Name: Subhojit Ghimire
Sch. Id.: 1912160

Serial : 04	Page No. : 10	Date : 03/11/2021	Remarks :

Q.1. Two channels, one with a bit rate of 100 kbps and another with a bit rate of 300 kbps, are to be multiplexed. How this can be achieved? What is the frame rate? What is the frame duration? What is the bit rate of the link?

Solution: We can allocate one slot to the first channel.
We can allocate three slots to the second channel.
Each frame carries 4 bits.
∴ The frame rate is 100,000 frames per second because it carries only one bit from the first channel.
∴ The frame duration is $\frac{1}{100000}$ s or 10 ms.
∴ The bit rate is 100,000 frames/s × 4 bits per frame, or 400 kbps.

Q.2. Four 2-kbps connections are multiplexed together. A unit is 1 bit. Find (a) the duration of 1 bit before multiplexing, (b) the transmission rate of the link, (c) the duration of a time slot, and (d) the duration of a frame.

Solution: (a) The duration of 1 bit before multiplexing = 1/2 kbps
= 0.0005 s
= 0.5 ms

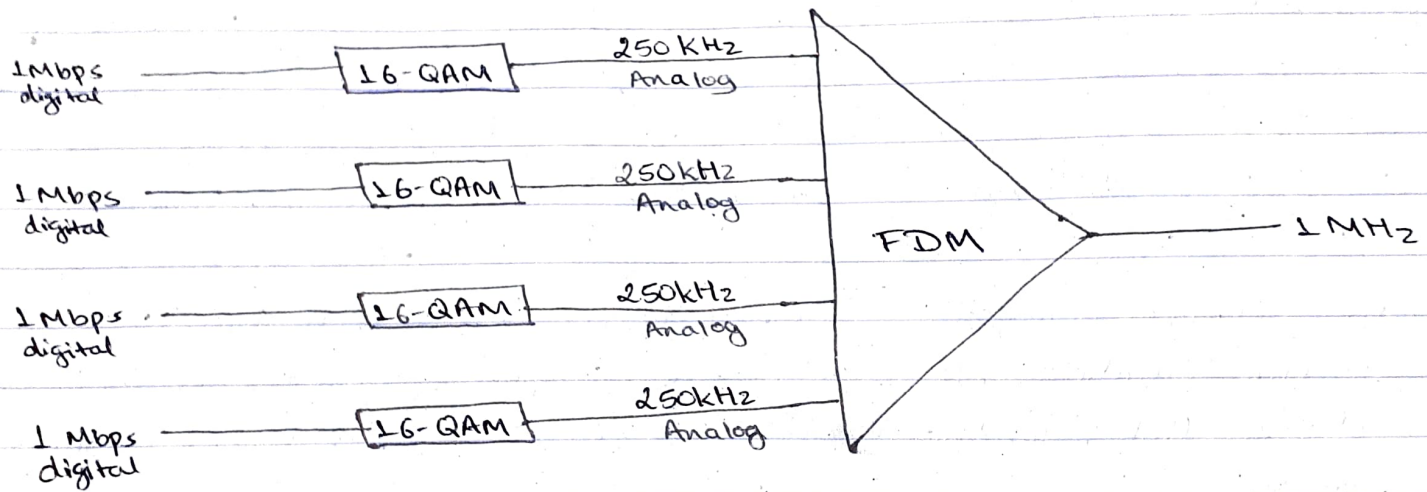
(b) The rate of link is four times the rate of connection = 4 × 2 kbps
= 8 kbps.

(c) The duration of time slot is one-fourth of the duration of each bit before multiplexing, i.e., $\frac{1}{4} \times 0.5$ ms = 0.125 ms
= 125 μs.

(d) The duration of frame is the same as the duration of a unit before multiplexing, i.e., 0.5 ms
= 500 μs

Q.3. Four data channels (digital), each transmitting at 1 Mbps, use a satellite channel of 1 MHz. Design an appropriate configuration, using FDM.

Solution: The satellite channel is analog.
Four data channels each with $\frac{1}{4}$ MHz = 250 KHz bandwidth.
Each digital channel is 1 Mbps, and each is modulated such that each 4 bits is modulated to 1 Hz.
So, 16-QAM Modulation:



Q.4. We have five sources, each creating 150 characters per second. If the interleaved unit is a character and 1 synchronising bit is added to each frame, find (a) the data rate of each source, (b) the duration of each character in each source, (c) the frame rate, (d) the duration of each frame, (e) the numbers of bit in each frame, and (f) the data rate of the link.

Solution: (a) Data Rate of each source = 150 × 8 = 1200 bps
(b) Duration of each character in each source = $\frac{1}{150}$ s = 6.66 ms
(c) Frame Rate = 150 frames per second.
(d) Duration of each frame = $\frac{1}{150}$ s = 6.66 ms.
(e) Numbers of bit in each frame = 4×8 + 1 = 33 bits
(f) Data Rate of the link = 150 × 33 = 4950 bps

Q.5. Assume that a voice channel occupies a bandwidth of 4KHz. We need to multiplex 10 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.

Solution: To multiplex 10 voice channels, we need 9 guard bands.

∴ The required bandwidth = (4KHz) × 10 + (500 Hz) × 9

= 44.5 KHz

Q.6. Three channels, each with a 100KHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 10KHz between the channels to prevent interference?

Solution: For three channels, at least 2 guard bands required.

∴ Minimum bandwidth of the link = 100×3 + 10×2

= 320 kHz

Q.7. Four channels are multiplexed using TDM. If each channel sends 400 bytes/s and we multiplex 1 byte per channel, show the frame travelling on the link, the size of the frame, the duration of a frame, the frame rate, and the bit rate for the link.

Solution: The size of the frame = 4×1 = 4 bytes = 32 bits.

The frame rate = $\frac{400}{4}$ = 100 frames per second.

The duration of the frame = $\frac{1}{100}$ = 0.01 s = 10 ms

The bit rate for the link = 100 × 32 = 3200 bps.