Advanced Computer Networks
263-3501-00
Exercise Session 1

Spring Semester 2015
Information about the Course

• [http://www.systems.ethz.ch/courses/spring2015/acn](http://www.systems.ethz.ch/courses/spring2015/acn)

• Assignments will be posted before the session

• 7-8 written assignments

• Submit your solutions on the due date

• 2 programming assignments (30% of final grade)
  – RDMA (IBVerbs, get, put, etc)
  – OpenFlow (MiniNet, topology detection)
  – Submission via SVN

• The exam (70% of final grade)
Assignment 1

Out: Feb. 19
Due by: Feb. 26
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 + 8Mb/1Gbs = 0.208s

- So throughput = 8Mb / 0.208s = ~ 38.5Mb/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 ≤ 64kB
  – TCP receive window size with RFC1323 scaling ≤ 1GB

• Sending a 10 MB file over 1 Gbps link with RTT = 100ms
  – Don’t forget TCP slow start
  – If TCP receive window is 1MB
    • How does it effect the throughput?
  – If TCP allowed receive window sizes much 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
Question

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