# Homework #1

- ✓ **Please upload your answer sheet in LMS. The uploading file must be PDF.**
- ✓ **Due date: 11pm, 10/6 (Wed)**

1. **This elementary problem begins to explore propagation delay and transmission delay, two central concepts in data networking. Consider two hosts, A and B, connected by a single link of rate *R* bps. Suppose that the two hosts are separated by *m* meters, and suppose the propagation speed along the link is *s* meters/sec. Host A is to send a packet of size *L* bits to Host B.**

   a. Ignoring processing and queueing delays, obtain an expression for the end-to-end delay, in terms of $m$, $s$, $L$, and $R$.

   b. Suppose $d_{prop}$ is greater than $d_{trans}$. At time $t=d_{trans}$, where is the first bit of the packet?

   c. Suppose $d_{prop}$ is less than $d_{trans}$. At time $t=d_{trans}$, where is the first bit of the packet?

   d. Suppose $s=2.5*10^8$, $L$=150bits, and $R$=128kbps. Find the distance $m$ so that $d_{prop}$ equals $d_{trans}$.

2. **Suppose that Handong students in campus share a 1Gbps link. Also suppose each user requires 10Mbps when transmitting, but each user transmits only 20 percent of the time. (See the discussion of packet switching versus circuit switching)**

   a. When circuit switching is used, how many users can be supported?

   b. For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

   c. Suppose there are 150 users. Find the probability that at any given time, exactly $n$ users are transmitting simultaneously. (Hint. Use the binomial distribution)

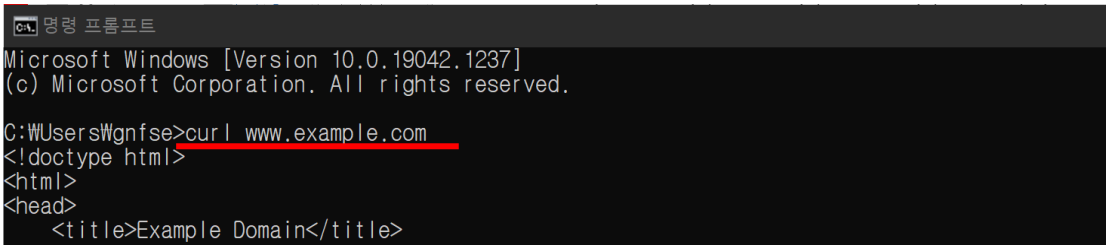
   d. Find the probability that there are 31 or more users transmitting simultaneously.

3. **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 128kbps bit stream on the fly. Host A then group the bits into 96-byte packets. There is one link between Hosts A and B; its transmission rate is 5Mbps and its propagation delay is 5msec. 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 packet's 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)?**

4. **Answer the following questions after capturing the DNS and HTTP packets using *curl* and *Wireshark*. For capturing the packets, access "www.example.com" using *curl*. You have to answer with screenshots of your Wireshark.**

   *Help 1*: You can find manual of Wireshark in the Internet. There are many manuals to use Wireshark!

   *Help 2*: You can use *curl* in Windows, Linux, and MacOS. Below is the *curl* executed in my desktop.




*Hint 3*: If you already access "www.example.com" just before you capture packets, DNS client may not send a query to DNS server since it already has cache data. In this case, you have to flush DNS. Please find the way by yourself according your OS.

a. What is the IP address of your default DNS server?

b. What kind of transport protocol is used for DNS packet?

c. Analyze the Flags field and query message in the DNS query packet.

d. Analyze the answers in the DNS response packet.

e. What is the IP address of www.example.com?

f. What kind of transport protocol is used for HTTP packets?

g. What is the User-Agent field in the captured HTTP request packet? What does it mean?

h. What version of HTTP is the server running?

i. What is the status code returned from the server to your browser?

j. When was the HTML file that you are retrieving last modified at the server?

k. How many bytes of content are being returned to your computer?