Computer Networking

Solution 4

Problem 1: CRC Error Detection (10 points)

Consider the 5-bit generator, G = 10011, and suppose that D has the value 1010101010 and 1000100101. What are the values of R?

Solution 1:

(1) If we divide 10011 into 1010101010 0000, we get 1011011100, with a remainder of R=0100. Note that, G=10011 is CRC-4-ITU standard.

(2) If we divide 10011 into 1000100101 0000, we get 1001001000, with a remainder of R=1000. Note that, G=10011 is CRC-4-ITU standard.

Problem 2: Slotted Aloha (10 points)

In this problem, we explore some of the properties of the CRC. For he generator G (= 1001) given in Section 6.2.3, answer the following uestions.

(1) Why can it detect any single bit error in data D?

(2) Can the above G detect any odd number of bit errors? Why?

Solution 2:

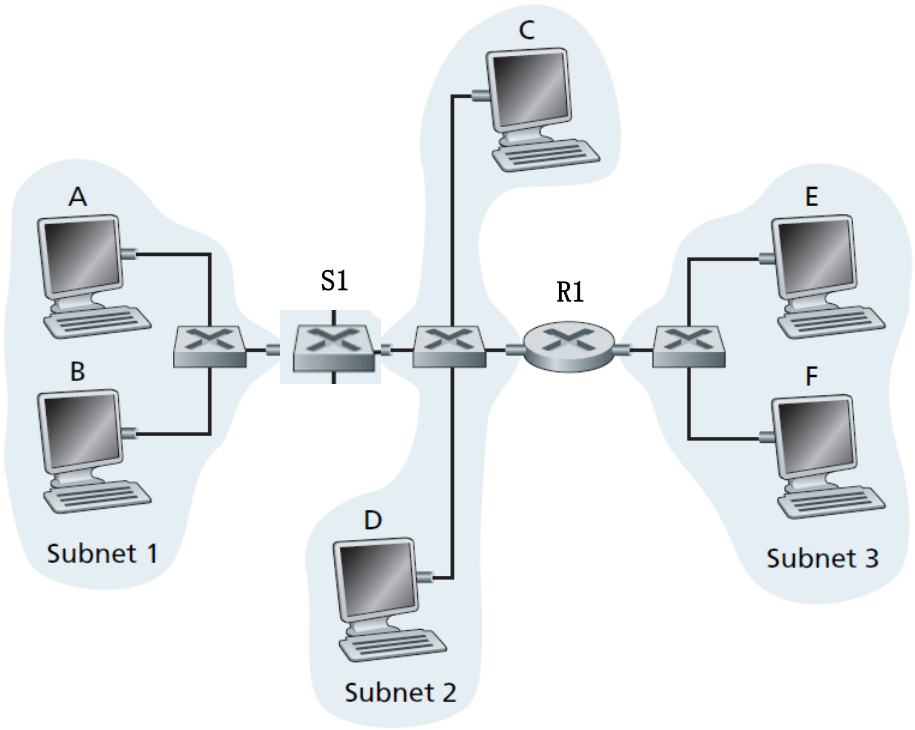
(1) Without loss of generality, suppose ith bit is flipped, where 0<= i <= d+r-1 and assume that the least significant bit is 0th bit. A single bit error means that the received data is K=D*2r XOR R + 2i. It is clear that if we divide K by G, then the reminder is not zero. In general, if G contains at least two 1's, then a single bit error can always be detected.

(2) Yes. The key insight here is that G can be divided by 11 (binary number), but any number of odd-number of 1's cannot be divided by 11. Thus, a sequence (not

necessarily contiguous) of odd-number bit errors cannot be divided by 11, thus it cannot be divided by G.

Problem 3: ARP protocol (15 points)

Consider the following network. Notice that a Host A can learn that a Host B is on the same LAN by checking its own routing table (yes, a host has a routing table as a router) and finding that the subnet prefix of B's IP is the same as itself.



(1) Consider sending an IP datagram from Host E to Host F. Will Host E ask router R1 to help forward the datagram? Why? In the Ethernet frame containing the IP datagram, what are the source and destination IP and MAC addresses?

(2) Suppose E would like to send an IP datagram to B, and assume that E's ARP cache does not contain B's MAC address. Will E perform an ARP query to find B's MAC address? Why? In the Ethernet frame (containing the IP datagram destined to B) that is delivered to router R1, what are the source and destination IP and MAC addresses?

(3) Suppose Host A would like to send an IP datagram to Host B, and neither A's

ARP cache contains B's MAC address nor does B's ARP cache contain A's MAC address. Further suppose that the switch S1's forwarding table contains entries for Host B and router R1 only. Thus, A will broadcast an ARP request message. What actions will switch S1 perform once it receives the ARP request message? Will router R1 also receive this ARP request message? If so, will R1 forward the message to Subnet 3? Once Host B receives this ARP request message, it will send back to Host A an ARP response message. But will it send an ARP query message to ask for A's MAC address? Why? What will switch S1 do once it receives an ARP response message from Host B?

(1) No. E can check the subnet prefix of Host F's IP address, and then learn that F is on the same LAN. Thus, E will not send the packet to the default router R1.
Ethernet frame from E to F:
Source IP = E's IP address
Destination IP = F's IP address
Source MAC = E's MAC address
Destination MAC = F's MAC address
(2) No, because they are not on the same LAN. E can find this out by checking B's IP address.
Ethernet frame from E to R1:
Source IP = E's IP address
Destination IP = B's IP address
Source MAC = E's MAC address
Destination MAC = The MAC address of R1's interface connecting to Subnet 3.

(3) Switch S1 will broadcast the Ethernet frame via both its interfaces as the received ARP frame's destination address is a broadcast address. And it learns that A resides on Subnet 1 which is connected to S1 at the interface connecting to Subnet 1.

And, S1 will update its forwarding table to include an entry for Host A.

Yes, router R1 also receives this ARP request message, but R1 won't forward the message to Subnet 3.

B won't send ARP query message asking for A's MAC address, as this address can be obtained from A's query message.

Once switch S1 receives B's response message(In fact, S1 may not receive a message from B), it will add an entry for host B in its forwarding table, and then drop the received frame as destination host A is on the same interface as host B (i.e., A and B are on the same LAN segment).

Problem 4: Switch self-learning (15 points)

Let's consider the operation of a learning switch in the context of a network n which 6 nodes labeled A through F are star connected into an Ethernet witch. Suppose that *(i)* B sends a frame to E, *(ii)* E replies with a frame to B, *iii)* A sends a frame to B, *(iv)* B replies with a frame to A. The switch table is initially empty. Show the state of the switch table before and after each f these events. For each of these events, identify the link(s) on which the ransmitted frame will be forwarded, and briefly justify your answers.

Action	**Switch Table State**	**Link(s) packet is forwarded to**	**Explanation**
B sends a frame to E	Switch learns interface corresponding to MAC address of B	A, C, D, E, and F	Since switch table is empty, so switch does not know the interface corresponding to MAC address of E
E replies with a frame to B	Switch learns interface corresponding to MAC address of E	B	Since switch already knows interface corresponding to MAC address of B
A sends a frame to B	Switch learns the interface corresponding to MAC address of A	B	Since switch already knows the interface corresponding to MAC address of B
B replies with a frame to A	Switch table state remains the same as before	A	Since switch already knows the interface corresponding to MAC address of A