CS422 Mid2 Answer Sheet

P1(a) 10 pts

TDMA, FDMA (or OFDM), CDMA
6 pts

Main drawback: Coordination overhead to reserver per-user resources.
2 pts

Main strength: Per-user reserved resources provide guaranteed service quality
2 pts

P1(b) 10 pts

Low loss networks where packet loss are infrequent.
4 pts

Upon detecting 3 duplicate ACKS, sender retransmits packet indicated by ACK sequence number without waiting for timeout.
3 pts

Duplicate ACKs indicate that a spurious packet loss may have occurred but not congestion per se. Hence quickly resending the missing packet without waiting for timeout is likely to lead to improved performance.
3 pts

P1(c) 10 pts

Signal decreases as 1/f^2 (quadratically) as a function of frequency f, hence the 15 GHz carrier frequency loses energy faster than the 5 GHz carrier.
4 pts

15 GHz carrier will have difficulty penetrating walls and other obstructions.
4 pts

One advantage is that the fast frequency, in principle, allows higher bit rate transmission when using amplitude modulation. Another potential benefit is that the signal not going very far can be a positive for personal area networks.
2 pts

P2(a) 12 pts

Set the congestion window to 1 and exponentially increase window size until a timeout occurs or the slow start threshold is reached.
6 pts

It is meaningful in the sense it is slower than sending the maximum allowed by the receiver/sender maximum window sizes.
3 pts

It is a misnomer in the sense that exponential increase is very fast and calling is "slow" can be misleading.
3 pts

P2(b) 12 pts

In Ethernet's CD, a sender must transmit a large enough packet so that if a collision occurs, it can be sensed. Ethernet's maximum link length limitation dictates how far another transmitter can be and, therefore, how large the minimum Ethernet packet size has to be.
6 pts

Long-haul links imply that distances are large (hundreds to thousands of miles) which require the minimum Ethernet packet size to be too large. This is wasteful when payload that needs to be transmitted is small.
6 pts

P2(c) 12 pts

The overall goal is to have an adequate amount (what we called Q*) of prefetched (i.e., future) video/audio content in the receiver's buffer that can be played back during periods of intermittent congestion without causing disruption/quality degradation.
6 pts

Video conferencing is a real-time app, meaning that delayed playback of video/audio is not an option.
6 pts

P3(a) 17 pts

CS: Since a geostationary satellite covers a large area CS will not be effective since a signal will incur noticeable delay before it can sensed by another station far away.
5 pts

MA: A large geographical footprint that includes a metropolitan area will have many users which implies that MA is likely to lead to collision.
5 pts

OFDM is superior to CSMA in that a carrier frequency is reserved per-user. However, due to the large number of users and limited spectrum available for wireless transmission, the total number of orthogonal carrier frequencies would be limited as well.
4 pts

The basic operation of cable TV is to broadcast information. Even with 1000 cable channels, 1000 OFDM carrier frequencies may suffice to deliver content to subscribers which does not depend on the size of the geographical area.
3 pts

P3(b) 17 pts

For throughput to increase, offered load must increase. Congestion occurs when as offered load increases throughput starts to decrease.
4 pts

If the congestion window size is increased by 1 per ACK received, then the following progression holds:
congestionwindow = 1
packet 1
ACK 1

congestionwindow = 2
packet 2
ACK 2 [add 1 per ACK, hence total is 4]
congestionwindow = 4
packet 4
ACK 4
...
The above leads to exponential increase.
4 pts

Increase the congestion window by 1 every window-full of ACKs.
3 pts

TCP's exponential decrease mechanism shrinks the congestion window whereas Ethernet's exponential decrease increases the wait time until the next retransmit is attempted. Ethernet does not have a linear increase mechanism.
3 pts

Linear increase/exponential decrease (i.e., method B in the lecture notes) leads to bounded oscillation (i.e., overshoot/undershoot) of the prefetched data in the receiver's buffer that does not settle down. This leads to periods of too little prefetched content which increases the likelihood of disruption/quality degradation during intermittent congestion. During periods of too much prefetched data, we incur potential waste.
3 pts

Bonus 10 pts

Given an extended service set (ESS) where basic service sets (BSS) are connected through Ethernet switches, when a station sends a packet destined to another station in the same ESS but different BSS, an Ethernet switch that receives the packet does not know where the destination station is. To make sure the packet reaches the destination, it broadcasts the packet on all outgoing links which is wasteful. Perlman's algorithm has a learning component where the switch remembers from which link the sender's packet arrived so that when a packet arrives for that sender, the switch knows on which link to send it out without resorting to inefficient broadcast.
10 pts