EECS 489 Winter 2010
Midterm Exam

This is an open-book, open-resources exam. Explain or show your work for each question. Your grade will be severely deducted if you don’t show your work, even if you get the correct answer.

Name: ________________________________________________
uniqname: ____________________________________________

Honor code: I have neither given nor received any help on this exam.

Signature: ____________________________________________

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QUESTION 1: Big MAC (15 points)
This question explores whether the Internet could be designed using only names and
MAC addresses, without a need for IP addresses. Suppose each network adapter, for any
link technology, has a unique MAC addresses from a single address space (such as 48-bit
MAC addresses used for Ethernet devices), and these addresses were used Internet-wide
for communication between end hosts. Suppose that the Domain Name System (DNS) is
changed to return MAC addresses rather than IP addresses, in response to queries.

Make sure you explain your answers below.
(a) In today’s Internet, why is it difficult to support continuous communication with a
host while it moves? Why would an Internet based on MAC addresses have the potential
to make mobile hosts easier to support?

(b) Today’s local area networks have several “boot-strapping” techniques, such as
DHCP, ARP, and MAC learning. In a world without IP addresses, which of these
techniques would still be necessary?

(c) How would moving to an Internet based on MAC addresses affect the size of the
forwarding tables in the network nodes (i.e., routers or switches)?

(d) How would the new design, based on MAC address, affect users’ privacy?
QUESTION 2. A Rose by Any Other Name (15 points)
This question explores the challenges of the Domain Name System.

(a) Before the 9/11 attacks, the top-level domain (TLD) server for South Africa was located in New York City. Explain why the physical destruction on 9/11 disrupted Internet communication within South Africa (e.g., for a Web user in South Africa accessing a Web site in South Africa)?

(b) Following up on question (a), explain why the effects in South Africa took place gradually, disrupting progressively more communication within the country in the hours (and even days) after connectivity to NYC was lost.

(c) How do the local DNS servers know the identity of the root servers? Why are most of the host-to-address queries seen by the root DNS servers for bogus or malformed names (like graceland.elvis or numeric top-level domains)?

(d) Who determines the value of the time-to-live field that determines how long DNS servers cache a name-to-address mapping? What are the pros and cons of using a small value?

(e) A local DNS server typically discards cached name-to-address mappings when the time-to-live expires. Alternatively, the local DNS server could optimistically issue a new query for the cached domain name. Given one advantage and one disadvantage of that approach.
PROBLEM 3. Finding Your Way (15 points)

(a) Show how the Dijkstra’s shortest path first algorithm builds the routing table for node D.
Show the modification to D’s table in the intermediate steps as done in lecture. Showing just the table of D without any intermediate steps will not be given full credit.
(b) Which routing protocol uses Dijkstra’s shortest path first algorithm for route computation: is it inter-domain routing or intra-domain routing? is it link-state routing protocol or distance-vector routing protocol?
PROBLEM 4. Dealing with Collisions (15 points)

*Wherever necessary consider a signal propagation speed of $2 \times 10^8$ m/s*

Suppose the round-trip propagation delay for Ethernet is 50 µseconds, for a bandwidth of 10Mbps. Assume the minimum frame size is T.

a. Why is it necessary to have a minimum frame size?

b. What should the minimum frame size be, in terms of T, if the propagation delay is held constant and the bandwidth is increased to 100Mbps? Explain your answer.

c. Give one drawback of this frame size.

Suppose 2 nodes A and B are attached to the opposite ends of a 10Mbps Ethernet, and the propagation delay between the two nodes is 325 bit times. Suppose node A begins transmitting a frame (of 512+64 bit times), and before A finishes, node B begins transmitting a frame.

a. Can A finish transmitting before it detects that B has transmitted? Why or why not?

b. If A finishes transmitting before it detects that B has transmitted, what is the implication? How does one fix this problem?
QUESTION 5. For Good Measure (15 points)

(a) Traceroute capitalizes on the “Time To Live” field in the IP packet header to measure the forwarding path from one host to another. Give two reasons why a hop in Traceroute might show a “*” (i.e., no IP address for the router at that hop in the path).

(b) Traceroute may report a path that does not exist. For example, Traceroute could return a path A-B-C (where A, B, and C are IP addresses) when there is no link between routers B and C. Give one example where that could happen. (Draw a picture if useful.)

(c) The delay between a TCP sender transmitting a SYN packet and receiving the SYN-ACK packet provides an estimate of the round-trip time between a client and a server. Give one reason why, on average, the SYN/SYN-ACK delay is larger than a typical round-trip delay between a client and server. Assume all DNS and ARP look-ups have already completed.

(d) Determining the geographic location of an Internet host, based on its IP address, is challenging. Propose two techniques that could be used to infer the rough location.

(e) Suppose a host’s local DNS server records the round-trip time for a successful query to an authoritative DNS server. This could be used as an estimate of the expected round-trip time for the host to communicate with machines at the remote site. Give one reason why this is a good heuristic for estimating the round-trip time between two hosts, and one reason why it is not.
PROBLEM 6. Internet Routing (5 points)

(a) Describe the two dominant AS relationships on today’s Internet. Give an example of an AS path that violates AS relationships and provide intuition why it is a violation.

(b) Consider the following network:

(i) AS1 uses OSPF routing with the link weights shown on the diagram. Specify the path the packet takes from AS1.R5 to AS1.R1 as a sequence of routers.
(ii). The inter-network use BGP routing between Autonomous systems. Specify the path a packet takes from AS1.R1 to AS2.R1 as a sequence of ASes. Note that AS4, AS5, and AS6 are transit ASes, while AS3 is a multi-homed AS.

(iii). AS2 uses statically configured routing tables. The routers uses longest prefix matching. Specify the path that a packet with destination address 128.32.112.37 (Host B) would take from AS2.R1 as a sequence of routers.

(iv). Host B replies to A by sending a packet, call it packet P to IP address 164.132.5.7 (Host A). Specify the path that packet P takes from B to AS2.R1 as a sequence of routers.