EECS489 Computer Networks,
Take-home Makeup Midterm (Winter 2007)
due in class Wednesday 3/28

Note that this is entirely optional, taking this exam will only improve your grade, and not taking it will not make your existing grade worse.

Instructions: You are allowed to use books or any other reference material; however, you cannot consult anyone else regarding the exam. Read each question carefully, and note all that is required of you. Please keep your answers clear and concise, and state all of your assumptions carefully.
Please write out the details of how you reach your final answer in order to get partial credit.

You are to abide by the University of Michigan/Engineering honor code.
Please sign below to signify that you have kept the honor code pledge.
Honor code pledge: I have neither given nor received aid on this exam.

Name: ______________________________

Signature: ______________________________

Unique name: ______________________________

Problem 1: Nagle's algorithm (TCP) – 10 points

The Nagle's algorithm, built into most TCP implementations, requires the sender to hold a partial segment's worth of data (even if PUSHed, i.e., with the PUSH flag set) until either a full segment accumulates or the most recent outstanding ACK arrives.

(a) Suppose the letters `abcdefghi` are sent, one per second, over a TCP connection with an RTT of 4.1 seconds. Draw a timeline indicating when each packet is sent and what it contains.

(b) If the above were typed over a full-duplex Telnet connection, what would the user see?

(c) Suppose that mouse position changes are being sent over the connection. Assuming that multiple position changes are sent each RTT, how would a user perceive the mouse motion with and without the Nagle algorithm?

Problem 2: TCP's congestion control– 10 points

Suppose TCP is used over a lossy link that loses on average one segment in four. Assume the bandwidth $\times$ delay window size is considerably larger than four segments, i.e., the link should accommodate more than 4 segments.

(a) What happens when we start a connection? Do we ever get to the linear increase phase of congestion avoidance?

(b) Without using an explicit feedback mechanism form the routers, would TCP have any way to distinguish such link losses from congestion losses, at least over the short term?

(c) Suppose TCP senders did reliably get explicit congestion indications from routers. Assuming links as above are common, would it be feasible to support window sizes much larger than four segments? What would TCP have to do?

Problem 3: Packet switched networks – 10 points

In this problem we consider sending voice from Host A to Host B over a packet-switched network (for example, Internet phone). Host A converts analog voice to a digital 64 kbps bit stream on the fly. Host A then groups the bits into 48-byte packets. There is one link between Host A and B; its transmission rate is 1 Mbps and its propagation delay is 2 msec. As soon as Host B receives an entire packet, it converts the packet's bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

Problem 4: Routing – 5 points

IP hosts that are not designated routers are *required* to drop packets misaddressed to them, even if they would otherwise be able to forward them correctly. In the absence of this requirement, what would happen if a packets addressed to IP address A were inadvertently broadcast at the link layer? What other justifications for this requirement can you think of?

Problem 5: Routing – 10 points

Suppose most of the Internet used some form of geographical addressing (i.e., addresses are tied with particular geographical locations), but that a large international organization has a single IP network address and routes its internal traffic over its own links.

(a) Explain the routing inefficiency for the organization's inbound traffic inherent in this situation.

(b) Explain how the organization might solve this problem for outbound traffic.

(c) For your method above to work for inbound traffic, what would have to happen?

(d) Suppose the large organization now changes its addressing to separate geographical addresses for each office. What will its internal routing structure have to look like if internal traffic is still to be routed internally?