CS 422 (Park) **Final** **May 1 (Mon.), 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) What is the technical meaning of congestion is the context of WLANs? Does packet loss in a wired IP network imply congestion? Discuss your reasoning. How is congestion on a highway different from congestion in a data network?

(b) What is the role of UDP in the protocol stack? What are the disadvantages of applications directly invoking IP through raw sockets, by-passing UDP? What are some advantages? Why is UDP more appropriate than TCP for transporting real-time multimedia traffic?

(c) What are the key differences between intra-domain routing and inter-domain routing? Where does subnetting come into play? Where does CIDR come into play? Describe the intra- and inter-domain routing decisions that are made at various stages as an IP packet travels from the CS Dept. at Purdue to Cisco's web server `www.cisco.com` in San Jose, CA (you may assume that both Purdue and Cisco are stub customers of Level 3).

(d) What is the hidden station problem in WLANs? How does RTS/CTS work to mitigate the problem? Why is it an imperfect solution? When is RTS/CTS least effective and is better left disabled?

PROBLEM 2 (30 pts)

(a) What is a denial of service (DoS) attack? Describe two specific forms of DoS attack. Why are DoS attacks difficult to defend against? How does ingress filtering help deal with IP spoofing? What are unforseen interactions between Mobile IP and ingress filtering? How has this been addressed?

(b) What are the mechanisms that have held back the address depletion problem in IPv4? Describe the solutions in decreasing order of importance. Who are the forces pushing for IPv6 with 128-bit addresses and why?

(c) Internet traffic tends to be bursty, must more so than telephone traffic. Why is this the case? What implications does burstiness have on network service providers with respect to providing high quality of service (QoS) to their customers at small cost by not wasting bandwidth? Can differentiated services (DiffServ) implemented over priority queue packet schedulers at routers guarantee high-quality service to multimedia applications?

PROBLEM 3 (30 pts)

(a) What is the 2-person consensus problem and how does it impact TCP's connection set-up and tear-down? What method is used for eventually establishing connection set-up? What "hack" is used for determining when a connection is completed? Why is the latter a hack? Explain what can go wrong. Does increasing the 3-way handshake to a 4-way handshake help? What about a 11-way handshake?

(b) What is the fundamental goal of congestion control in the context of pseudo real-time multimedia streaming? What are the common traits of congestion control methods A and B? In what sense is method B, also called linear increase/exponential decrease, superior to A? What additional information do methods C and D seek to exploit? Given that D is superior to B (used in TCP), why is D not employed in Internet file transfer protocols? For typical file transfers, in which phase does a TCP connection dwell before terminating (there are 4 phases)?

BONUS PROBLEM (10 pts)

TCP's congestion control is cooperative in the sense that upon detecting possible congestion, TCP throttles its sending rate. An ungentlemanly or noncooperative mode would be to not back off, expecting others to do so, thus hoarding a lion's share of the bandwidth. How is this problem related to the Prisoner's Dilemma game? What happens in the game when both prisoners are selfish? In what technical sense is selfishness "rational"? What could be done to induce potentially greedy TCP connections to behave cooperatively?