CSCI 4273/5273: Network Systems
Fall 2014
Homework 1 Solutions (Selected Exercises)

3. (a) Total Transfer Time = Handshake + Transmit Time + Propagation delay (last bit)
= 2 * RTT + $(1000*2^{10}*2^3)/(1.5*10^6)$ + 0.5 * RTT
= 2 * 50 * 10^{-3} + $(1000*2^{10}*2^3)/(1.5*10^6)$ + 0.5 * 50 * 10^{-3} sec.
= 5.586 sec.

(b) Total Transfer Time = Total Transfer Time in (a) + Total Wait time
= 5.586 + (999*RTT)
= 55.536 sec.

(c) Total Transfer Time = Handshake + (1000/20)*RTT + 0.5*RTT
= 2.625 sec.

(d) We need 10 RTTs to send all 1000 packets
Total Transfer Time = Handshake + 10*RTT + 0.5*RTT
= 2 * RTT + 10 * RTT + 0.5 * RTT
= 0.625 sec.

15. (a) RTT = 2 * (distance/signal speed)
= 2 *((385000*1000)/($3*10^8$))
= 2.567 sec.

(b) delay * bandwidth = 2.567 * 1 = 2.567 Gb

(c) This is the minimum number of bits a sender can continuously send until an acknowledgement for the first bit can be received.

(d) Minimum time elapsed = time for the request to reach the moon + time to transmit image + propagation delay
= 0.5*RTT + $(25*2^{20}*2^3)/(1*10^9)$ + 0.5*RTT
= 2.776 sec.

18. (a) Intermediate switches increase the latency, but the send data rate is unaffected. So, the effective bandwidth is 100 Mbps.

(b) Total time to send a packet and receive ack = Total packet transfer time + Total Ack transfer time

Total packet transfer time = Packet transmit time + 3 * packet switch delay + 4 * Link propagation delay

$= (12000)/(100*10^6) + 3 * ((12000)/(100*10^6))\text{sec} + 4 * 10 * 10^{-6} = 0.00052$ sec

Total Ack transfer time = Ack transmit time + 3 * Ack switch delay + 4 * Link propagation delay

$= (50 * 2^3)/(100*10^6) + 3 * ((50 * 2^3)/(100*10^6)) + 4 * 10 * 10^{-6} = 0.000052$ sec

Total time to send a packet and receive ack = 0.00052 + 0.000052

= 0.000572 sec

Effective bandwidth = Packet size/Total time to send a packet and receive ack

= 12000/0.000572 = 20979020 bps = 20.98 Mbps

(c) Effective bandwidth = Transfer size/Transfer Time

$= (100 * 4.7 * 2^{30} * 2^3)/(12 * 60 * 60)$ bps = 93455306 bps = 93.45 Mbps

21. (a) Option 1 (50% compression):

compression time + transmit time = $1 + (0.5 * 2^{20} * 2^3)/\text{bandwidth}$

Option 2 (60% compression):

compression time + transmit time = $2 + (0.4 * 2^{20} * 2^3)/\text{bandwidth}$

$1 + (0.5 * 2^{20} * 2^3)/\text{bandwidth} = 2 + (0.4 * 2^{20} * 2^3)/\text{bandwidth}$

bandwidth = 838860.8 bps = 838.86 Kbps

(b) Since propagation delay does not depend on the packet size, latency does not affect the answer in (a).