

Synchronous Time Division Multiplexing

Radhika Sukapuram

October 5, 2020

Synchronous time-division multiplexing

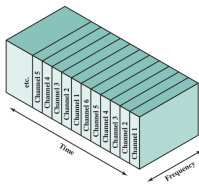


Figure: TDM

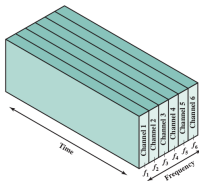
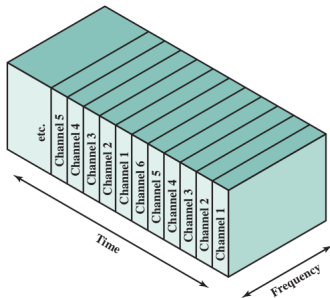


Figure: FDM

Synchronous time-division multiplexing

- Synchronous time-division multiplexing is possible when the achievable data rate of the medium exceeds the data rate of the signals to be transmitted
- Multiple digital signals (or analog signals carrying digital data) can be carried on a single transmission path by interleaving portions of each signal in time.
- Interleaving can be in bits, bytes or blocks of data

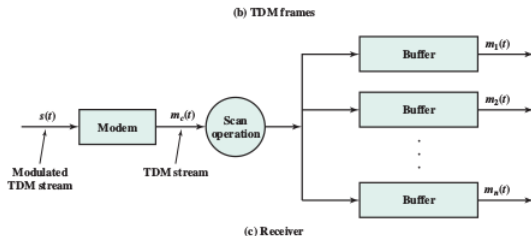
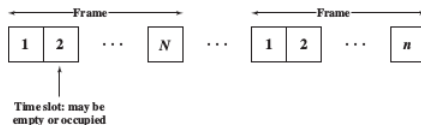
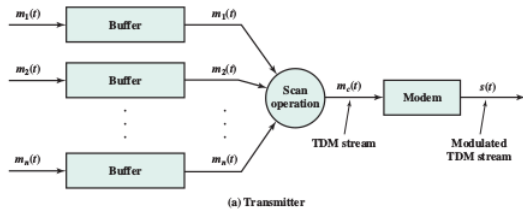
Question



If each input above is 1 Mbps, the line to carry them must at least have a capacity of

- (A) 1 Mbps
(B) 6 Mbps
(C) 2 Mbps

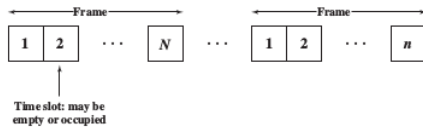
Synchronous TDM System



Synchronous TDM System

- Each buffer is typically one bit or one character in length
- Buffers are scanned sequentially
- The data rate of $m_c(t)$ must atleast equal the sum of the data rates of the $m_i(t)$

Synchronous TDM System



(b) TDM frames

- Data are organized into frames
- Each frame has a cycle of time slots
- In each frame one or more time slots is dedicated to each data source
- The sequence of slots dedicated to one source, from frame to frame, is called a channel
- The slot length equals the transmitter buffer length, typically a bit or a byte (character)

Synchronous TDM

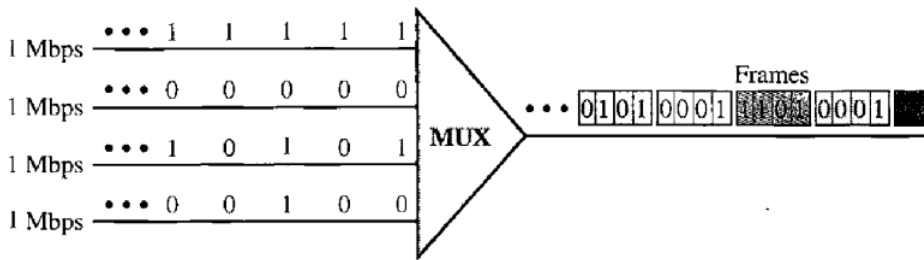
- Called synchronous not because synchronous transmission is used, but because the time slots are preassigned to sources and fixed.
- Time slots of each source — transmitted even if there is no data to send
- True with FDM too
- Capacity is wasted to achieve simplicity of implementation

Question

When fixed assignment is used, it is possible for a synchronous TDM device to handle sources of different data rates. How can this be done?

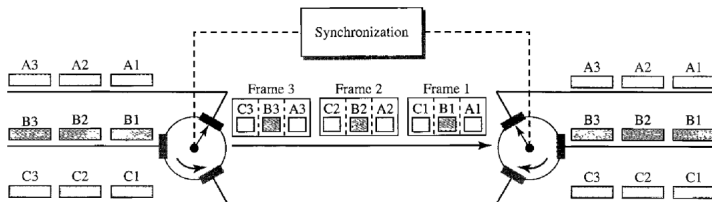
- (A) The slowest input device could be assigned one slot per cycle, while faster devices are assigned multiple slots per cycle.
- (B) The fastest input devices could be assigned one slot per cycle, while slower devices are assigned multiple slots per cycle.

Question



The figure shows a TDM system with one data stream for each input and one data stream for the output. The unit of data is 1 bit. Find a) the input bit duration b) the output bit duration c) the output bit rate and d) the output frame rate.

Synchronous TDM System

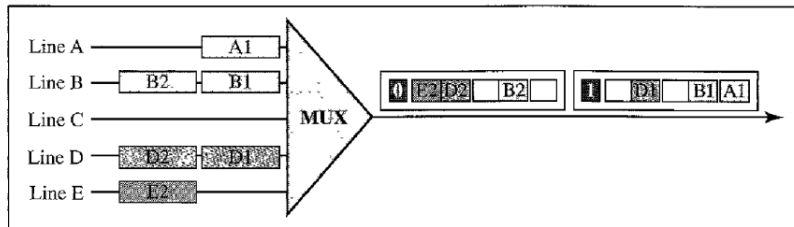


- TDM can be visualised as two fast-rotating switches
- The switches are synchronized
- One is on the sending side and the other on the receiving side
- They enable sending/receiving 1 unit of data on the line
- This process is called interleaving

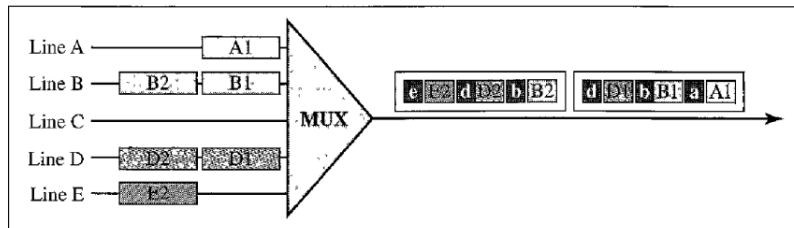
Question

Four channels are multiplexed using TDM. If each channel sends 100 bytes/s and we multiplex 1 byte per channel, find a) the size of the frame b) the duration of a frame c) the frame rate and d) the bit rate for the link

Statistical TDM



a. Synchronous TDM



b. Statistical TDM

- Dynamically allocates time slots on demand
- There are n I/O lines, but only k , where $k < n$ timeslots available on the TDM frame
- There are no pre-assigned or reserved slots — the address of the receiver needs to be included per slot
- Addressing can be x bits to define N different output lines where $x = \log_2 N$

Statistical TDM

- A slot carries address and data — therefore the ratio of the data size to address size must be reasonable to make transmission efficient
- The frames in statistical TDM need not be synchronized, so we do not need synchronization bits
- In statistical TDM, the capacity of the link is normally less than the sum of the capacities of each channel