Computer Networks - 2015

Problem set 1

September 17, 2015

1. Imagine that you have trained your St. Bernard, Bernie, to carry a SD card of 16 GByte instead of a flask of brandy. The dog can travel to your side, wherever you may be, at 18 km/hour. For what range of distance does Bernie have a higher data rate than a DSL line whose data rate is 12 Mbps?

2. An image is $1024x768$ pixels with 3 Bytes/pixel. Assume the image is uncompressed. How long does it take to transmit it over 56 Kbps modem channel? Over 12 Mbps ADSL line? And over 1 Gbps Fast-Ethernet?

3. There is an asymmetric point-to-point connection between a base station on Earth and a imaginary space station on Moon. The bandwidth of the line from Earth to Moon is 100 Mbps, while in the opposite direction it is 10 Gbps. The distance of Earth and Moon is approx. 385000 km. The data are transmitted by radio waves which means that the signal propagation speed in both direction is approx. $3 * 10^8$ m/s. **A.)** How long does it take to transmit a signal from Earth to Moon, and vice versa? **B.)** Let's assume that the base station wants to download an astro-photo of 200 MB from the station on Moon. To this end, a request message of 100 Byte is first sent to Moon and, after it is received by the other side, the base station can start downloading the photo. How much time elapses between sending the first bit of the request message and receiving the last bit of the photo?

4. Assign the following terms to one of the layers of the hybrid model: **E-mail, packet forwarding, Ethernet, Optical cable, TCP, Internet Protocol, Port "address", Coaxial cable, Token ring, Wi-Fi, IP address, HTTP, routing, Web Service, BitTorrent**.

5. Internet is roughly doubling in size in every 18 months. Although no one really knows for sure, one estimate put the number of hosts on it at 100 million in 2001. Use these data to calculate the expected number of Internet hosts in the year 2012. Do you believe this? Explain why or why not.

6. Calculate the delay elapsed from the first bit sent by A to the last bit received by B in the following store-and-forward system! Let's consider a link of speed 10 Mbps interconnecting A and B which is split into two equal sections by a store-and-forward switch. The propagation delays on both sections are 13 ms. What is the overall delay in case of transmitting a frame of 3500 bit? Calculate the delay in case of $N > 1$ switches?

7. The Internet was designed to withstand a nuclear war. How many bombs would it take to partition the nodes into two disconnected part in the networks, can be shown on the last slide of the lecture? Assume that any bomb wipes out a node and all of the links connected to it.

8. In some networks, the data link layer handles transmission errors by requesting damaged frames to be retransmitted. If the probability of a frame's being damaged is p, what is the mean number of transmission required to send a frame? Assume that acknowledgements are never lost.

9. Use the ping program to see how long it takes to get from your location to several known locations. You can use servers like berkeley.edu, mit.edu, vu.nl, www.uct.ac.za, www.usyd.edu.au .