Assignment #2 - Exercise #4

We will count the transfer as completed when the last data bit arrives at its destination. An alternative interpretation would be to count until the last ACK arrives back at the sender, in which case the time would be half an RTT (50ms) longer.

a) 2 initial RTT's (200ms) + 1000KB/1.5Mbps (transmit) + RTT/2 (propagation) $\approx 0.25 + 8$Mbit/1.5Mbps = 0.25+5.33 sec = 5.58 sec. If we pay more careful attention to when a mega is 10^6 versus 2^{20}, we get 8,192,000bits/1,500,000 bits/sec = 5.46 sec, for a total delay of 5.71 sec.

b) To the above we add the time of 999 RTTs (the number of RTTs between when packet 1 arrives and packet 1000 arrives), for a total of 5.71 + 99.9 = 105.61 sec.

c) This is 49.5 RTTs, plus the initial 2, for 5.15 seconds.

d) Right after the handshaking is done we send one packet. One RTT after the handshaking we send two packets. At n RTTs past the initial handshaking we have sent $1 + 2 + 4 + ... + 2^n = 2^{n+1} - 1$ packets. At $n = 9$ we have thus been able to send all 1,000 packets; the last batch arrives 0.5 RTT later. Total time is 2+9.5 RTTs, or 1.15 sec.