Advanced Computer Networks
263-3501-00
Exercise Session 1
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Spring Semester 2013
Information about the Course

- [http://www.systems.ethz.ch/courses/spring2013/acn](http://www.systems.ethz.ch/courses/spring2013/acn)

- Assignments will be posted before the session

- 6-7 written assignments
  - Submit your solutions on the due date
  - You can skip at most 2 of these assignments
  - Your submission might count 0.5 if it is half correct

- 2 programming assignments (30% of your grade)
  - RDMA & OpenFlow
  - Submission via SVN

- The exam (70% of your grade)
Assignment 1

Out: Feb. 28
Due by: Mar. 7
Q1 & Q2: Network performance

What is network performance?

Two fundamental measures:

• Bandwidth
  – Roughly: bits transferred in unit time
  – Not quite the Electrical Engineering definition
  – Also known as Throughput

• Latency
  – Time for 1 message to traverse the network
  – Half the Round Trip Time (RTT)
  – Also known as Delay
Bandwidth-Delay product

- Example: Latency = 200ms, Bandwidth = 40Gb/s
  - ⇒ “channel memory” = 8Gb, or 1 gigabyte
- What the sender can send before receiver sees anything
  - Or *must* send to keep the pipe full...
Example: sending 1MB down a 1Gb/s link, with 200ms RTT.

• What’s the *throughput*?

\[
\text{Throughput} = \frac{\text{Transfer size}}{\text{Transfer time}}
\]

• Transfer size = 1MB ~ 10Mb

• What’s the transfer time?

\[
\text{Transfer time} = \text{RTT} + \frac{\text{Transfer size}}{\text{Bandwidth}}
\]

Request + first byte delay
Example: sending 1MB down a 1Gb/s link, with 200ms RTT.

- Transfer time =

\[ 0.2s + \frac{8\text{Mb}}{1\text{Gb/s}} = 0.208s \]

- So throughput =

\[ \frac{8\text{Mb}}{0.208s} = \sim 38.5\text{Mb/s} \]

Hmm....
Q3: TCP extended

• TCP recap
  – Congestion window: not to exceed the capacity of the network
  – Receive window: not to exceed the process capacity of the receiver

• Protocol limits:
  – TCP receive window size without scaling \( \leq 64\text{kB} \)
  – TCP receive window size with RFC1323 scaling \( \leq 1\text{GB} \)

• Sending a 10 MB file over 1 Gbps link with RTT = 100ms
  – Don’t forget TCP slow start
  – If TCP allowed packet sizes larger that 64kB
    • How does it effect the throughput?
  – If TCP allowed receive window sizes larger than 1MB
    • How does it effect the throughput?
Q4: Bandwidth calculation

• Recap of simple bandwidth calculations:
  – HDTV high-resolution video at resolution of 1920*1080, 24 bits/pixel, 30 frames/second.
  – POTS (Plain Old Telephone Service) voice audio of 8-bits samples at 8 KHz.
  – GSM mobile voice audio of 260-bit samples at 50 Hz.
  – Assume a fax transmits an 8x10 inch black-and-white image at a resolution of 72 pixels per inch. How long would this take over a 14.4-Kbps modem?
Q5: Message segmentation

- End-to-end message transport
  - Transferring $7.5 \times 10^6$ bits long message with and without message segmentation
  - Pros and cons of segmentation?

Uses store and forward packet switching
Q6: Naming

Network naming

Saltzer’s (and Shoch’s) terminology:

• A *name* identifies what you want.
• An *address* identifies where it is.
• A *route* identifies a way to get there.

Note that in this terminology, *syntax* (human readable, binary, etc.) is completely irrelevant!
Objects to be named

• Services and users
  – Functions that are used ("Facebook") and clients that use them ("a web browser", "a user")

• Nodes
  – Computers that can run services or user programs

• Network attachment points
  – Places where a node is attached to a network (e.g. a network interface)

• Paths
  – Connections between network attachment points, traversing forwarding nodes and communication links
To talk to a service...

1. Find a node on which the service is running
   – Service name resolution

2. Find a network attachment point to which that node is connected
   – Node name location

3. Find a path from this attachment point to that attachment point
   – Routing, connection setup
The message...

Naming is complex

A clear model of naming (such as Saltzer’s):

• Does help to understand real networks
  – What is being named? What is its context?
  – Is the “name” an identifier, or an address, or both?

• Does not correspond to real networks
  – Real networks (particularly the Internet!) confuse and conflate different naming concepts
Question

What are the two observations about the naming of network objects (regarding form and bindings) made by Saltzer?