Assignment #1 (5%)

CS5263 Wireless Multimedia Networking Technologies and Applications
Department of Computing Science, National Tsing Hua University Hsin Chu, Taiwan

Please attach additional answer sheets and clearly mark the question numbers. Due at 3:30 p.m. on October 14th, 2013. Please turn in hardcopies before the lecture starts. See course website for grading policies, especially about late submissions.

1) (1%) Perform a `traceroute` between source and destination both in Taiwan at three different hours of the day.
   a) Find the average and standard deviation of the round-trip delays at each of the three hours.
   b) Find the number of routers in the path at each of the three hours. Did the paths change during any of the hours?
   c) Try to identify the number of ISP networks that the `traceroute` packets pass through from source to destination. Routers with similar names and/or similar IP addresses should be considered as part of the same ISP. In fact, try to use the IP to AS lookup database (http://asn.cymru.com) to identify the names of these ISPs.
   d) In your experiments, do the largest delays occur at the peering interfaces between adjacent ISPs?
   e) Repeat the above for a source in Taiwan and destination in North America. Compare the intra-continent and inter-continent results.

2) (1%) In this problem we consider sending real-time voice from Host A to Host B over a packet-switched network (VoIP). Host A converts analog voice to a digital 64 kbps bit stream on the fly. Host A then groups the bits into 56-byte packets. There is one link between Host A and B; its transmission rate is 2 Mbps and its propagation delay is 10 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packets bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)?

3) (1%) Suppose there is a 10 Mbps microwave link between a geostationary satellite and its base station on Earth. Every minute the satellite takes a digital photo and sends it to the base station. Assume a propagation speed of $2.4 \cdot 10^8$ meters/sec.
   a) What is the propagation delay of the link?
   b) What is the bandwidth-delay product, $R \cdot d_{prop}$?
   c) Let x denote the size of the photo. What is the minimum value of x for the microwave link to be continuously transmitting?

4) (1%) Consider sending a large file of F bits from Host A to Host B. There are three links (and two switches) between A and B, and the links are uncongested (that is, no queuing delays). Host A segments the file into segments of S bits each and adds 80 bits of header to each segment, forming packets of $L = 40 + S$ bits. Each link has a transmission rate of R bps. Find the value of S that minimizes the delay of moving the file from Host A to Host B. Disregard propagation delay.

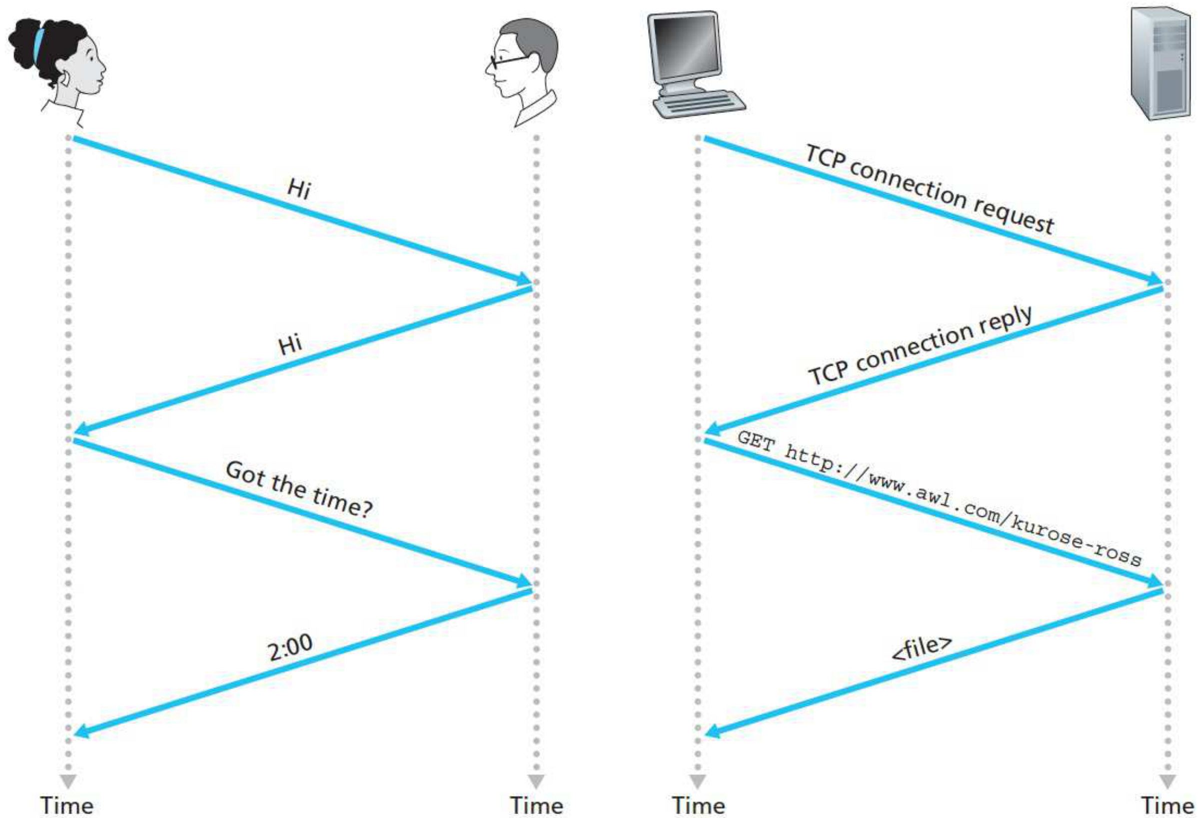

Figure 1.2 ♦ A human protocol and a computer network protocol

5) (1%) Design and describe an application-level protocol to be used between an automatic teller machine and a banks centralized computer. Your protocol should allow a users card and password to be verified, the account balance (which is maintained at the centralized computer) to be queried, and an account withdrawal to be made (that is, money disbursed to the user). Your protocol entities should be able to handle the all-too-common case in which there is not enough money in the account to cover the withdrawal. Specify your protocol by listing the messages exchanged and the action taken by the automatic teller machine or the banks centralized computer on transmission and receipt of messages. Sketch the operation of your protocol for the case of a simple withdrawal with no errors, using a diagram similar to that in Figure 1.2. Explicitly state the assumptions made by your protocol about the underlying end-to-end transport service.