Department of ICT, MIT, Manipal
Principles of Data Communication [ICT 2156]
Tutorial 9

1. Twenty-four voice signals are to be multiplexed and transmitted over twisted pair. What is the bandwidth required for FDM? Assuming a bandwidth efficiency (ratio of data rate to transmission bandwidth, as explained in Chapter 5) of 1 bps/Hz, what is the bandwidth required for TDM using PCM? Each voice signal requires a data rate of 64 kbps.

2. A character-interleaved time division multiplexer is used to combine the data streams of a number of 110 bps asynchronous terminals for data transmission over a 2400-bps digital line. Each terminal sends asynchronous characters consisting of 7 data bits, 1 parity bit, 1 start bit, and 2 stop bits. Assume that one synchronization character is sent every 19 data characters and, in addition, at least 3% of the line capacity is reserved for pulse stuffing to accommodate speed variations from the various terminals.

   a. Determine the number of bits per character.
   b. Determine the number of terminals that can be accommodated by the multiplexer.
   c. Sketch a possible framing pattern for the multiplexer.

3. Find the number of the following devices that could be accommodated by a TDM line of capacity 1.544Mbps if 1% of the line capacity is reserved for synchronization purposes.
   a. 110-bps teleprinter terminals
   b. 300-bps computer terminals

4. Ten 9600-bps lines are to be multiplexed using TDM. Ignoring overhead bits in the TDM frame, what is the total capacity required for synchronous TDM? Assuming that we wish to limit average TDM link utilization to 0.8, and assuming that each TDM link is busy 50% of the time, what is the capacity required for statistical TDM?