CS 4390: HW 3

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1 Data Rate Problem

It is desired to send a sequence of computer screen images over optical fiber. The screen is 3840 × 2160 pixels, each pixel being 24 bits. There are 60 screen images per second. What data rate is needed?

$$\text{Data Rate} = \frac{\text{Number of bits}}{\text{Bits per second}}$$

There are $24 \text{ bits} \cdot (3840 \times 2160) = 199{,}065{,}600$ bits per image. Transmitting 60 images per second gives a data rate of data rate is $60 \cdot 199{,}065{,}600 = \underline{1.194 \cdot 10^{10} \text{ bits per second.}}$

2 FDM Multiplexing Problem

Ten signals, each requiring 4000 Hz, are multiplexed onto a single channel using FDM. What is the minimum bandwidth required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

$$\text{Bandwidth} = [\#\text{ of channels} \cdot \text{channel bandwidth}] + [(\#\text{ of channels} - 1) \cdot \text{guard band width}]$$

The minimum bandwidth required is $[10 \cdot 4000\text{Hz}] + [(9) \cdot 400\text{Hz}] = \underline{43{,}600 \text{ Hz.}}$

3 Analog Sampling Data Rate Problem

A 3-kHz (analog) signal is sampled every 1 msec. What is the (minimum) data rate of a digital channel required to carry this signal? Assume that the quantization uses 256 levels.

$$\text{Minimum Data Rate} = 2 \times \text{Bandwidth} \times \log_2(\#\text{ of Q-Levels})$$

The minimum data rate is $2 \times (3 \cdot 10^3) \times \log_2(256) = \underline{48{,}000 \text{ bits per second.}}$

4 Network Topology Problem

5 Copper Wire Price Problem

6 Downstream Bandwidth Problem

7 Sattelite Problem