HW #3: Networking Questions

Solution Set

1. **Bit Stuffing.**
(a) A bit string, 1001111110010111110001 1, needs to be transmitted at the data link layer. What is the string transmitted across the Link after bit stuffing by the sender?

01111110 1001111101001011111000011 01111110

(b) A frame is received by the data link layer, which was transmitted using bit stuffing: 0111111000111110110011111001101111110. What is the bit string that the link layer passes up the stack to the network layer after bit de-stuffing?

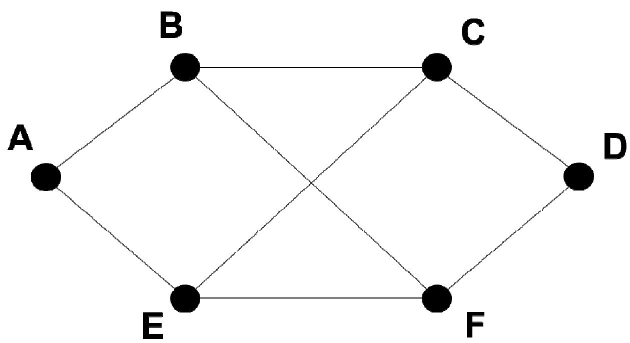
Original: 0111111000111110110011111001101111110
Strikeout: ~~01111110~~0011111~~0~~110011111~~0~~011~~01111110~~
Final: 0011111110011111011

2. **Link Layer Protocols.** A channel has a bit rate of 4 kilobits per second and a propagation delay of 20 milliseconds. For what range of frame sizes does stop-and-wait give a link utilization efficiency of at least 50%?

With stop-and-wait, the link layer will send a frame, and then wait until an ack is received before sending the next frame. Each round-trip latency will be equal to the time to send the frame (#_bytes / 4 kbps) plus the latency for the last transmitted bit to propagate from sender to receiver (0.02 ms), plus the latency for the ack to propagate back from the receiver to sender. In order for the utilization efficiency to be at least 50%, we can derive the following equation:

(frame_bytes / 512 Bps) / ((frame_bytes / 512 Bps) + 0.04) > 0.5
frame_bytes > 20.48 bytes
frame_bytes > 163.84 bits

3. **Distance Vector Routing.** Consider the subnet shown below. Distance vector routing is used, and the following vectors have just come in to router C: from **B**: (5, 0, 8, 12, 6, 2); from **D**: (16, 12, 6, 0, 9, 10); and from **E**: (7, 6, 3, 9, 0, 4). The measured delays from C to **B**, **D**, and **E** are 6, 3, and 5, respectively. What will C's new routing table be after this update? Show both the outgoing line to use and the expected delay.



C’s New Routing Table:

Destination	Calculated Distance	Next Hop
A	11	B
B	6	B
C	-	
D	3	D
E	5	E
F	8	B

4. **TCP Sequence Numbers.** To get around the problem of sequence numbers wrapping around while old TCP packets still exist, TCP could use 64-bit sequence numbers instead of 32 bits. However, theoretically an optical fiber can run at 75 Terabits per second. What maximum packet lifetime would be required to prevent sequence number wrap-around even with 64-bit sequence numbers? Assume that each byte of a packet has its own sequence number (as TCP does).

   bytes_per_second = 75e12 / 8
   seqnums = 2^{64}
   lifetime = seqnums/bytes_per_second / 60 / 60
   = 1.96e6 seconds
   = 32794 minutes
   = 546 hours

5. **DNS.** Using an online whois lookup service like whois.net, look up duke.edu. On what date was the domain registered? When does it expire? What are the DNS servers for this domain? Include a screenshot of your source.

   Example Output:
   Created: 1986-06-02 04:00:00Z
   Expires: 2018-06-02 04:00:00Z
   DNS servers: DNS-AUTH-01.OIT.DUKE.EDU, DNS-AUTH-02.OIT.DUKE.EDU, DNS-NC1-01.OIT.DUKE.EDU

6. **Internet Services.** Using netcat (the 'nc' command) in a terminal, manually display the following URL to the console.
http://people.duke.edu/~tkb13/courses/ece650/resources/awesome.txt