**CSEE-5110: HW quiz 9 and 10, takehome, 2015** ______________________________

1. (10 points)

   (a) (5 points) In RIP, distances to subnets are advertised. What is advertised in BGP?

   The sequence of ASs on the routes.

   (b) (5 points) Why do Link State Advertisements have sequence numbers and Distance Vectors do not?

   Link state advertisements are periodically broadcast throughout the whole network. They can become lost and get out of order, so sequence numbers are needed. Distance vectors are only send to direct neighbors, so there is no need for sequence numbers.

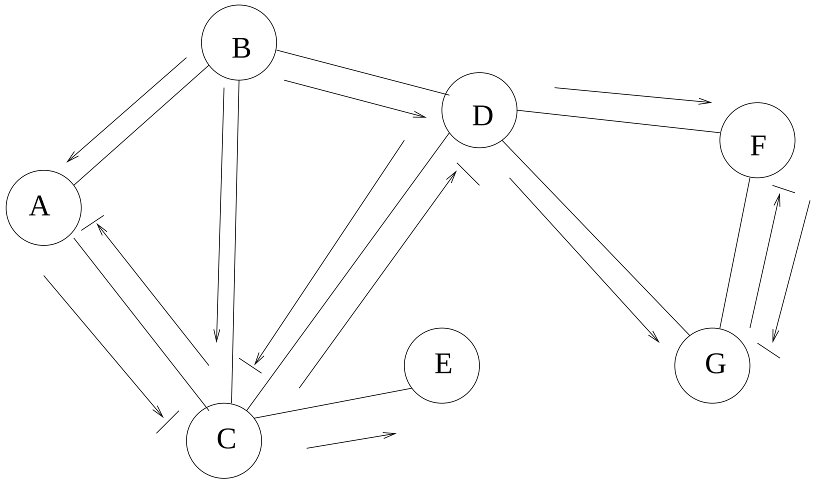
2. (10 points)

   (a) (5 points) What method and network protocols are used to distribute Link State Advertisements?

   LSA's are periodically flooded through the network using reverse-path forwarding. OSPF does not use either UDP or TCP. Instead it directly uses IP (as protocol number 89).

   (b) (5 points) What method and network protocols are used to distribute Distance Vectors?
   Distance vectors are periodically unicast to neighbors using UDP.

3. (10 points)
Consider the topology below, and assume each link has unit cost. Suppose node B is chosen as the source using a multicast routing algorithm and has 1 packet to send.




(a) (5 points) What is the total number of packets transmitted across the network using RPF?

12

(b) (5 points) What is the total number of packets transmitted across the network using a Minimum Spanning Tree?
6

4. ( 10 Points total )

(a) (5 points) What is the size of the multicast address space?

$2^{28}$

(b) (5 points) Suppose that two multicast groups randomly choose a multicast address. What is the expression for probability that they choose the same address?

This is the same type of question as the famous probability question "What is the probability that 2 people have their birthday on the same day of the year?"
Each has $2^{28}$ choices independently, so the sample space is $2^{28} \cdot 2^{28} = 2^{56}$. In order *not* to choose the same address, group 1 can choose any of the $2^{28}$ addresses and group 2 can choose any of the remaining $2^{28} - 1$ addresses. So the probability that they do choose the same address is:

$$p = 1 - \frac{2^{28} \cdot (2^{28} - 1)}{2^{56}}$$

If you were to calculate this, this would be: $3.725290298 \cdot 10^{-9}$, very small indeed.

5. ( 10 Points)
Consider a 4 bit generator 1001 for CRC. Find the value of $R$ for the following value of $D$:
11010110

$R = 111$

6. (10 points)
Suppose three active nodes $A$, $B$, $C$ - are competing for access to a channel using slotted ALOHA. Each node attempts to transmit in a slot with probability $p$. The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

(a) (5 points) What is the expression for the probability that the first success (by any node) is in slot 3?

The probability a node is successful in a slot is $p(1-p)^2$
The probability that any of the three nodes is successful in a slot is $3p(1-p)^2$
The probability that none of the three are successful in a slot $1 - 3p(1-p)^2$
The probability of a first success by any node in slot 3 is

$$(1 - 3p(1-p)^2)^2 3p(1-p)^2$$

(b) (5 points) What is the expression for the probability that node $B$ succeeds for the first time in slot 4?

$$(1 - p(1-p)^2)^3 p(1-p)^2$$

7. (10 points)
Consider a CSMA/CD MAC protocol with a minimum frame size of 64 Bytes. The data rate of this LAN is 100Mbps. Assuming that the propagation delay is $2 \cdot 10^8$m/s, what is the maximum distance that can exist between stations so that the protocol can still sense collisions?

$$\frac{L}{R} > \frac{2D}{S}$$

$L = 512$bits, $R = 1 \cdot 10^8$bps, $S = 2 \cdot 10^8$m/s, so $D = 512$m

8. (10 points)
Consider two LANs connected by bridges S1 and S2, and are interconnected by one router, R1 as shown below.

A – S1 — R1 — S2 – B

Station A has IP address 134.193.2.58 and MAC address 11:22:33:44:55:66.
Router R1's interface with S1 has IP address 134.193.2.10 and MAC address AA:BB:CC:DD:EE:FF.
Router R1's interface with S2 has IP address 217.49.5.02 and MAC address 11:11:11:11:11:11.
Station B has IP address 217.49.5.201 and MAC address FC:55:55:55:55:55.

(a) Station A is sending a frame to station B. What are the source and destination IP and MAC addresses for the frames sent on each link?
A $\longrightarrow$ S1 ?
S1 $\longrightarrow$ R1 ?
R1 $\longrightarrow$ S2 ?
S2 $\longrightarrow$ B ?

The source and destination IP addresses in the packet *do not change* from source to destination. Only the router will look at it to determine the next hop. Bridges do not have MAC addresses.

| Link | Source IP | Dest. IP | Source MAC | Dest. MAC |
|---|---|---|---|---|
| A $\longrightarrow$ S1 | 134.193.2.58 | 217.49.5.201 | 11:22:33:44:55:66 | AA:BB:CC:DD:EE:FF |
| S1 $\longrightarrow$ R1 | 134.193.2.58 | 217.49.5.201 | 11:22:33:44:55:66 | AA:BB:CC:DD:EE:FF |
| R1 $\longrightarrow$ S2 | 134.193.2.58 | 217.49.5.201 | 11:11:11:11:11:11 | FC:55:55:55:55:55 |
| S2 $\longrightarrow$ B | 134.193.2.58 | 217.49.5.201 | 11:11:11:11:11:11 | FC:55:55:55:55:55 |

9. ARP and DHCP are very similar in that stations are trying to discover addresses. Why is the response to an ARP query sent unicast whereas the response to DHCP is always sent to the broadcast IP address?

   In DHCP, the station does not have an IP address until the very end of the DHCP session. Therefore, a unicast response from a DHCP server to the node will not be accepted since the node has no IP address. A node making an ARP query already has a IP address, so the response is unicast