Chapter 1

3.

a) $2 \times 50 + 1000KB / 1.5 Mbps$

$= 100 + 5333.33$

$= 5433.33ms = 5.43333s$

b) Total time $= 5433.33 + 999 \times 50 ms$

$= 5433.33 + 49950$

$= 55383.33 ms$

$= 55.38333 s$

c) $100 + 49.5 \times 50 = 2575 ms$

$= 2.575 s$

d) 1000 packets have to send

The packets send in RTT as

$1, 2^1, 2^2, \cdots, 2^n$

when $n=9$, all packets can be sent

since data needs 0.5 RTT to arrive

to destination, so in total

$100 + 9.5 \times 50 = 575 ms = 0.575s$

11.

$10 Gbps = 10^{10} bps$.

$\Rightarrow 1 \div 10^{10} = 10^{-10}$ sec wide

$\Rightarrow$ length $= 10^{-10} \times 2.3 \times 10^8 m/s = 0.023 m$

19.

a) $100\ Mbps \times 10\ \mu s$

$= 100 \times 10^6\ bps \times 10 \times 10^{-6}\ s$

$= 10^3$ bits

b) $100\ Mbps \Rightarrow$ each bit takes $100 \times 10^{-10}\ s$ to transmit

delay time : $12000 \times 100 \times 10^{-10} = 1.2 \times 10^{-4}\ s$

$4 \times (1.2 \times 10^{-4} + 1 \times 10^{-5}) = 5.2 \times 10^{-4}\ s$

$\Rightarrow 100\ Mbps \times 5.2 \times 10^{-4}\ s$

$= 100 \times 10^6 \times 5.2 \times 10^{-4}$

$= 5.2 \times 10^4$ bits

c) delay × bandwidth product

$= 1.5\ Mbps \times 50\ ms$

$= 7.5 \times 10^4$ bits

d) propagation speed = 3×10^8 m/s

distance = $2 \times 35{,}900{,}000$

$= 7.18 \times 10^7$ m

delay = $(7.18 \times 10^7) \div (3 \times 10^8)$

$= 0.24$s

1.5 Mbps $\times 0.24 = 3.6 \times 10^5$ bits

20.

a) delay = 10^4 bits / 10^8 bps = $100 \mu s$

$\Rightarrow 2 \times 100 + 2 \times 20 + 35 = 275 \mu s$

b) delay is 50 μs each time

(packet)	1	2
$T=0$	start	
$T=50$	sent(S)	start
$T=70$	arrive(S)	
$T=100$		sent(S)
$T=105$	sent(B)	
$T=155$		sent(B)

Total time = wait time + send time + delay(A → S) + wait in S + delay(S → B) + receive time

$= 50+50+20+35+20+50$

$= 225\ \mu s$

Chapter 2

6. 11010111111011111001011111110

The error would be seven 1's in a row

40.

Coaxial Cable:

$1500 \div 0.77 \approx 6.49 \mu s$

link: $1000 \div 0.65c \approx 5.13 \mu s$

repeaters: $2 \times 0.6 = 1.2 \mu s$

transceivers: $6 \times 0.2 = 1.2 \mu s$

drop table: $6 \times 50 \div 0.65c \approx 1.54 \mu s$

Total: $6.49 + 5.13 + 1.2 + 1.2 + 1.54 = 15.56 \mu s$

$\Rightarrow 15.56 \times 2 = 31.12 \mu s$

42.

a) $4640+48=4688$ bits

b) Since packet size is larger than many packet size at higher level, so the bandwidth is wasted

c)
if maximum collision domain diameter reduce, packet size could be smaller.

Chapter 3

	destination	Port
S_1	A	1
	B	2
	default	3
S_2	A	1
	B	1
	C	3
	D	3
	default	2
S_3	C	2
	D	3
	default	1
S_4	D	2
	default	1

21.

a) B_2 would be the root since it has the second smallest ID (except B1) and will disable links like

B5 → A, B7 → B, B6 → G,

B6 → I

b) So network D-H would have no direct connection, it would partition into two parts, A, B, C, D, E, F and G, H, I, J

All links would be active.