EE332
Digital Communications
Correction

December 10, 2002

C8-5 Each of 20 analog audio signals of frequency content up to 10 kHz is first transformed into 11-bit digital form. The 20 PCM signals are then time-division-multiplexed together before transmission over a light fiber.

a. Determine the frequency of the transmitter commutator.

Solution: Each audio signal requires sampling at

$$f_S \geq 2f_{\max} = 2(10\,\text{kHz}) = 20\,\text{kHz}.$$

The solution originally posted for this problem reduced the bandwidth to 5 kHz. Doing so would not distort voice appreciably but would noticeably lower the quality of music, for example. Since the problem does not state that the lower bandwidth is sufficient, the full 10 kHz is kept here. With 11 bits per sample, we need

$$\left(11\,\frac{\text{bits}}{\text{sample}}\right)\left(20\,\frac{\text{ksamples}}{\text{s}}\right) = 220\,\text{kbps}$$

for each audio signal. This is the frequency at which the commutator completes a cycle.

b. Determine the minimum transmission bandwidth for the light fiber.

Solution: All 20 channels have the same sampling rate, so we need

$$(20\,\text{channels})\left(220\,\frac{\text{kbps}}{\text{channel}}\right) = 4.4\,\text{Mbps}.$$

This is the bandwidth of the transmission fiber.