**Introduction to Computer Networks**

**Homework 5 - Solutions**

[1] **(1 point)**Consider using cyclic redundancy check to error detection. If the sender and receiver have agreed on a generator G = 10011, and suppose that the data D has the value of 1010101010. What is the checksum should be? Aka. What is the value of R? Show your calculation steps for credits.

Answer: 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] **(3 points)** Consider three LANs interconnected by two routers, as shown below.

E

C

192.168.1.001

00-00-00-00-00-00

A

192.168.3.001

77-77-77-77-77-77

192.168.2.001

44-44-44-44-44-44

Router 2

Router 1

192.168.2.003

55-55-55-55-55-55

192.168.2.002

33-33-33-33-33-33

192.168.1.002

22-22-22-22-22-22

192.168.3.002

88-88-88-88-88-88

192.168.2.004

66-66-66-66-66

192.168.1.003

11-11-11-11-11-11

D

B

192.168.3.003

99-99-99-99-99-99

F

(a) Host E is sending an IP data gram to Host B. Suppose all of the ARP tales are up to date. List all frames that are transmitted on all the three LANs by filling in the table.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Sender | Type  (ARP request, ARP response, or regular data) | Source MAC address | Destination MAC address | Source IP | Destination IP |
| 1 | E | **Regular data** | **77-77-77-77-77-77** | **88-88-88-88-88-88** | **192.168.3.001** | **192.168.1.003** |
| 2 | **Router2** | **Regular data** | **55-55-55-55-55-55** | **33-33-33-33-33-33** | **192.168.3.001** | **192.168.1.003** |
| 3 | Router1 | **Regular data** | **22-22-22-22-22-22** | **11-11-11-11-11-11** | **192.168.3.001** | **192.168.1.003** |
| 4 |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |

**Forwarding table in E determines that the datagram should be routed to interface 192.168.3.002.**

1. **The adapter in E creates and Ethernet packet with Ethernet destination address 88-88-88-88-88-88.**
2. **Router 2 receives the packet and extracts the datagram. The forwarding table in this router indicates that the datagram is to be routed to 198.162.2.002.**
3. **Router 2 then sends the Ethernet packet with the destination address of 33-33-33-33-33-33 and source address of 55-55-55-55-55-55 via its interface with IP address of 198.162.2.003.**
4. **The process continues until the packet has reached Host B.**

[3] **(2 points)** Suppose node A and B are on the same 10Mbps Ethernet bus, and the propagation delay between the two nodes is 325 bit times. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame.

Can A finish transmitting before it detect that B has transmitted? Why or why not? *Hint: suppose at time t = 0 bit times, A begins transmitting a frame. In the worst case, A transmits a minimum-sized frame of 512+64 bit times. So A would finish transmitting the frame at t = 512+64 bit times. Thus, the answer is no. if B’s signal reaches A before bit time t = 512+64bits. In the worst case, when does B’s signal reach A?*

**At   transmits. At ,  would finish transmitting. In the worst case,  begins transmitting at time t=324, which is the time right before the first bit of A’s frame arrives at B. At time t=324+325=649 's first bit arrives at . Because 649> 576,  finishes transmitting before it detects that B has transmitted. So A incorrectly thinks that its frame was successfully transmitted without a collision.**

[4] Suppose four nodes, A, B, C, and D are all connected to a hub via 10Mbps Ethernet cables. The distance between the hub and these four nodes are 300m 400m, 500m, and 700m, respectively. Recall that the CSMA/CD protocol is used for this Ethernet. Assume that the signal propagation speed is 2\*108 m/sec.

1. **(2 points)**What is the minimum required frame length? What is the maximum required frame length?

**Answer: minimum required frame length is given by**

**2\*dprop\* BW=2\*(500+700)/( 2 ⋅108) \* 10 \* 106=120 bits.**

**There is no maximum required packet length.**

1. **(2 points)**If all frames are 1500bits long, find the efficiency of this Ethernet.

**Answer: Efficiency is given by**

**1/(1+5\* dprop/ dtrans) =1/(1+5\*120/2/1500 )=0.83**