Final exam – December 19, 2:00 PM

Open book section (70 points)

The exam is to be turned in at 5:00 PM. The closed book section should be turned in before you open your books and notes to work the open book section. For the open book section, write your answers on separate pieces of paper.

Problem 1. (5 points)

What options are supported by Class A IP networks but not by class B networks?

Problem 2. (10 points)

Suppose you have a mesh of LANs interconnected by spanning tree bridges. After an epidemic of bridge and LAN crashes, the bridge with the highest priority (the lowest id number) is connected to only one LAN. Will this node still be elected root even though it can't forward traffic between two LANs? How will this effect the efficiency of the network?

Problem 3. (10 points)

It is possible to make direct TCP connections between computers in the United States and Australia. However, electronic mail between the two countries is not delivered directly but is forwarded through a *mail exchanger* in Virginia.

What is gained and what is lost in using an exchanger rather than direct mail delivery? If *type of service* routing (Comer, §7.7.4) were well-supported by IP gateways, would the need for the mail exchanger increase or decrease?

Problem 4. (10 points)

In the December 1989 issue of *Communications of the ACM,* John McCarthy suggests that electronic mail "will be supplanted by telefax" because telefax is a better match to the ubiquitous telephone than the computer networks we've been building the last twenty years. He sees odd address formats, such as *user*`@`*domain* or `brock@cs.unc.edu`, as one of the problems with electronic mail and suggests the use of more familiar telephone-oriented addresses, such as *user*`@`*telephone-number* or `brock@19199621700`. Note that McCarthy is *not* proposing that we abandon the NSFnet for dial-up modems but rather that we use as our "net addresses" a very common and widely accepted naming scheme, telephone numbers.

Let's embrace McCarthy's idea and implement it on top of the existing Internet architecture. In a couple of paragraphs, outline how you would modify the the Internet software to use Telephone Number Based Electronic Mail Addressing (TeleNBEMA). Remember, the messages still go to the same machines over the same network. Only the format of mail addresses changes.

Problem 5. (5 points)

Why might an RPC server stub cache the results of recent calls? How could it use such information?

Problem 6. (10 points)

Give three reasons why datagrams are generally preferred to connected communication [virtual circuits] for implementing RPCs. Explain why acknowledgement messages are not generally needed in implementing RPCs.‡

Problem 7. (10 points)

Suppose a program running on a workstation here at Chapel Hill is trying to send a datagram to a workstation at Purdue. Assume that the IP network at Purdue is divided into subnets and that all Purdue machines use subnets properly (*i.e.,* no psuedo-ARPs). Associated with the target machine at Purdue are four different numbers:

(1) an IP host number,
(2) an IP network number,
(3) an IP subnet number, and
(4) an ethernet address.

Which of these numbers must the Chapel Hill machine know in order to initiate delivery of the packet? How are these numbers used in the gateways between Chapel Hill and Purdue in order to route the packet?

Problem 8. (10 points)

A Chapel Hill travel agency is struck by a meteorite and its computer, with all its data, is completely destroyed. The computer of the agency was used to make reservations at many different airlines. The programs of both the travel agency and the airlines were written in Argus and, consequently, use two-phase commit.

Suppose that just before the meteorite stuck a travel agent had entered a single transaction to obtain two reservations: one, with Epsilon airlines; the other, with Zeta airlines. Unfortunately, the agency's computer was destroyed before it printed the result of the transaction. What are the possible "outcomes" of the transaction? Was the transaction necessarily aborted? Were all the locks and versions obtained by the transaction at Epsilon and Zeta airlines released?

‡ Taken from *Distributed Systems: Concepts and Design* by Coulouris and Dollimore.