CSE 461 - Winter 2008
HW1 Section Notes

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1. Given these definitions:
   (a) Latency = propagation + transmit + queue
   (b) Propagation = Distance/Speed of Light
   (c) Transmit = Size/Bandwidth
   (d) Bandwidth-delay = One-way Latency × Bandwidth (how big the pipe is)

   Do the following:

2. Given a point-to-point link 100 km in length, what bandwith will propagation delay ($2 \times 10^8\,\mathrm{m\,s^{-1}}$) equal transmit delay?

   Propagation delay is:

$$\frac{100 \times 10^3\,\mathrm{m}}{2 \times 10^8\,\mathrm{m\,s^{-1}}} = 500\,\mu\mathrm{s}$$

   (a) With 100-byte packets:

$$\frac{800\,\mathrm{bits}}{500\,\mu\mathrm{s}} \times \frac{10^6\,\mathrm{s}}{\mu\mathrm{s}} = 1.6\,\mathrm{Mbits\,s^{-1}}$$

   (b) With 512-byte packets:

$$\frac{4096\,\mathrm{bits}}{500\,\mu\mathrm{s}} \times \frac{10^6\,\mathrm{s}}{\mu\mathrm{s}} = 8.2\,\mathrm{Mbits\,s^{-1}}$$

3. Encoding a signal stream:
   - NRZ = simple coding
     - (non-return to zero)
     - What are the problems with this? (clock drift, too many of 1 or 0 will result in drift, incorrect reading)
   - NRZI = switch signal to denote 1, if 0, stay.
     - (non-return to zero inverted)
     - Switch in the middle of bit
     - What's wrong with this? (clock drift, too many zeroes)
   - Manchester = merge clock signal with NRZI
     - Explicitly merges the clock signal with NRZI's 0/1 attitude
     - Always go up-to-down or down-to-up in the middle of a bit
     - What's wrong with this? (almost too explicit, sending twice as much data)

- 4B/5B = Hash bytes to 5-bit codes to maximize transitions.
Data byte	5-bit code
0000	11110
0001	01001
0010	10100
  - Uses NRZI encoding
  - 5-bit codes never have more than 1 leading and 2 trailing zeros
  - Recall that the problem with NRZI is just zeros, this addresses that. (80% efficiency)
  - 6 invalid 5-bit strings, other 7 are control (00000 = dead connection, 11111 = idle, etc)

4. Determining number of sliding window:

   Given:

   - 1.5 Mbps point-to-point connection to the nearest UW satilite
   - one-way latency of 0.5 seconds
   - each frame holds 1 KB of data

   What are the minimum amount of frames needed? How many bits do you need for the stack number?

$$1,500,000\,{}^{\text{bits}}/_{\text{sec}} \times \frac{\text{byte}}{8\,\text{bits}} \times \frac{\text{KB}}{1024\,\text{bytes}} = 180\,{}^{\text{KB}}/_{\text{sec}} \times 1\,\text{sec} = 180\,\text{KB}$$

   We can have 180 KB of data in-flight at any time. The number of frames must at least be twice this (360 frames). The number of bits to describe this is 9 bits.