

Introduction to Computer Networks and Data Communication, WS 2013/2014  
Assignment 1

**Exercise 1-1**

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.

- Express the propagation delay  $d_{prop}$  in terms of  $m$  and  $s$ .
- Express the transmission delay  $d_{trans}$  in terms of  $L$  and  $R$ .
- What will be the total end-to-end delay?
- Suppose  $s = 2.5 * 10^8$ ,  $L = 100$  bits, and  $R = 28$  Kbps. Find the distance  $m$  so that  $d_{prop}$  equals  $d_{trans}$

**Exercise 1-2**

Consider a point-to-point link 100 km in length. The propagation speed of bits in this link is  $2 * 10^8$  m/s. At what bandwidth will propagation delay equal transmission delay for a 100 byte packets?

**Exercise 1-3**

Host A wants to send a 1Mbyte packet to Host B. The propagation speed of bits is  $2 * 10^8$  m/sec. Assume that A and B are connected via a router R. Link AR connects A to R, and link RB connects R to B. Link AR is 1Km long and link RB is 2Km long. Suppose that the capacity of each of the 2 links is 10 Mbytes/sec and the processing delay in the Router (R) is 10 msec. Find after how long will host B receive the packet. Note the Router (R) must receive the whole packet before being able to forward it.

**Exercise 1-4**

A system has an  $n$ -layer protocol hierarchy. Applications generate messages of length  $M$  bytes. At each of the layers an  $h$ -byte header is added. What fraction of the network bandwidth is filled with headers?