ECE 465: Computer Network Protocols and Applications
Homework 2
Solution
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Chapter 1 Problems

Problem 13.

The command:

```
traceroute -q 20 www.eurecom.fr
```

will get 20 delay measurements from the issuing host to the host, www.eurecom.fr. The average and standard deviation of these 20 measurements can then be collected. Do you see any differences in your answers as a function of time of day?

Problem 14.

a) 40,000 bits
b) 40,000 bits
c) the bandwidth-delay product of a link is the maximum number of bits that can be in the link
d) 1 bit is 250 meters long, which is longer than a football field
e) s/R

Problem 15.

25 bps

Problem 16.

a) 40,000,000 bits
b) 400,000 bits
c) .25 meters

Problem 17.

a) $t_{trans} + t_{prop} = 400$ msec $+ 40$ msec $= 440$ msec
b) $10 * (t_{trans} + 2\ t_{prop}) = 10*(40$ msec $+ 80$ msec$) = 1.2$ sec

Problem 18.

a) 150 msec

b) 1,500,000 bits
c) 600,000,000 bits

Problem 20.

a) Time to send message from source host to first packet switch $=$
$\dfrac{7.5 \times 10^6}{1.5 \times 10^6}$ sec $= 5$ sec. With store-and-forward switching, the total time to move
message from source host to destination host $= 5\,\text{sec} \times 3\ hops = 15\,\text{sec}$

b) Time to send 1st packet from source host to first packet switch $= .$
$\dfrac{1.5 \times 10^3}{1.5 \times 10^6}$ sec $= 1\,m\text{sec}$. Time at which 2nd packet is received at the first switch $=$
time at which 1st packet is received at the second switch $= 2 \times 1\,m\text{sec} = 2\,m\text{sec}$

c) Time at which 1st packet is received at the destination host $= .$
$1\,m\text{sec} \times 3\ hops = 3\,m\text{sec}$. After this, every 1msec one packet will be received;
thus time at which last (5000th) packet is received $=$
$3\,m\text{sec} + 4999 * 1m\text{sec} = 5.002\,\text{sec}$. It can be seen that delay in using message
segmentation is significantly less (almost $1/3^{\text{rd}}$).

d) Drawbacks:
   i. packets have to be put in sequence at the destination.
   ii. Message segmentation results in many smaller packets. Since header size is usually the same for all packets regardless of their size, with message segmentation the total amount of header bytes is more.