

[Solution] CS5222 Assignment 3 (on Chapter 6)

P1. Suppose we are using cyclic redundancy check (CRC) for encoding. Consider the 5-bit generator, $G=10011$, and suppose that D has the value 1010101010 . What is the value of the remainder R ? What is the length of this remainder R (in bits)?

If we divide 10011 into $1010101010\ 0000$, we get 1011011100 , with a remainder of $R = 0100$ (4 bits).

P15. Consider Figure 5.33. Now we replace the router between subnets 1 and 2 with a switch $S1$, and label the router between subnets 2 and 3 as $R1$.

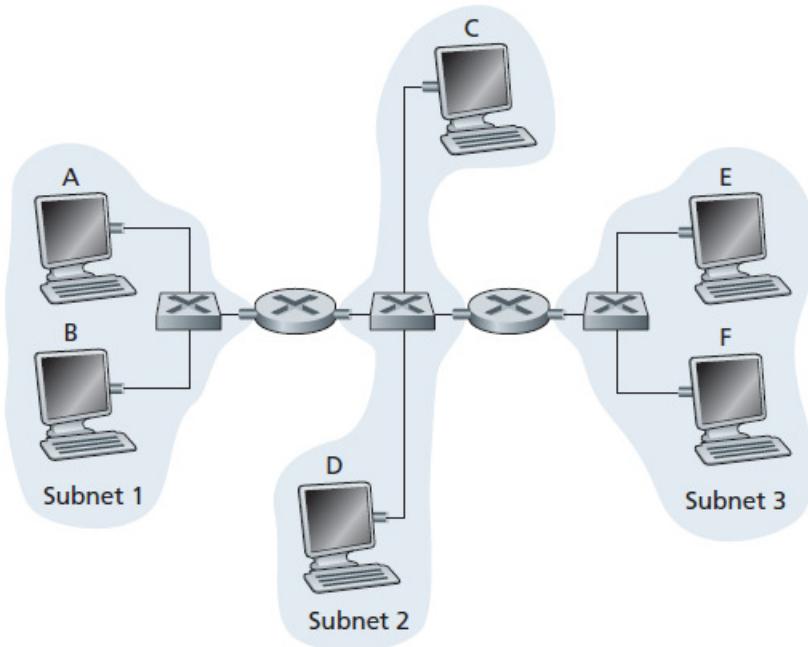


Figure 5.33 ♦ Three subnets, interconnected by routers

- 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?
- 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?
- 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? Also, will switch S1 receive an ARP response message from Host B? Why?

Problem 15

- a) 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

- b) 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.

- c) 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.

No, Switch S1 will not receive the ARP response from B, because the left most switch in the figure already knows that it has to forward this to the link towards A and not towards S1 (its forwarding table already includes an entry for Host A).

P18. Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 325 bit times. Suppose CSMA/CD and Ethernet packets are used for this broadcast channel. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame. Can A finish transmitting before it detects that B has transmitted? Why or why not? If the answer is yes, then A incorrectly believes that its frame was successfully transmitted without a collision. *Hint:* Suppose at time $t=0$ bits, 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 $t=512+64$ bits. In the worst case, when does B's signal reach A?

Problem 18

At $t = 0$, A transmits. At $t = 576$, A would finish transmitting. In the worst case, B begins transmitting at time $t=324$, which is the time right before the first bit of A's frame arrives at B. At time $t=324+325=649$, B's first bit arrives at A. Because $649 > 576$, A finishes transmitting before it detects that B has transmitted. So A incorrectly thinks that its frame was successfully transmitted without a collision.

- P31. In this problem, you will put together much of what you have learned about Internet protocols. Suppose you walk into a room, connect to Ethernet, and want to download a Web page. What are all the protocol steps that take place, starting from powering on your PC to getting the Web page? Assume there is nothing in our DNS or browser caches when you power on your PC. (*Hint:* the steps include the use of Ethernet, DHCP, ARP, DNS, TCP, and HTTP protocols.) Explicitly indicate in your steps how you obtain the IP and MAC addresses of a gateway router.

Problem 31

(The following description is short, but contains all major key steps and key protocols involved.)

Your computer first uses DHCP to obtain an IP address. You computer first creates a special IP datagram destined to 255.255.255.255 in the DHCP server discovery step, and puts it in a Ethernet frame and broadcast it in the Ethernet. Then following the steps in the DHCP protocol, your computer is able to get an IP address with a given lease time.

A DHCP server on the Ethernet also gives your computer a list of IP addresses of first-hop routers, the subnet mask of the subnet where your computer resides, and the addresses of local DNS servers (if they exist).

Since your computer's ARP cache is initially empty, your computer will use ARP protocol to get the MAC addresses of the first-hop router and the local DNS server.

Your computer first will get the IP address of the Web page you would like to download. If the local DNS server does not have the IP address, then your computer will use DNS protocol to find the IP address of the Web page.

Once your computer has the IP address of the Web page, then it will send out the HTTP request via the first-hop router if the Web page does not reside in a local Web server. The HTTP request message will be segmented and encapsulated into TCP packets, and then further encapsulated into IP packets, and finally encapsulated into Ethernet frames. Your computer sends the Ethernet frames destined to the first-hop router. Once the router receives the frames, it passes them up into IP layer, checks its routing table, and then sends the packets to the right interface out of all of its interfaces.

Then your IP packets will be routed through the Internet until they reach the Web server.

The server hosting the Web page will send back the Web page to your computer via HTTP response messages. Those messages will be encapsulated into TCP packets and then further into IP packets. Those IP packets follow IP routes and finally reach

your first-hop router, and then the router will forward those IP packets to your computer by encapsulating them into Ethernet frames.