CMPT 371 Assignment 4

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1) **[19 points]** A source host sends a packet with an MTU of 1500 octets in an Ethernet frame. The MTU or maximum transmission unit indicates the length of the data field in the Ethernet frame (the length of the IP packet). The length of the IPv4 header is 32 octets. The length of the TCP header is 24 octets. On its way to the destination the packet passes through a network with a MTU of 920 octets. Explain how the packet is fragmented by filling in the requested information in the diagram below. You should create a copy of the diagram below including the information requested in your solution. The data you are to fill in is indicated in two ways

    a. A space after an = needs to be filled with a numeric value

    b. A ? needs to be replaced with a label indicating the type of header and its length in octets

    c. A %% indicates that the field should hold the length of the application data (without any encapsulating headers). In addition to the final answer you should provide an equation showing how that length was calculated (either words or just an expression showing how you combined the supplied values to determine the length.).

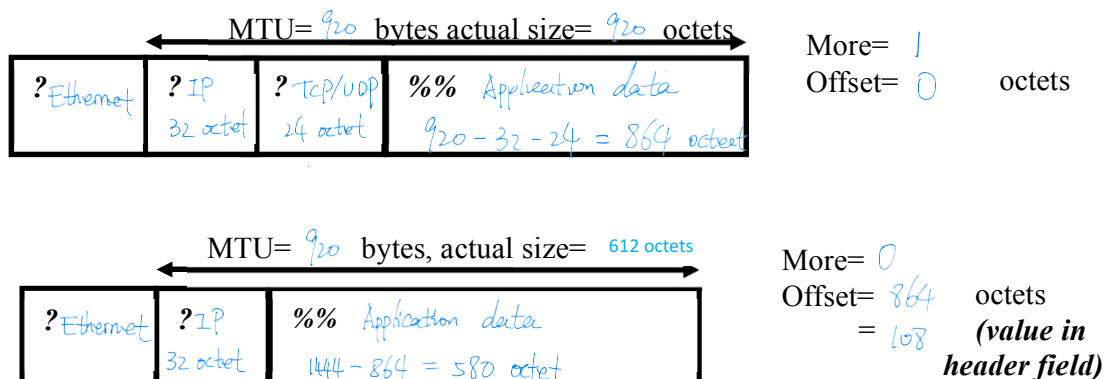Remember the payload of the IP datagram for each fragment (except the last) must be a multiple of 8.

Consider what would change in your calculation if the MTU was increased to 927. Does the amount of data and / or the offset in the first fragment change when the MTU is increased from 920 to 927? Give an explanation, including a calculation, of why the amount of data changes (or does not change) and why the offset changes (or does not change).

    If the MTU was increased to 972, the amount of data or the offset of the first fragment will not change. Because the payload of the IP datagram should be multiple of 8, except the last one. The MTU of IP datagram = 972-32-24 = 916 octets and 916/8 = 114.5, which is not multiple of 8. So, the pay load of the IP datagram of the first one is still 888 octets and the remaining space will be empty.

Original Ethernet frame before fragmentation

? Ethernet	? IP 32 octets	? TCP/UDP 24 octets	%%	Application data 1500 − 32 − 24 = 1444 octets

Ethernet frames containing IP fragments after fragmentation

MTU= 920 bytes actual size= 920 octets

? Ethernet	? IP 32 octet	? TCP/UDP 24 octet	%%	Application data 920 − 32 − 24 = 864 octets

More= 1
Offset= 0   octets

MTU= 920 bytes, actual size= 612 octets

? Ethernet	? IP 32 octet	%%	Application data 1444 − 864 = 580 octet

More= 0
Offset= 864 octets
    = 108 *(value in header field)*

2) Consider routing within an AS (autonomous system). Answer the following questions regarding routing protocols. Each answer should be no more than two sentences per point.

a) **[2 points]** What is an AS?

Answer: An autonomous system (AS) is group of routers and hosts controlled by a single administrative authority with a unified routing policy

b) **[1 point]** Where is an internal routing protocol used?

Answer: When exchanging routing information between routers within an autonomous system. This routing information can then be used to route network-layer protocols like IP.

c) **[1 point]** Where is an external routing protocol used?

Answer: External routing protocols are used to exchange routing information between autonomous systems.

d) **[2 points]** What is a distance vector?

Answer: A simple routing protocol that uses distance or hop count as its primary metric for determining the best forwarding path. A distance vector protocol routinely sends its neighboring routers copies of its routing tables to keep them up-to-date.

e) **[1 point]** When using a link state type protocol what routing information is exchanged?

Answer: Send a packet containing addresses and delays to neighbor's information to all other routers.

f) **[2 points]** Consider a router A in an AS. When using a link state type protocol which routers send routing information to Router A? Which routers does Router A send routing information to?

Answer: All the routers send the information to router A, because every node supposed to flood the information to other routers. A send routing information to his neighbor.

g) **[2 points]** One of the problems with distance vector-based routing is slow convergence. What is slow convergence?

Answer: Slow convergence is one of the problem of distance vector routing. If some link is broken, then it will take super long time to transmit the notice information to all other routers. Then they are disconnected because of the local connection routers are updated periodically. Since the notice will take long time it is known as slow convergence

h) **[3 points]** Is RIP a link state routing protocol? How does RIP mitigate (reduce) the effects of slow convergence?

Answer: The RIP is a distance vector routing protocol. RIP helps prevent slow convergence by sending update messages immediately after updates have been completed. Also, RIP reduces routing loops by limiting the number of routers on the destination path. So, if a connection broken, all other routers will know about the failure quicker than having infinite routers.

i) **[2 points]** What problem does RIP use triggered updates to mitigate? Briefly explain how triggered updates mitigate this problem.

Answer: To mitigate count to infinity or slow convergence. RIP uses a modified hop count as a way to determine network distance. RIP accepts 15 hops. If a packet can not reach a destination in 15hops, then the destination is unreachable. RIP sends vector

j) **[1 point]** When using a link state protocol what routing information is exchanged?
Answer: The information about locally connected routers distance is exchanges., which for the shortest path concept.

k) **[4 points]** Give an example of a link state protocol discussed in class. What method does this protocol used to share routing information between routers? Give a two to three sentence summary of this method.
Answer: OSPF uses the Dijkstra algorithm. OSPF will listen to neighbors and gather all link state data available to build a topology map of all available paths in its network and then save the information in its topology database. it will calculate the best shortest path to each reachable subnet/network. Three operations: First, meet your neighbors. Second: make good friends. Third, keeping in touch with friends.

3) **[14 points]** Consider the distributed Bellman-Ford algorithm used in the first generation internet. At station A, new routing tables have just arrived from A's nearest neighbors B and D. The cost from A to B is 6 and the cost from A to D is 4. These newly received distance vectors are given below. Based on these newly received distance vectors calculate a new distance vector for node A.

	from B		from D	
	Cost	Next	Cost	Next
A	6	A	2	A
B	-	-	7	G
C	3	C	6	G
D	8	A	-	-
E	2	E	5	G
F	10	C	13	G
G	3	E	4	G
H	7	E	8	G

|	B	D	New table	
	Cost	Cost	Cost	Next
A	- (12)	- (6)	-	-
B	6	11	6	B
C	9	10	9	B
D	14	4	4	D
E	8	9	8	B
F	16	17	16	B
G	9	8	8	D
H	13	12	12	D

4) **[20 points]** Consider a system using flooding with a hop counter. Suppose that the hop counter is originally set to the diameter of the network. When the hop count reaches zero, the packet is discarded except at its destination. Does this always ensure that a packet will reach its destination if the case that there exists at least one operable path? Why or why not? Give an example or counter example.

Answer: In my opinion, there is no guarantee that a packet will reach its destination if at least one operable path exists. Firstly, according to the problem assumption, the hop counter is set to the longest length of the shortest cost path through the network, which means that the length of the shortest cost path is one more than the number of intermediate stations that extend the path. The hop count decreases each time a packet is retransmitted. For example, when all the links are serving in the network with diameter D, the hop count will be less than or close to 0 when the packet reaches all the sites through the longest and smallest cost path. If an intermediate link fails during this period, packets will not be forwarded when the hop count is zero, so all sites cannot be reached before the hop count is reduced to zero. Assuming the length of the longest minimum cost path can only be 2 in a network with diameter D. If one of the links breaks and the minimum cost path to a node (call it Station1) will be increase, therefore the packet with hop count of 2 will never reach station1. So that's why It can't guarantee delivery to its destination if a least one operable path exists.

5) A CRC is constructed to generate a 8 bit Frame Check sequence for a 19 bit message. The generator polynomial is $P(X) = X^8 + X^7 + X^4 + X^3 + X + 1$, The message bits for a particular message are

1 1 0 0 1 1 0 0 0 0 1 1 1 0 1 0 1 1 1

a) **[4 points]** Draw a shift register circuit to perform the calculation of the CRC bits.
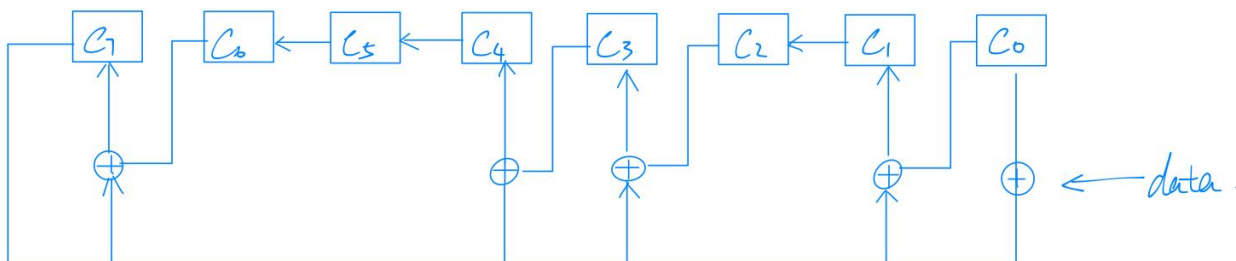
b) **[4 points]** List four examples of the types of errors an FCS can detect.
   odd numbers of bit errors
   two-bit errors
   single bit errors
   burst error

a) **[6 points] [6 points]** Can the errors represented by each of the following error polynomials E(X) be detected by the CRC? Why or why not?

```
0010000100000010000
0010000100000010000/110011011 = 11110110100010100...11011100
Error will be represented, since the remainder is not 0.
0000000010101100000
0000000010101100000/110011011 = 11000101110...11100010
Error will be represented, since the remainder is not 0.
```

```
0001000111111000000
0001000111111000000/110011011 = 1111101100111010…111110
Error will be represented, since the remainder is not 0.
```

c) **[7 points]** Determine the FCS using polynomial division. Show your work

```
                              1 0 0 0 0 0 0 1 0 0 1 1 1 1 0 1 0 0 0
    1 1 0 0 1 1 0 1 1 √ 1 1 0 0 1 1 0 0 0 0 1 1 1 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0
                      1 1 0 0 1 1 0 1 1
                              1 1 0 1 1 1 0 1 0
                              1 1 0 0 1 1 0 1 1
                                    1 0 0 0 0 1 1 1 1
                                    1 1 0 0 1 1 0 1 1
                                      1 0 0 1 0 1 0 0 0
                                      1 1 0 0 1 1 0 1 1
                                        1 0 1 1 0 0 1 1 0
                                        1 1 0 0 1 1 0 1 1
                                          1 1 1 1 1 1 0 1 0
                                          1 1 0 0 1 1 0 1 1
                                              1 1 0 0 0 0 1 0 0
                                              1 1 0 0 1 1 0 1 1
                                                  1 1 1 1 1 0 0 0 0
```

The FCS is 111110000

d) **[9 points]** Determine the FCS using your shift register circuit. Show your work.

```
0 0 0 0 0 0 0 0
                          1 1 0 0 1 1 0 0 0 0 1 1 1 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0
1 1 0 0 1 1 0 0
                          0 0 1 1 1 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0
1 0 0 1 1 0 0 0
0 0 0 0 0 0 1 1
                          0 1 1 1 0 1 0 1 1 1 0 0 0 0 0 0 0 0 0
1 1 0 1 1 1 0 1
                          0 1 1 1 0 0 0 0 0 0 0
1 0 1 1 1 0 1 0
0 0 1 0 0 0 0 1
                          1 1 1 0 0 0 0 0 0 0
1 0 0 0 0 1 1 1
                          1 0 0 0 0 0 0 0 0
0 0 0 0 1 1 1 1
1 0 0 1 0 1 0 0
                          0 0 0 0 0 0 0 0
0 0 1 0 1 0 0 0
1 0 1 1 0 0 1 1
                          0 0 0 0 0 0 0
0 1 1 0 0 1 1 0
1 1 1 1 1 1 0 1
```

                              0 0 0 0 0 0
1 1 1 1 1 0 1 0
0 1 1 0 0 0 0 1
                              0 0 0 0 0
1 1 0 0 0 0 1 0
                              0 0 0 0
1 0 0 0 0 1 0 0
0 0 0 1 1 1 1 1
                              0 0 0
1 1 1 1 1 0 0 0

The FCS is 111110000