Homework Assignment #1 – Due Sep 20 @ 3:50 PM

EE122: Introduction to Communication Networks (Fall 2006)

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1. Peterson & Davie, Exercises 1.13, 1.15, 1.18

2. Ping

The ping program determines the round-trip-time (RTT) to any host in the Internet. Using a computer on campus ping the following hosts: cmu.edu (Pittsburgh, PA), mit.edu (Boston, MA), washington.edu (Seattle, WA), ucsd.edu (San Diego, CA), uchicago.edu (Chicago, IL), columbia.edu (New York, NY), odu.edu (Norfolk, VA), and www.vanderbilt.edu (Nashville, TN). For each of these locations find the physical distance from Berkeley (or San Francisco) using http://routesinternational.com/buslines.htm#distance, and then compute the shortest possible time T to reach that location.

(a) Plot a graph where the X axis represents the distance to each city, and the Y axis represents the ratio between the RTT as measured by the ping program and the shortest possible time T to reach that city. (Note that the Y-values are no smaller than 2 since it takes at least 2T time for any packet to reach the destination and get back.)

(b) Give two reasons of why the Y-values you plot are larger than 2.

3. RFCs

The Request for Comments (RFC) documents define and standardize the bulk of the protocols used by the Internet. They are published on behalf of the Internet Engineering Task Force (IETF), which forms the main standards body of the Internet.

If you want to understand a protocol in full detail (especially to write your own implementation of it), these are the documents to refer to.

(a) One of the RFCs defining Internet protocols concerns sending packets ("IP datagrams") over carrier pigeons. It was published as a part of the IETF's April Fools series, but is written as though a true protocol, and in fact appears to be implementable.

Search http://rfc-editor.org to locate this document.

Hint #1: it doesn't actually mention "pigeons".

Hint #2: find the first version of the standard, not the later one that discusses "Quality of Service" for carrier pigeons.

Once you find the document, read it and summarize in your own words what it says about the MTU (= Maximum Transmission Unit) for such transmission, i.e., the largest individual message that can be sent.

(b) A great strength of the IP protocol is how it provides the "glue" to communicate data over a series of widely varying, lower-layer network (or "link) technologies. Using http://rfc-editor.org (or whatever search means you want to use, providing your work by yourself), locate RFCs that refer to transmitting IP over <XXX>, where <XXX> is some link technology. For example, RFC 1201 is "Transmitting IP traffic over ARCNET networks".

List all the different lower-layer networking technologies for which you can find an RFC whose title indicates it defines how to send IP packets (or datagrams, or traffic) over that technology. Give both the name of the technology and the RFC defining the transmission.

Extra credit: find more lower-layer networking technologies than the TAs did, which was 21, when counting very similar entries like “IP over 802” and “IP over 802.3” as the same, and allowing general entries like “IP over public data networks” to be counted.

4. End-to-End Arguments

Suppose you run a document delivery company, BearsEx, similar to Federal Express. You're just starting out, so currently you only deliver from Berkeley to New York. Each package you handle is dropped off at your Berkeley office. From there, a driver takes it to Oakland airport, where it's flown to Denver and then on from Denver to New York. At New York, a driver takes it straight to its destination in the city. So a complete trip consists of the following "hops":

1: Berkeley -> OAK via truck.
2: At OAK, from the drop-off point to the plane
3: OAK -> DEN via plane.
4: At DEN, from the arriving plane to the connecting plane.

5: DEN -> JFK via plane.
6: At JFK, from the arriving plane to the baggage claim.
7: JFK -> destination via truck.

However, you have problems with loss & theft. Indeed, as packages are transported by truck drivers, they're stolen 3% of the time. When they are moving through airports, they're stolen 2% of the time. And when they're on airplanes, they're lost 1% of the time.

(a) What's the likelihood that a package makes it to its destination?

(b) As CEO, you are considering spending money to reduce all BearsEx theft/loss rates to 0.05%. Consider each of the following alternatives:

(i) Suppose that for the sender of a package, the most important thing to them is that the package eventually gets there. For lost packages, the receiver notices after a day that it hasn't shown up and phones the sender, who always sends it again until it finally arrives.
or:
(ii) Suppose that for the sender of a package, the most important thing to them is that the package gets there the next day. If it doesn't, they will give up and look for a different document delivery company.

For each of these possibilities, discuss what the End-to-End Principle would dictate regarding whether BearsEx should spend extra money to reduce the theft/loss rates. (Ignore just how much money this would be versus other costs and prices. The question here is the principle of whether to spend some money on improving the service.)