



Assignment 3

- **College:** College of Computing
- **Major:** Computer Science
- **Supervisor:** Man Hon Michael CHEUNG
- **Student Name:** CHEN Xian
- **Student Number:** [REDACTED]

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)?

ANS:

The value of the remainder R is 4, and the length is 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 $R1$.

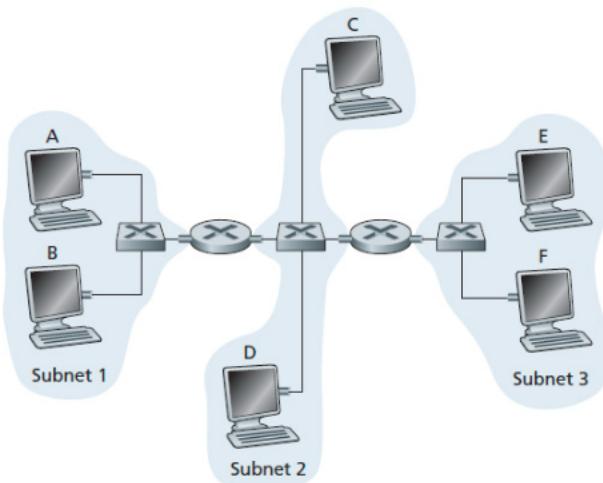


Figure 5.33 ♦ Three subnets, interconnected by routers

- 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?

ANS:

a. No. Because Host E and Host F are both in the same subnet. According to IP routing logic, E will recognize that F's IP address is in the same network segment as its own, so it sends the packet directly at the link layer without using the default gateway.

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 Host B is in Subnet 1 while E is in Subnet 3, they are in different subnets. E must send the packet to its default gateway (the Subnet 3 interface of router R1). Therefore, E will only perform an ARP query for R1's MAC address.

Source IP: E's IP address; Destination IP: B's IP address; Source MAC: E's MAC address; Destination MAC: R1's MAC address;

c. S1 will flood the frame, and at the same time, S1 will learn A's MAC address and record it in its forwarding table.

R1 will receive the ARP request, because it is connected to S1. However, R1 will not forward this message to Subnet 3, because routers isolate broadcast domains, and an ARP request is a link-layer broadcast that cannot pass through a router.

No. Because A's ARP request already contains A's IP and MAC address. When Host B receives the request, it automatically adds A's mapping entry to its own ARP cache, so it does not need to perform a reverse query

Yes. The ARP reply is a unicast frame sent from B to A. The physical path is Host B → Switch S1 → Host A. Therefore, S1 will inevitably receive and forward the frame.

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?

ANS:

Yes.

To detect a collision while transmitting, a node must still be transmitting the frame when the collision signal from the other node reaches it. In the worst-case scenario, the time it takes for a collision signal to propagate back to sender A is twice the propagation delay

$$\rightarrow \rightarrow [L \geq (2 \times d_{prop})]$$

BUT:

Time for A to finish transmitting the frame:

$$\rightarrow \rightarrow T_{trans} = L = 576 \text{ bit times.}$$

Time for the collision signal to return to A (Worst-case Round Trip Time):

$$\rightarrow \rightarrow RTT = 2 \times d_{prop} = 2 \times 325 = 650 \text{ bit times.}$$

RTT > T_{trans}

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.

ANS:

- a. DHCP (obtaining its own IP and gateway information)

When the PC is powered on, it has no IP address. It runs the DHCP protocol over UDP. The PC broadcasts a DHCP Discover frame. The DHCP server replies with a DHCP Offer, which includes the PC's IP address, subnet mask, DNS server IP, and the IP address of the default gateway router.

- b. ARP (obtaining the gateway's MAC address):

The PC needs to send a query to the DNS server, so the packet must be sent to the default gateway. The PC checks its ARP cache and finds no MAC address corresponding to the gateway's IP. The PC uses the ARP protocol to broadcast: "Who has Gateway IP?" The gateway router replies with an ARP response, providing its MAC address.

- c. DNS (resolving the domain name):

Now that the PC knows the gateway's MAC address, it can send a DNS query. The query asks: "What is the IP address of www.xxxx.com?" Packet: Src IP = PC, Dst IP = DNS server. Frame header: Dst MAC = gateway's MAC. The DNS server replies with the IP address of the target website.

- d. TCP (establishing a connection):

After obtaining the web server's IP address, the PC begins establishing a connection using the TCP protocol. Three-way handshake: send SYN → receive SYN+ACK → send ACK.

- e. HTTP (requesting the webpage):

After the TCP connection is established, the PC sends an HTTP GET request. The server returns an HTTP response. The browser renders the webpage.