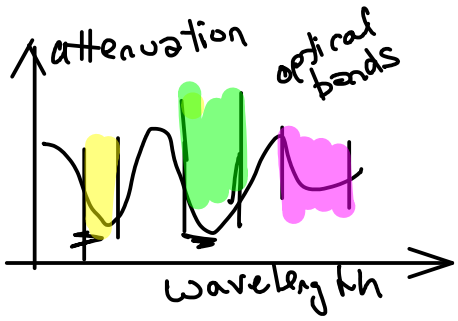
Lecture 12

$1530\ nm = 1530 \times 10^{-9} = 1.530 \times 10^{3} \times 10^{-9} = 1.53 \times 10^{-6}$
$= 1.53\ \mu m$

Exercise 1: Assume there are 5 million people in the Vancouver area and each creates an average of 1 Mb/s Internet traffic. What is the total Internet traffic?

Assuming optical fiber that can carry wavelengths from 1530nm to 1565nm with low loss, what is the bandwidth of one optical fibre?

Could one fibre carry the above data rate assuming 1 b/s/Hz spectral efficiency?



$5 \times 10^{6} \cdot 1 \times 10^{6} = 5 \times 10^{12} = 5\ Tb/s$

people · b/s/person = b/s

f_1 f_2

$f = \frac{c}{\lambda} \approx \frac{3 \times 10^{8}}{1.53 \times 10^{-6}} - \frac{3 \times 10^{8}}{1.565 \times 10^{-6}} = \frac{3 \times 10^{8}}{10^{-6}} \left(\frac{1}{1.53} - \frac{1}{1.565}\right)$

$\approx 4.4 \times 10^{12} \Rightarrow 4.4\ Tb/s$ (almost!)

Exercise 2: What is the bit rate of an STS-1?

$9 \times 90 \times \frac{8}{\text{bits/byte}} \times 8\ kHz = 51.84\ Mb/s$

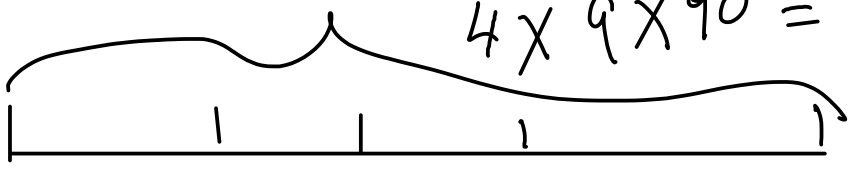
units: rows × columns = bytes/frame; $\frac{\text{frames}}{\text{second}} \rightarrow b/s$

Exercise 3: What are the payload and overhead data rates for STS-1?

payload = $87 \times 9 \times 8 \times 8 \times 10^3 = 50.112$ Mb/s

overhead (Section & line) = $3 \times 9 \times 8 \times 8 \times 10^3 = 1.72$ Mb/s

Exercise 4: What is the maximum timing variation that can be accommodated by pointer variation?



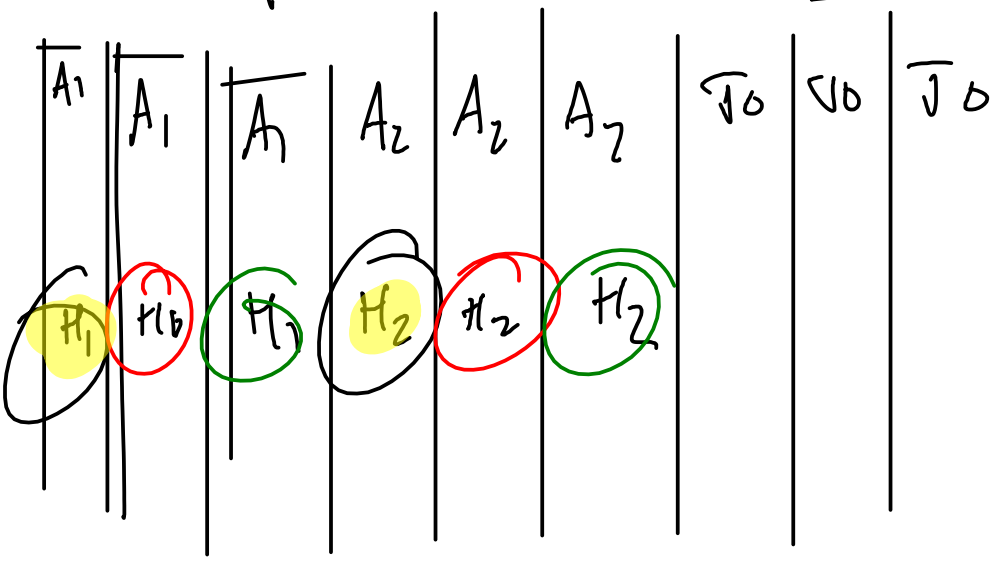
$4 \times 9 \times 90 = 4 \times 810 = 3240$ bytes per 4 frames.

± 1 byte in 4 frames

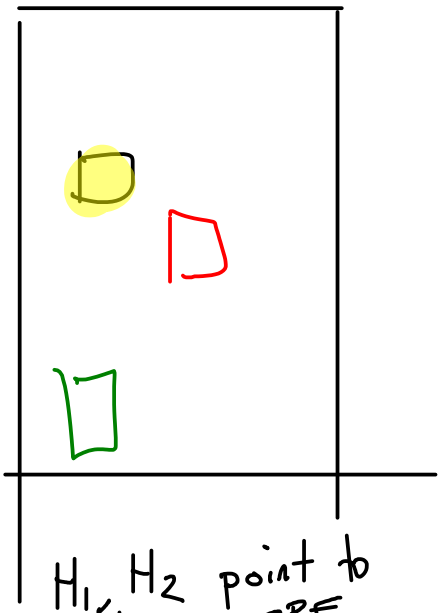
$$\frac{1}{3240} \simeq 0.030 \simeq 3 \times 10^{-4}$$

$\simeq 30$ ppm.

SONET frames are byte-interleaved (STS-3 example)



SPE (synchronous payload envelope)



H_1, H_2 point to start of SPE relative to start of SONET frame (A1 byte)