CPE 348 **Exam #2 (50 pts)** **November 04 2019**

Name Solution

1) (6 pts) You are designing a reliable byte stream transport layer protocol (not TCP) to operate over a $1x10^7$ bps network and it is using a sliding window for flow control. The time for keeping the transmission pipe full is taken to be the RTT of the network which is 50ms. Each number in the advertised window or sequence number represents 2 Bytes of data.

a) **(2pts)** What is the minimum number of bits necessary for the Advertised Window field of your protocol header? Provide this minimum number as a whole number (round your answer up to the next whole value. i.e. if you calculate 20.67 bits necessary, then the answer is 21)

$$delay \times BW = (50\times10^{-3})\times(1\times10^{7}) = 5\times10^{5} \text{ bits}$$

$$2^{x} \cdot 2 \cdot 8 \geq 5\times10^{5}$$

$$2^{x} \geq 31250 \qquad x \geq 14.93 \qquad \text{Then } \boxed{x = 15} \text{ bits}$$

b) **(2pts)** How would you choose the Sequence number size in accordance with the Advertised Window size determined in a)?

At least Twice as large as Advertised Window.

$\boxed{16 \text{ bits}}$

c) **(2pts)** Given this sequence number size, how long will it take for it to wrap around?

$$\frac{2^{16} \times 2 \times 8}{1\times10^{7}} = 0.1 \text{ s}$$

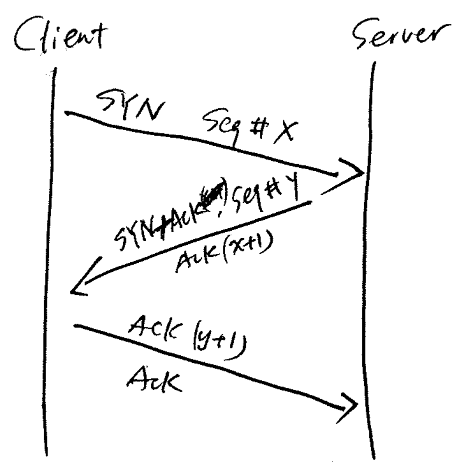
2) (4 pts) Fragmentation. Consider a packet that is transmitted from host A to host B in the following network. The maximum transmission unit (MTU) size in Bytes is shown on each link. **The header length for a packet sent on any link is 40 Bytes**. The MTU value includes this header value (i.e. if the MTU is 1200 Bytes, then 40 Bytes are header information and 1160 Bytes are data). **Note: routers strip off headers** from the received packets and then apply a new header to the data when the packet is forwarded.

Host A is transmitting packets with a data size of 1560 Bytes (transmitted packet size is 1600 Bytes: 40 Bytes of header and 1560 Bytes of data). For a single data packet transmitted from A to B, determine for each link the number of packets that are sent and the amount of **data** each packet holds.

A → R1	R1 → R2	R2 → B
~~1600 (~~	800 (760)	600 (560)
1200 (1160)	440 (400)	240 (200)
440 (~~360~~ 400)	440 (~~360~~ 400)	440 (400)
		440 (400)

3) (12 pts) Answer the following short answer questions.

a) (3 pts) Draw the three-way handshake used to initiate a TCP connection.



b) (2 pts) How to overcome the count-to-infinity problem in the distance vector-based routing algorithm?

Split horizon

OR

Set an upper-bound.

c) (3 pts) For each of the following applications, determine whether you would use TCP or UDP.

i. File transfer
ii. Watching a real-time streamed video
iii. Canvas login

i> TCP

ii> UDP

iii> TCP

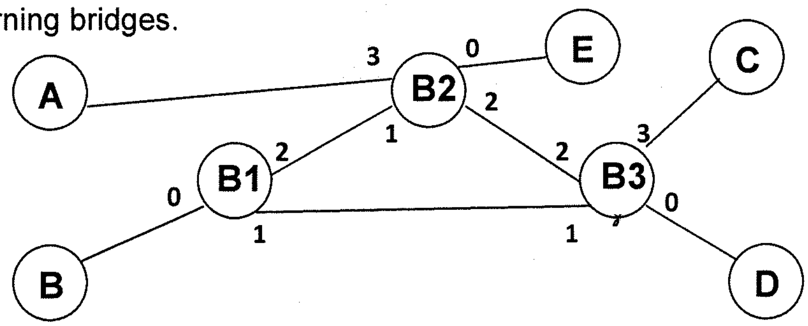
d) (4 pts) A router has the following (CIDR) entries in its routing table:

Address/mask Next hop
135.46.56.0/22 Interface 0
135.46.60.0/22 Interface 1
192.53.40.0/23 Router 1
default Router 2

For each of the following addresses, what will the router do if a packet with that address arrives?

i. 135.46.63.10 → Interface 1
ii. 135.46.52.2 → default Router 2

4) (8 pts) Consider the following network where A, B, C, D and E are nodes and B1, B2 and B3 are learning bridges.



Assume that the forwarding tables for the three bridges are all empty when the four **transmissions below are made in the order shown**. After the transmissions have been made, what are the contents of the forwarding tables for the three bridges? If a bridge learns the location of a node on multiple interfaces, use the interface with the lowest number. In the above network, B1 has interfaces 0, 1 and 2. If it learns about Node D on interfaces 1 and 2, then put 1 into the table.

Transmissions:
1) B transmits to A 2) C transmits to B 3) A transmits to C 4) E transmits to B

Fill in the table below for the three Bridges. If a destination node is unknown for a bridge, **write unknown** for the interface (in that case the bridge would forward a packet for that destination out on all outgoing interfaces). **The tables below are to be filled in with the interface number that the bridge would use to forward a packet to the destination specified.** The bridges learn this information as nodes make transmissions on the network.

Bridge B1		Bridge B2		Bridge 3	
Destination	**Interface**	**Destination**	**Interface**	**Destination**	**Interface**
A	2	A	3	A	2
B	0	B	1	B	(
C	1	C	unknown	C	3
D	unknown	D	unknown	D	unknown
E	2	E	0	E	unknown

5) (10 pts) Link State: Perform the Link State Routing Algorithm (Dijkstra's or forward search algorithm) for node A by completing the confirmed and tentative list columns. The link state packets sent by the nodes in the network are shown below. **Link state packets are in the form of (destination, cost, next hop).** When finished, provide the routing table for node A.

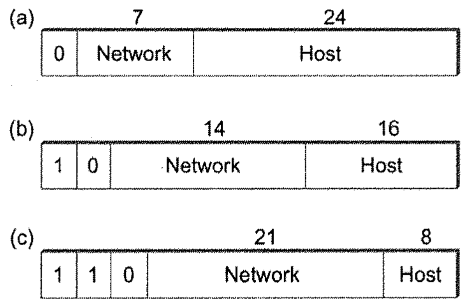
For a cost tie in the tentative column, chose the lower letter node first [i.e. if tentative list contains (A,4,E) and (C,4,D) select (A,4,E) over (C,4,D)]

Node A	Node B	Node C	Node D	Node E	Node F
B,4,B	A,4,A	A,2,A	B,1,B	A,3,A	C,3,C
C,2,C	D,1,D	F,3,F	E,1,E	D,1,D	E,1,E
E,3,E				F,1,F	

Confirmed	Tentative
(A, 0, -)	(B,4,B), (C,2,C), (E,3,E)
(A, 0, -), (C,2,C)	(B,4,B), (E,3,E), (F,5,C)
(A, 0, -), (C,2,C) (E,3,E)	(B,4,B), (D,4,E), (F,4,E)
(A, 0, -), (C,2,C) (E,3,E), (B,4,B)	(D,4,E), (F,4,E)
(A, 0, -), (C,2,C) (E,3,E), (B,4,B), (D,4,E)	(F,4,E)
(A, 0, -), (C,2,C) (E,3,E), (B,4,B), (D,4,E), (F,4,E)	

Node A Routing Table		
Destination	Cost	NextHop
B	4	B
C	2	C
D	4	E
E	3	E
F	4	E

6) (10 pts) You are the CTO of a startup and have to get IP addresses to connect 1,200 computers to the Internet. You can get IP addresses from two providers, IPMart and EastSideIP. IPMart sells class A, class B and class C blocks, while EastSideIP sells CIDR blocks. As the IPv4 address space is scarce, you want to save money and get the smallest number of addresses possible. Assume all 0-255 can be used in one IP address. The class A-C format is shown below.



a) **(3pts)** If you get **one** block from IPMart, which class do you have to get? What is the problem with that?

Class B.

Efficiency: $\frac{1200}{2^{16}} = 1.83\%$ Low!

b) **(2pts)** If you are not limited to the number of blocks you can buy from IPMart, which class and how many of them do you get so that the address utilization efficiency is the highest?

Class C.

$x \cdot 2^8 \geq 1200$

$x \geq 4.68$ Then $\boxed{x=5}$

c) **(2pts)** If you get **one** block from EastSideIP, how many bits are there in the mask (e.g., is it a /8, /22)? How many addresses are wasted?

$$2^{32-x} \geq 1200$$

$$32 - x \geq 11$$

$$x \leq 21 \quad \text{Then, } \boxed{\text{mask} = /21}$$

number of wasted address: $2^{11} - 1200 = \boxed{848}$

d) **(3pts)** Suppose you can get **two** blocks from EastSideIP, and they can be of different sizes. How many bits are there in the masks for each of the blocks? How many addresses are wasted now?

$1024 + 256$ or $2^{10} + 2^{8}$

Then, $\boxed{/22}$ and $\boxed{/24}$ blocks

80 wasted.

7) Bonus (3 pts) What would expect the course to change or to keep?