Stanford University
Computer Science Department

Fall 2002 Comprehensive Exam in Networks

1. **Closed Book:** no notes, textbooks, laptops, Internet access, etc.
2. **Write only in the Blue Books: No credit** for answers written on these exam pages.
3. **Write Magic number** on the cover of **EACH blue book**.
4. **The exam is timed for one hour.**

The following is a statement of the Stanford University Honor Code:

A. *The Honor Code is an undertaking of the students, individually and collectively:*

  1. that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;

  2. that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.

B. *The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.*

C. *While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.*

Comprehensive Exam: Networks (60 points)   Autumn 2002

1. (15 points total) *TCP transport protocol* TCP has a 32-bit sequence number field and a 16-bit window

   (a) (5 points) Give a quantitative argument, as the designers of TCP might have done in 1980, that 32-bits is a good choice of size for the sequence number field.

   (b) (5 Points) In the same vein, why is 16 bits a reasonable choice for the window parameter.

   (c) (5 points) Quantify the limitations and concerns that these sizes raise based on how the technology has changed since 1980, i.e. lower cost memory, faster processors, optical links, etc.

2. (15 points total) *Virtual Circuits vs. Datagrams* Alexander Graham Bell returns from the dead to set us straight on (virtual) circuit switching, given he considers we went off the rails in using datagrams in the Internet. Give your cogent response to each of the points that this old cadaver makes:

   (a) (5 points) "Hot dang, this datagram stuff requires huge packet headers that incur excessive bandwidth overhead. Circuit switching allows you to use itsty bitsy tiny little circuit IDs."

   (b) (5 Points) "This new fangled datagram nonsense cost much more to do packet classification and forwarding decisions in each switch because of the large clumsy headers. With circuit switching, the circuit id can be an index into a table that directly indicates the next hop."

   (c) (5 points) "This datagram nonsense does not allow you to reserve bandwidth so you cannot know whether your packets are going to get through. Good grief, the only guarantees are death and taxes, and I'm already dead."

3. (15 points total) *Ethernet*

   (a) (5 points) Describe the Ethernet media access control (MAC) protocol, CSMA-CD, comparing it to the Aloha network and p-persistent protocols.

   (b) (5 points) Original Ethernet was at 10 Mbps with limitations on cable length and packet size. Now, IEEE is busy standardizing 10 Gbps Ethernet. Describe how these parameters need to change, if at all, if you insist on using the MAC protocol above at this higher speed.

   (c) (5 points) Peterson and Davie say: "it might seem that a wireless protocol would follow the exactly the same algorithm as the Ethernet" as a lead-in to why not. Describe why not and what 802.11 does about it.

4. (15 points total) *End to end.*

   (a) (6 points) Describe the "end-to-end" argument in networking,
   illustrating how a file transfer program should behave if it was truly "end-to-end".

(b) (6 Points) Osama Bin Laden, pointing out yet another hypocrisy of the West, argues that if we really believed in end-to-end, we would not mess around with Ethernet CRCs, IP checksums, TCP checksums and TCP retransmissions. George W. Bush claims it's an important part of our way of life. Describe why Bin Laden's wrong in this particular instance.

(c) (3 Points) Give an example of how Internet protocols are not completely consistent with the end-to-end argument.

The End