Comprehensive Exam: Networks: (60 points)
Closed Book: Fall 2007

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1. (15 points total) *End to end*

   (a) (7 points) Define the so-called "end-to-end principle" as applied to the Internet and provide an example of how it has been applied.

   (b) (5 points) Britney Spears goes into rehab, blaming her troubles on the presence of "middleboxes" such as web caches, load-balancers, firewalls, VPN gateways in the Internet which she claims compromise the end-to-end principle. Describe to what degree she is right (if any) and wrong, if so. (You can predicate your comments on assumptions of what these various boxes do, if you are not familiar with their operation.)

   (c) (3 points) There is a known major risk to high winds coming up when fighting forest fires in steep terrain. In the summer of 1994 in Glenwood Springs, Colo., 13 firefighter died tragically when the wind came in a steep canyon in which they were fighting a forest fire (mirroring a similar trajedy in 1949). In the book "Fire on the Mountain," John N. Maclean documents how the firefighters did not receive a revised weather report because of "bureaucratic bungling" at the Bureau of Lands and Mines. How would an "end-to-end" firefighter operate?

2. (15 points total) *Transport Protocol Design*

   (a) (8 points) Describe for each of: a) slow start b) fast retransmit c) AIMD (additive-increase-multiplicative-decrease) what it is, how it works and why it is compelling to include in TCP. (If you do not recognize these terms, describe how TCP supports congestion control in the Internet.)

(b) (7 points) TCP performs a 3-way handshake on connection setup and connection teardown. Describe the purpose of each, how it accomplishes that, and what bad things could happen if you went to less mechanism, e.g. 2-way message exchange.

3. (15 points total) *Network Routing*

   (a) (7 points) Describe how an IP router handles an incoming packet, focusing how it determines which port to send it out (if any) and what changes it makes to the packet (if any).

   (b) (8 points) Compare and contrast the three basic routing techniques, namely: flooding, distance-vector and link-state.

4. (15 points total) *Ethernet*

   (a) (5 points) Describe how CSMA-CD (carrier-sensor multiple access-collision detection) provides good throughput with minimal delay in a 10 Mbps Ethernet, being as quantitative as you can. Recall that a minimum Ethernet packet is 64 bytes so a minimum-size packet is roughly 50 microseconds and the speed of light is one foot per nanosecond (but the signal propagates at closer to 50 percent of that speed.)

   (b) (5 points) Hillary Clinton, after hearing how successful CSMA-CD was in the original Ethernet, proposes to legislate its use as "universal healthcare" for all networks, including high-speed, low-speed, wireless, satellite, etc. Describe the issues that CSM-CD runs into as you change the speed of the network and go to other technologies such as wireless, switched, etc., again being quantitative.

   (c) (5 points) Describe how an Ethernet packet manages to find the destination port to which it is addressed in a switched Ethernet network. That is, does the Ethernet switch run a layer 2 routing protocol or what. Also, point out 3 key challenges in the way this facility is implemented.

The End