P28)

- EE department IP addresses for 3 computers (from left to right) : 111.111.1.1, 111.111.1.2, 111.111.1.3. Subnet mask is 111.111.1/24.
- CS department IP addresses for the 3 computers 111.111.2.1, 111.111.2.2, 111.111.2.3. Subnet mask is 111.111.2/24.
- The router's interface card that connects to port 1 can be configured to contain two sub interface IP addresses: 111.111.1.0 for EE and 111.111.2.0 for CS.
- Each IP address is associated with a VLAN ID. 111.111.1.0 is associated with VLAN 11, and 111.111.2.0 is associated with VLAN 12. This means that each frame that comes from subnet 111.111.1/24 will be added an 802.1q tag with VLAN ID 11, and each frame that comes from 111.111.2/24 will be added an 802.1q tag with VLAN ID 12.
- Suppose that host A in EE department with IP address 111.111.1.1 would like to send an IP datagram to host B (111.111.2.1) in CS department.
- Host A first encapsulates the IP datagram (destined to 111.111.2.1) into a frame with a destination MAC address equal to the MAC address of the router's interface card that connects to port 1 of the switch. Once the router receives the frame, then it passes it up to IP layer, which decides that the IP datagram should be forwarded to subnet 111.111.2/24 via sub-interface 111.111.2.0 using forwarding table. Then the router encapsulates the IP datagram into a frame and sends it to port 1.
- Note that this frame has an 802.1q tag VLAN ID 12 because it will go to CS department. Once the switch receives the frame port 1, it knows that this frame is destined to VLAN with ID 12, so the switch will send the frame to Host B which is in CS department. Once Host B receives this frame, it will remove the 802.1q tag.

P19.

Suppose nodes A and B are on the same 10 Mbps broadcast channel, and the propagation delay between the two nodes is 245 bit times. Suppose A and B send Ethernet frames at the same time, the frames collide, and then A and B choose different values of K in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide? For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at $t = 0$ bit times. They both detect collisions at $t = 245$ t bit times. Suppose $K_A = 0$ and $K_B = 1$. At what time does B schedule its retransmission? At what time does A begin transmission? (*Note*: The nodes must wait for an idle channel after returning to Step 2—see protocol.) At what time does A's signal reach B? Does B refrain from transmitting at its scheduled time?

R=10Mbps

Propagation Delay = 245 bit times

Collision found at 245 bit times

K_A=0, K_B=1

A,B Starts transmission at t=0 bit times

Collision is discovered at 245 bit times by A,B

A,B finish transmitting jam signal (48 bit times) at 293 bit times

After the collision is discovered, Both the nodes wait for some random back off time.

A chooses k=0 and then waits for back off time = 0 x 512 = 0 bit times
B chooses k=1 and then waits for back off time = 1 x 512 = 512 bit times
From here, A begins retransmission immediately while B waits for 512 bit times.
node A gets the authority to retransmit immediately, but does not retransmit immediately.
It waits for the channel to clear from the last bit aborted by it on discovering the collision.
Time Thus, taken by the last bit to get off the channel = Propagation delay = 245 bit times
So, node A at 293+245 = 538 bit times detects an idle channel. node A starts the retransmission 538 +96 = 634
node B can start the retransmission at 293+512 = 805 bit times if the channel is idle!
B must sense idle channel for 96 bit times before it transmits. node B start the retransmission at 805 + 96 = 901 bit times.
At 634 + 245 = 879 the first bit of A reaches B. Because the minimum frame length is at least 512 bit times -> size of 1 slot then for sure B has to wait before start retransmit! So he will reschedule his retransmission and wait until the line is idle + 96 bit times before start

transmiting. So A,B will not collide as B will wait and not start transmiting as the channel is not idle!

If the first bit of A reaches B after 901 bit times then collision will occur again!!! That is because B will start transmission and after some bit times A will reach B signals and collide!!

R14.

2

R11.

An ARP query with destination MAC address FF-FF-FF-FF-FF-FF is sent in a broadcast frame because the querying host does not know which adapter -> MAC address corresponds to the IP address is requested. So a broadcast frame is sent to the whole LAN to learn the MAC address of the destination IP address. All nodes will receive this ARP query message in the LAN. The node that the destination IP address matches his IP address will response with an ARP response containing his MAC address. The other nodes will discard the frame because IP address will not match. Now the sending node knows the MAC address -> adapter to which the response will be sent and therefore there is not a need for broadcast frame now but unicast frame.

R10.

C's adapter will process the frames, but the adapter will not pass the datagrams up the protocol stack because destination MAC address will not match with his own one. If the LAN broadcast address is used, then C's adapter will both process the frames and pass the datagrams up the protocol stack and the network layer to check the IP address.

R31.

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,
Then puts DHCP request encapsulated in UDP,encapsulated in IP,encapsulated in 802.1 ethernet frame and broadcast it in the LAN. Router running DHCP SERVER will receive it too. Then following the steps in the DHCP protocol, you 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 IP addresses of local DNS servers (if they

exist). Encapsulation at DHCP server frame forwarder through LAN. DHCP client receives DHCP ACK reply. 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.
DNS query created, encapsulated in UDP, encapsulated in IP, encasulated in Ethernet. In order to send frame to router, need MAC address of router interface -> ***ARP***
An ARP query broadcast, received by router, which replies with ***ARP reply*** giving MAC address of router interface. client now knows MAC address of first hop router, so can now send frame containing DNS query.

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.