

Quiz 6: PCM : Pulse Coded Modulation

Name: KEY

Sec. 1

Five television signals (video and audio) with a bandwidth of 4.5 MHz each, are to be transmitted by binary PCM. The signals are sampled at 25% above the Nyquist rate. Samples are quantized into 1024 levels. In every frame, framing and synchronization requires an additional 4% extra bits. A PCM encoder is used to convert these signals before they are time-multiplexed into a single data stream.

- a) Determine the sampling rate and the sampling interval for each channel.

$$\text{Sampling rate: } = 1.25 * \text{Nyquist rate} = 1.25 * 2 * 4.5\text{M} = 11.25 \text{ M samples /sec}$$

$$\text{Sampling interval: } = 1 / \text{sampling rate} = 1 / (11.25 \text{ M}) = 88.88889 \text{ n sec}$$

- b) At the quantizer, how many bits are used to represent each sample.

$$\log_2 1024 = 10$$

- c) In every frame, how many bits are there?

$$5 * (10) * 1.04 = 52 \text{ bits}$$

- d) Determine the data rate of the multiplexed signal.

$$\begin{aligned} \text{Date rate (bits/sec)} &= 52 \text{ bits/sampling interval(sec)} = 52 \text{ bits} * \text{ sampling rate} \\ &= (52)(11.25\text{M}) = 585 \text{ M bits/sec} \end{aligned}$$

- e) Determine the minimum required bandwidth of baseband communication.

$$\text{Min baseband BW} = \text{Rate}/2 = 585 \text{ M} / 2 = 292.5 \text{ M HZ}$$