CS 164 COMPUTER NETWORKS
Assignment 3 -- Answers

1. Exercise #21 on p.58

(a) 10^7 bits/sec * 10^{-5} sec = 100 bits = 12.5 bytes

(b) The first-bit delay is 520 µs through the store-and-forward switch, as in 18(a). Because:
One packet consists of 5000 bits, and so its transmission delay equals 500 µs. The packet is also delayed 10 µs on each of the two links due to propagation delay, for a total of 520 µs. Then, BW-Delay product = 10^7 bits/sec * 520 * 10^{-6} sec = 5200 bits.

(c) 1.5 * 10^6 bits/sec * 50 * 10^{-3} sec = 75,000 bits = 9375 bytes

(d) This was intended to be ***through*** a satellite, not ***to*** a satellite, *i.e.* between two ground stations; this ground-to-ground interpretation makes the total one-way travel distance 2 * 35,900,000 meters. With a propagation speed of c = 3 * 10^8 meters/sec, the one-way propagation delay is thus 2* 35,900,000/c = 0.24 sec.
BW-Delay product = 1.5 * 10^6 bits/sec * 0.24 sec = 360,000 bits = 45 KBytes

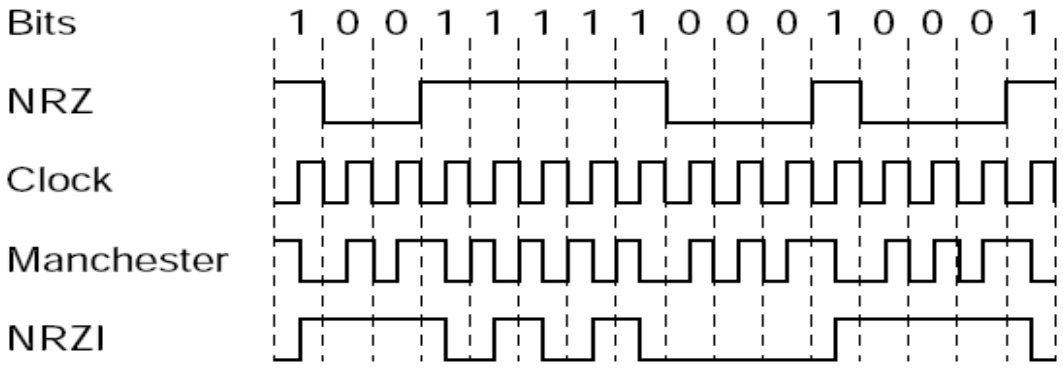
2. Exercise #23 on p.59

(a) Without compression the file size is 1MB. When we compress the file, with the first compression, its size reduces to 0.5 MB. With the second compression, it becomes 0.4 MB (60% is compressed, therefore 40% remains).
We want to have: compression time + compressed size/bandwidth to be equal in both cases.
Equating, we get:

(0.5 MB/bandwidth) + 1 sec = (0.4 MB/bandwidth) + 2 sec.
Bandwidth = 1024 * 1024 * 8 * 0.1 = 838.9 Kbps.

(b) Latency doesn t affect the answer because it would affect the compressed and uncompressed transmission equally.

3. Exercise #1 on p.150



4. Exercise #8 on p.151

& , DLE, DLE, DLE, ETX, ETX.

5. Exercise #11 on p.151

Suppose an undetectable three-bit error occurs. The three bad bits must be spread among one, two, or three rows. If these bits occupy two or three rows, then some row must have exactly one bad bit, which would be detected by the parity bit for that row. But if the three bits are all in one row, then that row must again have a parity error (as must each of the three columns containing the bad bits).

6. Exercise #18 on p.152

(a) We take the message 11001001, append 000 to it, and divide by 1001. The remainder is 011; what we transmit is the original message with this remainder appended: 1100 1001 011.

(b) Inverting the first bit gives 0100 1001 011; dividing by 1001 ($x^3 + 1$) gives a quotient of 0100 0001 and a remainder of 10.