CSC4200 – Homework 1 (Each question is worth 10 points)

1. What is the difference between circuit switching and packet switching?

Ans:

Circuit switching	**Packet Switching**
creates an end-to-end wire	creates a virtual end-to-end wire
Route can not be changed once created	Routes are per packet. Different packets can take different paths
In-order delivery	Out-of order delivery
Dumb endpoints, smart network	Dumb network, smart endpoints

2. What are the different layers in today's Internet? Why do we create layers?

Ans: Find it in the slides.
Layers allow us to organize functionality. E.g., implementing a new protocol in the Network layer does not require changes in all other leyers.

3. Suppose there is a 10 Mbps microwave link between a geostationary satellite **(approximately 36K thousand killometers)** and its base station on Earth. Every minute the satellite takes a digital photo and sends it to the base station. Assume a propagation speed of 2.4 * 10^8 meters/sec.

a. What is the propagation delay of the link?

Ans: (3.6*10^7)/(2.4*10^8) = 0.15sec (approx)

b. What is the bandwidth-delay product, R · d prop ?

Ans: R = 10^7 bits per sec, BDP = 10^7*0.15 = 1,500, 000bits = .18MB

c. Let x denote the size of the photo. What is the minimum value of x for the microwave link to be continuously transmitting?

Ans: How much data can the link send every minute? 10Mbps = 10^7bits 10^7bits*60 =600, 000, 000 bits. So, each picture must be 75Megabytes.

3. Calculate the total time required to transfer a 1000-KB file in the following cases, assuming an RTT of 50 ms, a packet size of 1 KB data, and an initial 2 × RTT of "handshaking" before data is sent:

(a) The bandwidth is 1.5 Mbps, and data packets can be sent continuously.

Ans: We have a 2xRTT initial handshake, followed by the time to transmit 1000 KB, and finally the propagation delay (half RTT) for the last bit to reach the other side. Therefore, total delay:
2*0.05 + 1000*2^10*8bits/(1.5·10^6)bits/sec + 0.05/2 = 5.586 sec

(b) The bandwidth is 1.5 Mbps, but after we finish sending each data packet we must wait one RTT before sending the next.

Ans: After transmitting a packet, we wait for one RTT. Therefore, since RTT>transmission time+propagation delay, by the time we transmit the next packet, the first packet has already reached the other side. So, we need the transmission time of a packet + one RTT for each of the first 999 packet. For the last packet, we must wait for the propagation delay for the last bit to reach the other side. Therefore, the total time is as before plus 999 RTTs.

Ans: Total time = 5.586+999*0.05 = 55.536seconds

(c) The bandwidth is "infinite," meaning that we take transmit time to be zero, and up to 20 packets can be sent per RTT.

We have 49 RTTs between batches of 20. The last batch needs half RTT for propagation delay. We also have the 2 initial RTTs, for a total of 51.5 RTTs, i.e 51.5*0.05 = 2.575 secs

4. Assuming a framing protocol that uses bit stuffing, show the bit sequence transmitted over the link when the frame contains the following bit sequence:

110101111101011111101011111110

Mark the stuffed bits.

Ans: 110101111100101111101010111110110

5. Suppose the following sequence of bits arrives over a link:

11010111110101111100101111110110

Show the resulting frame after any stuffed bits have been

removed. Indicate any errors that might have been introduced
into the frame.

1101011111 1011111 01011111 110

The receiver would not detect any stuffing errors in this frame. The onlyerror the receiver can identify while using bit stuffing is a sequence on 7 ones

6. Show an example two-dimensional parity that detects a 3-bit
error.

1 1 0 0 1 1 1 | 1
1 0 1 1 1 0 1 | 1
0 1 1 1 0 0 1 | 0 ← Correct
0 1 0 1 0 0 1 | 1

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0 1 0 1 0 1 0 | 1

1 1 0 0 0 1 1 | 1
1 0 1 1 1 0 1 | 1
0 0 1 1 0 0 1 | 0 ← with error , each error affects two parity bits
0 1 1 1 0 0 1 | 1

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0 1 0 1 0 1 0 | 1

7. How can a wireless node interfere with the communications of
another node when the two nodes are separated by a distance
greater than the transmission range of either node?

Ans: Hidden terminal problem. The communications can interface at a third node that both nodes can reach,

8. What kind of problems can arise when two hosts on the same
Ethernet share the same hardware address? Describe what
happens and why that behavior is a problem.

They will both receive the same packets and both reply.

9. How can hidden terminals be detected in 802.11 networks?

They can not be detected directly. CSMA/CA senses the carrier before transmitting but the nodes can not directly detect hidden terminals.

10. Draw a timeline diagram for the sliding window algorithm with SWS = RWS = 3 frames, for the following two situations. Use a timeout interval of about 2 × RTT.
(a) Frame 4 is lost.
(b) Frames 4 to 6 are lost.