and between groups.

For each group, design the subblocks and give the subnet address (in CIDR notation) for the first and last subblocks in each group. Find out how many addresses are still available after these allocations. Give the first and last unallocated addresses.

Question 3 (1.5 points) (This question is related to ILO 2b – “be able to comprehend and explain the principle behind link-state and distance-vector routing” and ILO3 – “be able to carry out routing algorithms”.)

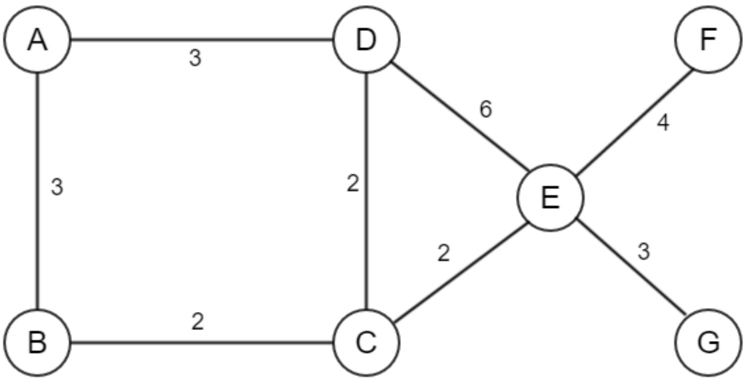
a) (1) Given the following weighted network graph, find the least cost route from **Node A** to all other nodes by using Dijkstra’s shortest-path algorithm. Present your calculation in a format similar to Table 4.3 of the textbook. Also, present the forwarding table of **Node A**. (Each entry of the forwarding table includes {destination, cost, nexthop}. Nexthop in this context is referred to the router id of the next hop to which packets for the entry should be forwarded to.)



b) (0.5) Using the concept of flooding, how many packets will be created if a packet originates at **Node A** and there is a hop limit (TTL) of three? Explain your answer.

Question 4 (1 point) (This question is related to ILO 2b – “be able to comprehend and explain the principle behind link-state and distance-vector routing” and ILO3 – “be able to carry out routing algorithms”.)

Consider the network given in below diagram. Suppose each node initially knows the costs to each of its neighbors. Compute the distance-vector tables of each node after the initialization step and after each iteration of **a (hypothetical) synchronous version** of the distance-vector (Bellman-Ford) algorithm (similar to Figure 4.30 of the textbook). Show all iterations until no update messages are sent. Then, present the forwarding table of **node B**.



Question 5 (1 point) (This question is related to ILO2 – "be able to describe the working principles behind key protocols used in modern computer networks - CRC".)

a) (0.4) Suppose we want to transmit the message 1011000011101010 and protect it from errors using the CRC polynomial $x^4 + x^2 + x + 1$. Determine the message *T(x)* that should be transmitted.

b) (0.3) Suppose the channel introduces a burst error that affects the 2nd, 4th, 5th & 6th bits of *T(x)* (counting from the left). What is received? Can the error be detected?

c) (0.3) Repeat part (b) with a burst error that affects the 1st, 2nd, 4th & 5th bits (counting from the left).

Question 6 (1 point) (This question is related to ILO2c – "be able to comprehend the challenges and explain the principles in providing medium access control in shared link-layer network".)

a) (0.5) If the greatest distance between two hosts in a new CSMA/CD network is 2 km, and we have chosen a packet size of 100 – 1000 bytes, what is the largest bandwidth (in Mb/s) that will permit collision detection? Assume that the speed of light in the wire is 2×10^8 m/s. Also assume that there are no repeaters between the two hosts, so that queuing delay is 0.

b) (0.5) Consider the CSMA/CA protocol adopted by 802.11 (slide no. 17 of the lecture note 06-DataLink-Part2.pdf and section 6.3.2 of the textbook). It is interesting to see that after a wireless station has successfully transmitted a frame (i.e., has received the ACK) and if it has another frame to send, rather than transmits the next frame immediately (if the channel is sensed idle), the protocol restricts this station to pick a random backoff value and count down. What rationale might the designers of this CSMA/CA protocol have had in mind by setting this restriction?