Four 1 Kbps devices are to be multiplexed using synchronous TDM. The multiplexor will take one bit from each source during each cycle. Find

a) The duration of the bit before multiplexing
b) The duration of the bit after multiplexing
c) The duration of the multiplexed frame
d) The multiplexer bit rate
e) The multiplexer frame rate.

Duration of bit before MUX = 1/1K = 1 msec
Multiplexer bit rate is 4x1K = 4Kbps and hence the bit duration at output of MUX is 1/4K = 0.25 msec
Duration of multiplexed frame is 4x0.25msec = 1msec
Frame rate is 1/1msec = 1000 frames/sec

We have 14 sources, each creating 500 8-bit characters per second. Since only some of these devices are active at any moment, a statistical TDM, using character interleaving, is used to aggregate these sources. Each frame consists of 6 time slots (each time slot will support a character). Four bits of overhead (address) are added to each character in each time slot.

a) The number of bits in the multiplexed frame
b) The multiplexer frame rate
c) The duration of the multiplexed frame
d) The multiplexer bit rate

a. Frame size = 6 × (8 + 4) = **72 bits**.
b. We can assume that we have only 6 input lines. Each frame needs to carry one character from each of these lines. This means that the frame rate is **500 frames/s**.
c. Frame duration = 1 /(frame rate) = 1 /500 = **2 ms**.
d. Data rate = (500 frames/s) × (72 bits/frame) = **36 kbps**.

Find the number of devices that can be supported by a synchronous T1 (a T1 is at a rate of 1.544 Mbps)

type synchronous TDM line if 1% of the line capacity is reserved for synchronization purposes.

a) 110-bps teleprinter terminals,
b) 300-bps computer terminals,
c) 1200-bps computer terminals,
d) 9600-bps computer output ports,
e) 64-kbps PCM voice frequency lines.

How would these numbers change if each of the sources were operational an average of 10% of the time? In this case, there will be statistical TDM usage and the line should be utilized at most up to 80% of its capacity.

T1 line : 1.544 Mbps, and 1% is used for synchronization purposes, remaining is 1.544 Mbps x 0.99 = 1,528,560 bps

(a) N = 1,528,560 bps/110 bps = 13,896
(b) N = 1,528,560 bps/300 bps = 5,095
(c) N = 1,528,560 bps/1200 bps = 1,273
(d) N = 1,528,560 bps/9600 bps = 159
(e) N = 1,528,560 bps/64 Kbps = 23

If the sources are operational 10% of the time, then, we can connect 10 times more of those devices to the T1 line
If we are further required to have only 80% utilization of the link, then we can increase the number of devices to 8 times more, rather than 10 times.