Chapter 1

Problem 3

Part a

The 2 initial RTTs that must be taken will take 100ms. We add this to 8000000/15000000 (packet size/transmit speed). This means that it will take roughly 0.63 seconds to transmit the packet.

Part b

We must find the number of packets that will be sent in the network. With a packet size of 1KB, a 1000KB file will take 1000 packets to send. A wait of one RTT after each packet would add an additional 50,000ms to the total time, meaning that the total time will be 50,630ms (or 50.63 seconds).

Part c

Since we need to send 1000 packets to send a 1000KB file, it will take $\frac{1000}{20} \cdot 50ms = 2500ms$ to send the file.

Part d

It would take us 9 round trips to send all 1000 packets. With an RTT of 50ms, it would take 450ms to send a 1KB file.

Problem 5

The propogation delay would be $\frac{4x10^3m}{2x10^8m/s} = 200ms$. For 800 bit packets, it is 800 / 200/ms = 4Mbps. For 512-byte packets, it rises to 20.5Mbps.

Problem 16

Part a

For each switch, it takes $\frac{1Gbps}{12kb} = 12\mu s$ to transmit the 12kb packet. With the additional delay introduced by the switch, the link will have a latency of $44\mu s$.

Part b

The 3 links will result in 4 transmit delays ($12\mu s$ each) and 4 propogation delays ($10\mu s$ each), for a total of $88\mu s$ of latency.

Part c

Handling the first 200 bits will take $200ns$. This initial processing will replace most of the transmit delays, resulting in a total latency of $12\mu s + .6\mu s + 40\mu s = 52.6\mu s$.

Problem 18

Part a

The transmit delay would be $\frac{12Mbps}{12kb} = 1024\mu s$. Each 12kb packet will suffer from 4 transmit delays and 4 propogation delays, meaning a 12kb packet will take $4096\mu s + 40\mu s = 5036\mu s$ to send. Per second, it could send about 199 packets, each being 12kb. This would make the effective bandwidth $12kb \cdot 199 = 19.1Mbps$.

Part b

Part c

Those DVDs would hold a total of 470GB, or 3,600,000,000,000 bits, a of data. If they were sent over 12 hours, then the bandwidth would be 83,000,000 bits per second, or roughly 83Mbps.

Problem 21(a)

We can set up an equality that models this situation like so: $1 + 0.5x = 2 + 0.4x$ where x represents the bandwidth. Solving for the bandwidth, we get 10, so the bandwidth would need to be 10Mbps.

Problem 26

Part a

Part b

Part c

Part d

Chapter 9

Problem 4

If you submit an invalid command to SMTP, you get back a status code of 500 and a message stating that the command submitted does not work.