CS 422 (Park) **Midterm** **Mar. 21 (Tue.), 2006**

Remarks: Keep the answers compact, yet precise and to-the-point. Long-winded answers that do not address the key points are of limited value. Binary answers that give little indication of understanding are no good either. Time is not meant to be plentiful. Make sure not to get bogged down on a single problem.

PROBLEM 1 (40 pts)

(a) Explain why sequence numbers are needed in stop-and-wait. Give an example that shows what can go wrong otherwise.

(b) What is the technical meaning of "high-speed" networks? In what sense is it a misnomer? What might be a more accurate term? Is there a sense in which "high-speed" is a correct expression?

(c) ARQ can use positive as well as negative ACKs to achieve reliable packet transmission. What are their pros/cons? Ethernet's CSMA/CD protocol can be said to follow negative ACK. Explain why this is the case.

(d) All else being equal, using a higher frequency f can achieve a higher bit rate in baseband networks. Why is this the case? Provide an expression for throughput (bps) in terms of f. State your assumptions. What are the key reasons that make high-frequency communication difficult in wireless networks?

PROBLEM 2 (30 pts)

(a) What are the key differences between Ethernet's CSMA/CD and WLAN's CSMA/CA? Can IEEE 802.11 WLANs evolve to a "switched" WLAN as IEEE 802.3 Ethernet has done? Explain.

(b) Why is stop-and-wait insufficient for achieving high throughput over today's high-speed networks? How does sliding window control overcome this problem? If the "bully problem" is ignored, is there a simpler way to achieve high throughput?

(c) Suppose an ISP claims to provide high-speed Internet access to a large customer base in the midwest using geostationary satellites that hover over the Big-10 states. Suppose CSMA is used to mediate bandwidth sharing among wireless clients. What technical reasons make such an architecture infeasible?

PROBLEM 3 (30 pts)

(a) What is a switched Ethernet? How is it fundamentally different from a hub-based Ethernet? What role does CSMA/CD play in switched Ethernet? Why is switched Ethernet throughput superior to hub-based Ethernet throughput? How is it possible to use a 1 Gbps Ethernet to carry packets between two switches hundreds of miles apart, given Ethernet's inherent distance limitation?

(b) Both Ethernet CSMA/CD and FDDI ring networks employ "cooperative" protocols, in the sense that fair sharing of bandwidth is facilitated if every host follows the same rules. How might a selfish user with technical savvy hijack bandwidth for himself/herself by breaking the rules in Ethernet and FDDI? As a network manager, how would you go about detecting such misbehaving users from `tcpdump` traffic measurements?

BONUS PROBLEM (10 pts)

Given that 48-bit LAN addresses are globally unique, is there a need to invent another set of addresses (e.g., IP with 32 bits) on top of LAN addresses? What are the benefits and costs? In your estimation, which comes out on top? Justify your reasoning.