ITS 323 – DATA TRANSMISSION EXAMPLES

1 Bit Rates

What is the bit rate for high-definition TV (HDTV)?

HDTV uses digital signals to broadcast high quality video signals. The HDTV screen is normally a ratio of 16 : 9. There are 1920 by 1080 pixels per screen, and the screen is renewed 30 times per second. 24 bits represents one colour pixel.

Bits per second = 1920 x 1080 x 30 x 24 = 1492992000 = 1.5Gb/s

The TV stations reduce this rate to 20 to 40 Mbps through compression.

2 Nyquist Theorem

Example 3.3 from Stallings, page 80

Consider a voice channel being used, via modem, to transmit digital data. Assume a bandwidth of B = 3100Hz. Then the Nyquist capacity, C, of the channel is:

C = 2B = 2 x 3100 = 6200b/s

If we now assume M = 8, a value used for some modems, then C = 2 B log M = 2B x 3 = 18600b/s.

3 Shannon Capacity

Example 3.4 from Stallings, page 81

Suppose the spectrum of a channel is between 3MHz and 4MHz (hence bandwidth of 1MHz) and the SNR = 24dB.

Then absolute SNR = $10^{(24/10)}$ = 251

Using Shannon's formula:

C = 1MHz $\log_2$ (1 + SNR) = 106 x = 8 x 106 = 8Mb/s

This is a theoretical limit, but if we assume we can reach it, then how? Nyquists theorem also tells us:

C = 2B $\log_2$(M)

So 8Mb/s = 2 x 1MHz x $\log_2$(M)

So we need M = 16

That is, our signal needs to be able to carry 16 different levels.