

CSC4200 – Homework 2 (Total 80 points)

Due – Feb 5th 2023, 11:59 PM CST

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1. Give some (4-5) key differences between circuit switching and packet switching? 10 points

Circuit Switching has three phases, while Packet Switching is a direct data transfer.

Circuit Switching knows the entire path address provided by the source, while Packet Switching each data unit just knows the final address.

Circuit Switching has data processed at the source, while Packet Switching is processed at all nodes including the source.

Circuit Switching has uniform delay, while Packet Switching does not have uniform delay.

Circuit Switching is more reliable than Packet Switching.

2. What are the different layers in today's Internet? Why do we create layers? 10 points

Physical, Data Link, Application, Network, and Transport are the 5 main layers in today's internet. This is because we can easier separate the functions that are related and can test each layer independently as they can no see other layers.

3. Suppose there is a **10 Mbps** microwave link between a geostationary satellite and its base station on Earth that are **36 thousand KM** apart. **Every minute** the satellite takes a digital photo and sends it to the base station. Assume speed of light in the link is **$2.4 * 10^8$** meters/sec. - 25

a. What is the propagation delay of the link? – 10 points

b. What is the bandwidth-delay product, $R \cdot d$ prod? – 5 points

c. Let x denote the size of the photo. What is the minimum value of x for the microwave link to be continuously transmitting? - 10 points

Hint for the part C – How much data can be transmitted via the microwave link every minute?

a.) $36,000 \text{ km} / 2.4 * 10^8 = 0.15 \text{ seconds}$

b.) $10 \text{ Mbps} = 10^7 \text{ bits/s}$ then multiple by our propagation delay of 0.15 seconds to get $150 * 10^4$ bits

c.) Take our 10 Mbps and turn into 10^7 bits/s times 60 seconds to get $6 * 10^8$ bits.

4. 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 $2 \times \text{RTT}$ of “handshaking” before data is sent: - 25 points

Hint: Speed of light is not given but RTT is given as 50ms, Propagation delay = Half of RTT

- (a) The bandwidth is 1.5 Mbps, and data packets can be sent continuously. – 10 points
- (b) The bandwidth is 1.5 Mbps, but after we finish sending each data packet, we must wait one RTT before sending the next. – 10 points
- (c) The bandwidth is “infinite,” meaning that we take transmit time to be zero, and up to 20 packets can be sent per RTT. – 5 points

a.) $2 \times \text{R.T.T.} = 2 \times 50\text{ms} = 100\text{ms}$ and Packet size = $1\text{kb} = 8,192$ bits. So Bandwidth = $1.5 \times 1000 \times 1000 = 1500000$ bits/s and Transmit time = $8192/1500000 = 5.46$ s so $2 \times \text{RTT} + \text{Transmit time} + \text{propagation} = 2 \times .05\text{s} + 5.46\text{s} + 0.05/2 = 5.585\text{s}$

b.) We take our 100ms as the $2 \times \text{R.T.T.}$ and tell that 1 R.T.T. equals 50 ms. We find Total Time = Initial Time (100ms) + 1000 packets T.T. + $999 \times \text{R.T.T.}(50\text{ms}) = 100 + 1000(16/3) + 999(50) = 55535 \text{ ms} = 55.535\text{s}$

c.) $1000/20 = 50$ RTT but the last 20 only do RTT/2 so total equal 49.5. $2 \times \text{RTT} + \text{Required RTT} = 2 \times \text{RTT} + 49.5 \times \text{RTT} = 51.5 \times 0.05 = 2.575\text{s}$.

5. Assuming a framing protocol that uses bit stuffing, show the bit sequence transmitted over the link when the frame contains the following data bit sequence : - 10 points

100111110101011111010101111110

Stuff and Mark the stuffed bits if needed.

100111110010101011111010101011110110

Add a 0 when 5 1's have been put in consecutive order from left to right.