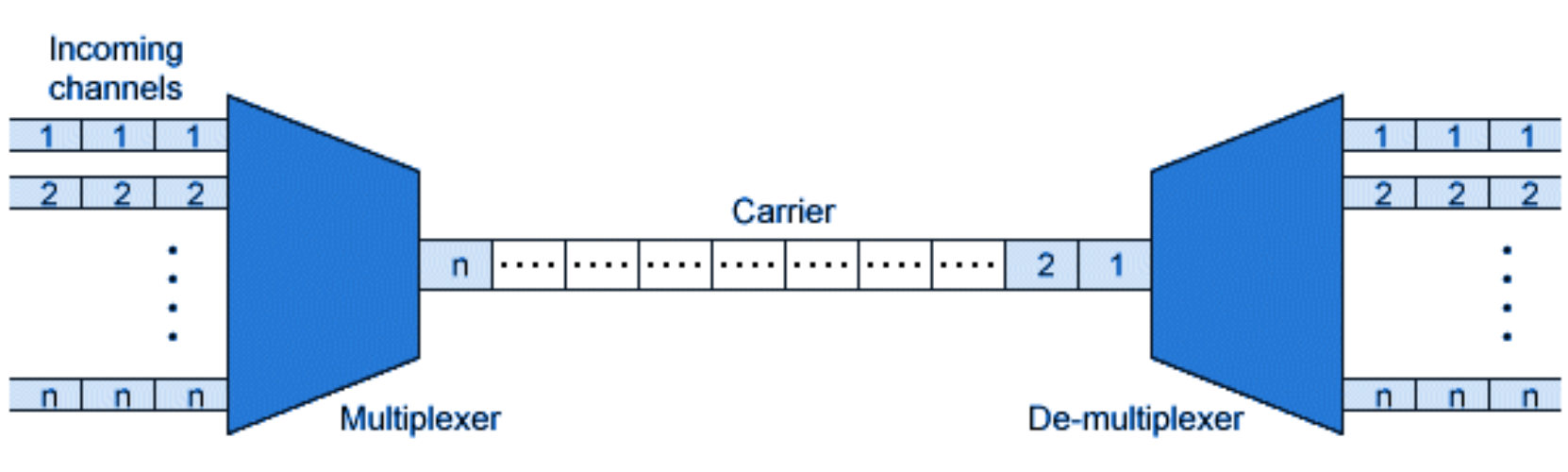
MULTIPLEXING



Presented by:
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INTRODUCTION

- Under the simplest conditions, a medium can carry only one signal at any moment in time
- If we try to pass multiple signals through a common medium , they will possibly interfere with each other.
- When two or more signals with same frequency pass at the same time through a common medium the interference phenomena occurs

INTRODUCTION

- This means we have to devise a way to avoid the interference of the signals

- Which means that multiple signals
  i. Should have different frequency
  ii. Must not travel at same time
  iii. Must not travel through same medium

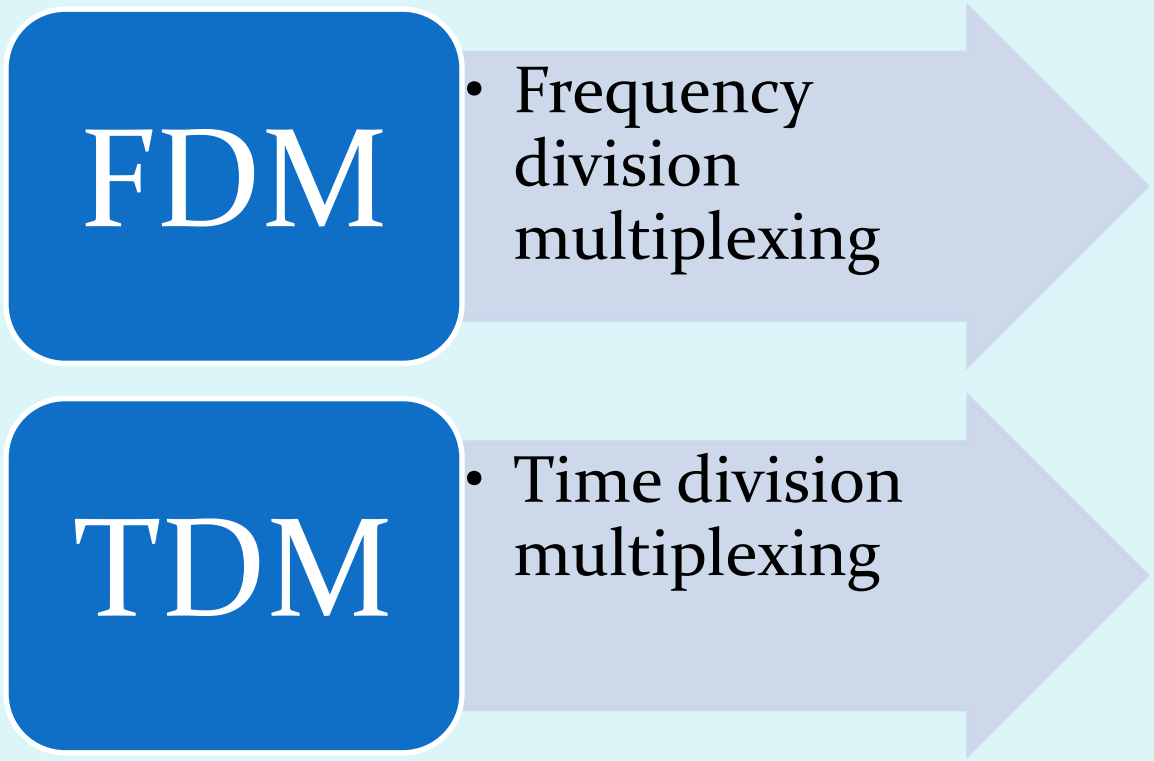
- For multiple signals to share a medium , the medium must somehow be divided , so that each signal receives a portion of the total bandwidth.

Need for MULTIPLEXING

- Transmission services are very expensive (leased lines , packet switched networks)
- Multiplexing and compression techniques save the business money
- As the data capacity of line increases , it will become more cost effective for a company
- Most data services require modest data rate support

TYPES

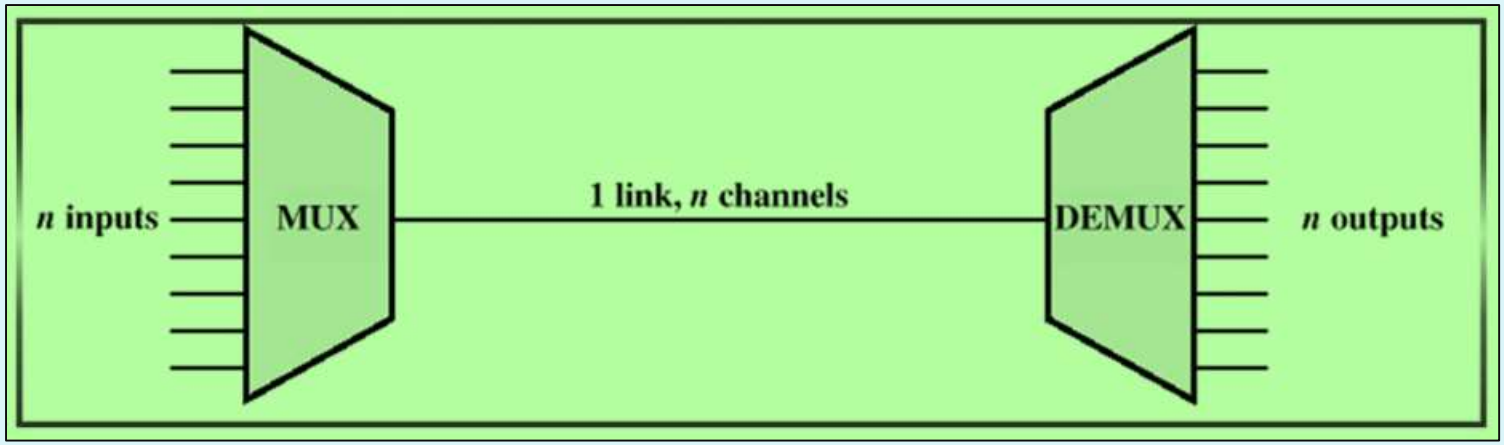
The current techniques that can accomplish multiplexing includes :



MULTIPLEXING

- Multiplexing is nothing but sharing of medium

Multiplexor (MUX)
De-multiplexor(DEMUX)
Sometimes just called a MUX



Simple block diagram of Mux-Demux pair

Frequency Division Multiplexing

- Frequency spectrum is divided among multiple logical channels

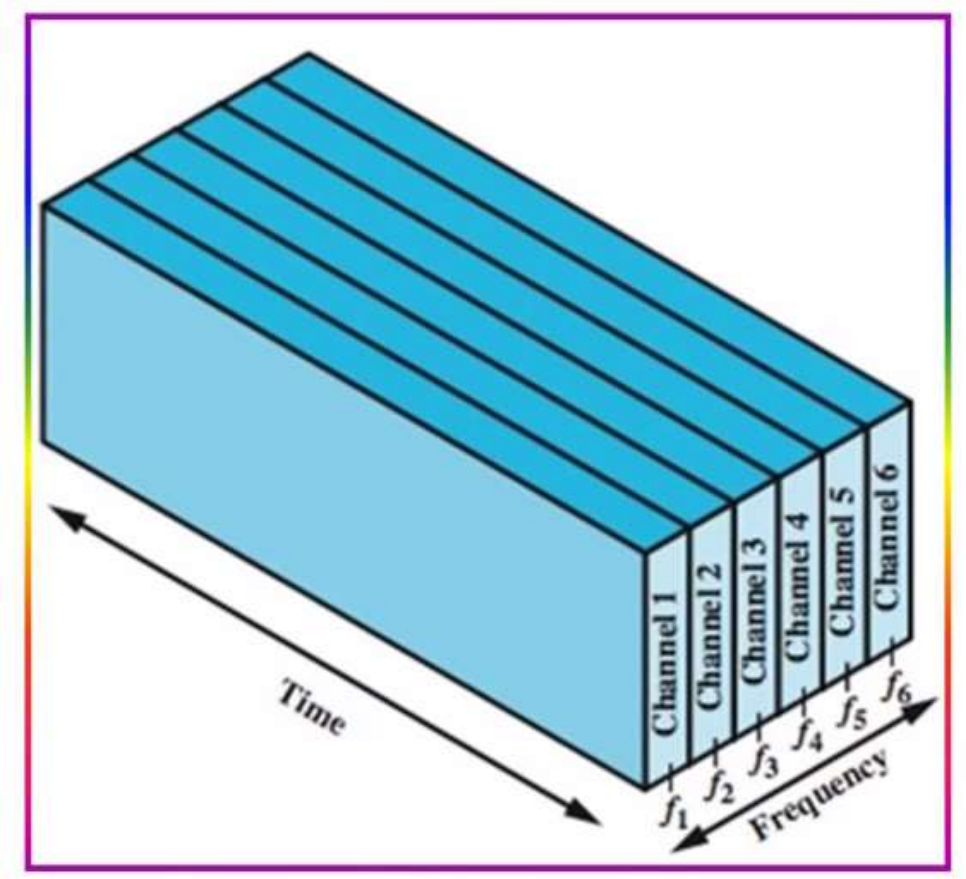
- Each user can have access to its own assigned frequencies or logical channels at all the time that the individual user is active

Frequency division multiplexing

f_1= Lowest frequency of the band

f_6= Highest frequency of the band

f_n= subcarrier frequency



Logic diagram

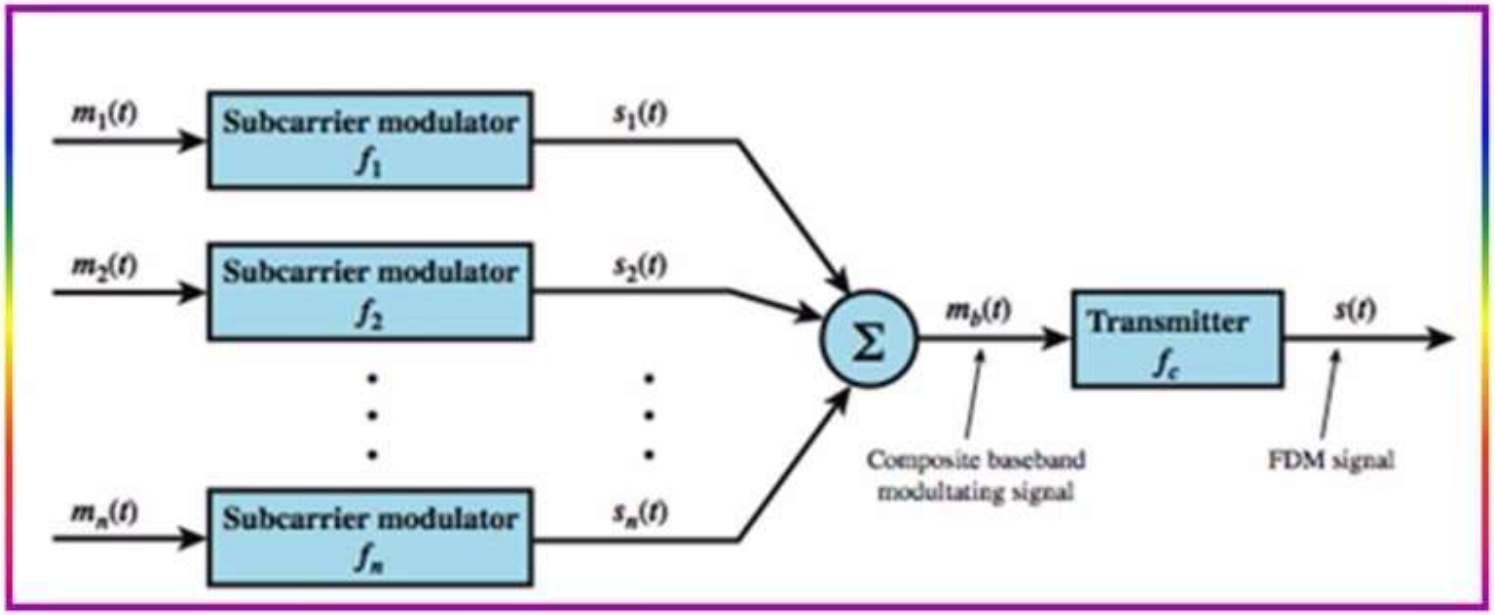
Frequency division multiplexing

- Sends the signal in several distinct frequency ranges
- Each signal is modulated on the different carrier frequency which are separated by guard bands
- The bandwidth of the transmission medium must exceed the required bandwidth of all signals

Frequency division multiplexing

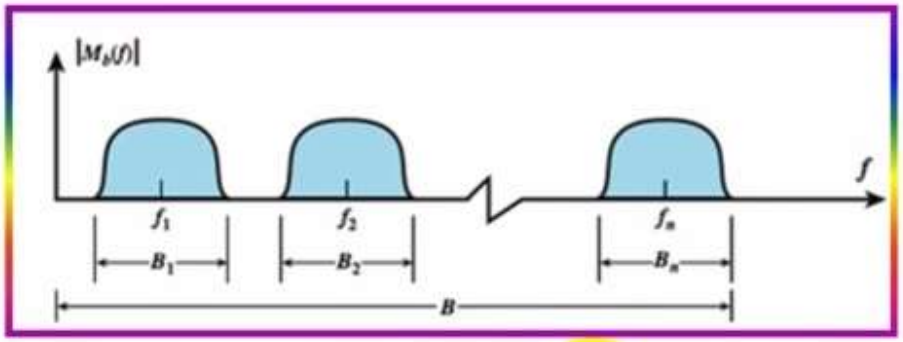
- Used in cable TV to carry multiple video channels on a single cable network
- Broadcast radio and TV and the AMPS cellular phone systems use FDM
- Since it involves analog signaling , it is more susceptible to noise
- This is the oldest technique of multiplexing

FDM System Transmitter



Transmitter

Spectrum of composite baseband modulating signal



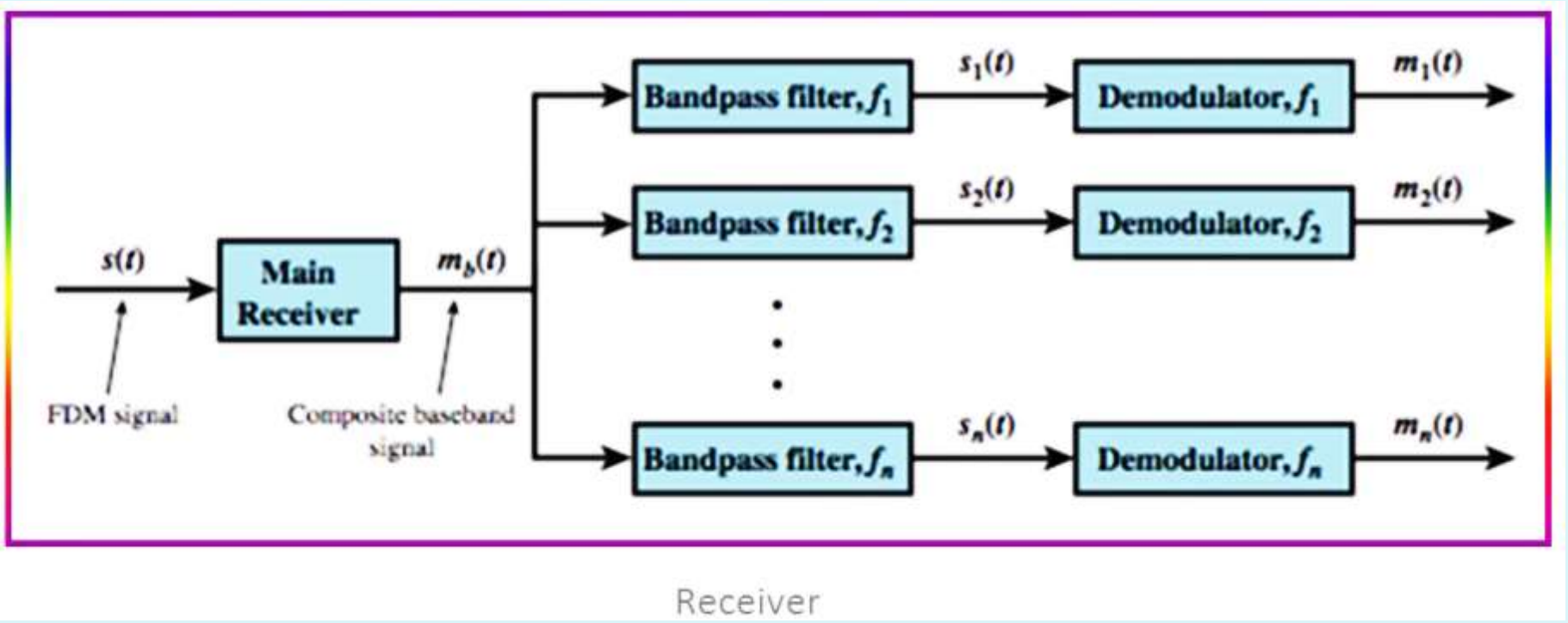
FDM System Transmitter

- In FDM each user is assigned non-overlapping frequency ranges so that multiple signals can be transmitted at the same time

- Multiple message signals $\{m_1(t), m_2(t)...m_n(t)\}$ from multiple sources are modulated over different subcarrier frequencies $(f_1,f_2...f_n)$ and send them to an adder

- Now this composite signal (Adder output) is modulated over carrier frequency (f_c) and transmitted over channel

FDM System Receiver



Receiver

FDM System Receiver

- In FDM receiver we first get the transmitted which was modulated using carrier frequency (f_c) and then pass this composite signal through suitable band-pass filters

- These band-pass filters have the same frequency as the subcarriers of FDM transmitters

- Now these signals $s_1, s_2 \ldots s_n$ are passed through respective demodulators to get the actual message signals $\{m_1(t), m_2(t) \ldots m_n(t)\}$

Disadvantages of FDM

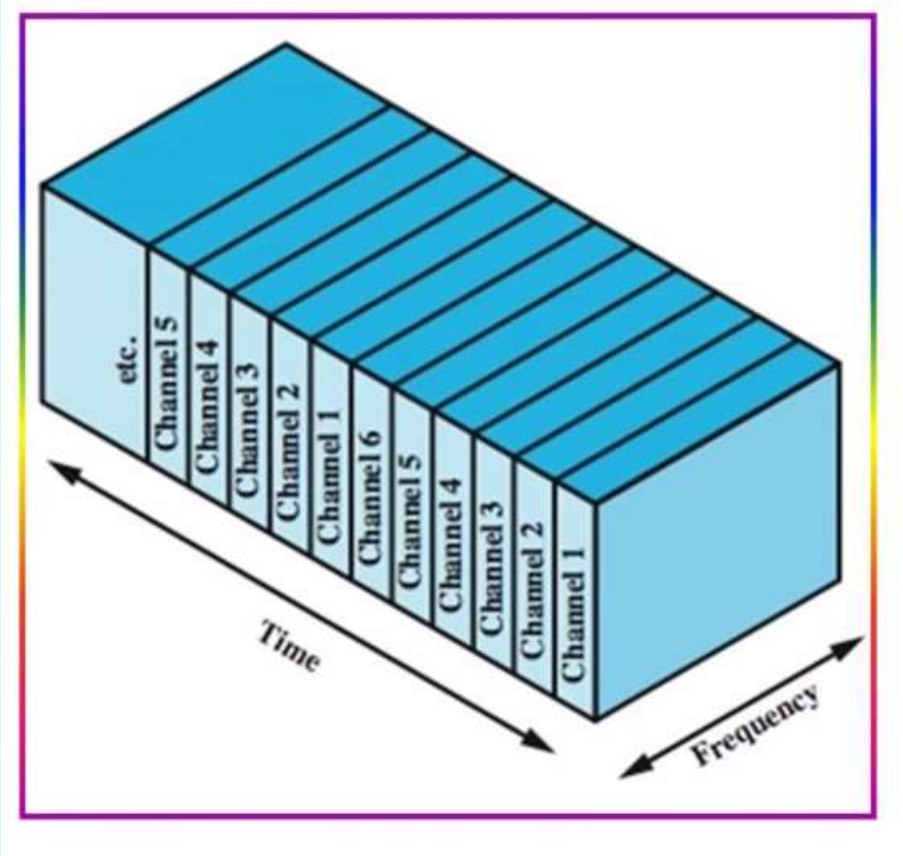
- The problem with FDM is that it cannot utilize the full capacity of the system
- We need to ensure that the adjacent bands do not overlap each other , otherwise the signal in one band may interfere the signal in other band
- Although system has the capacity still in some cases the channel cannot pass the actual signal

TIME DIVISION MULTIPLEXING

- In Time division multiplexing the time is divided into multiple smaller units called slots and each user is given a slot to transmit the signal

- Each user has the entire bandwidth of the channel for a short interval of time

TIME DIVISION MULTIPLEXING

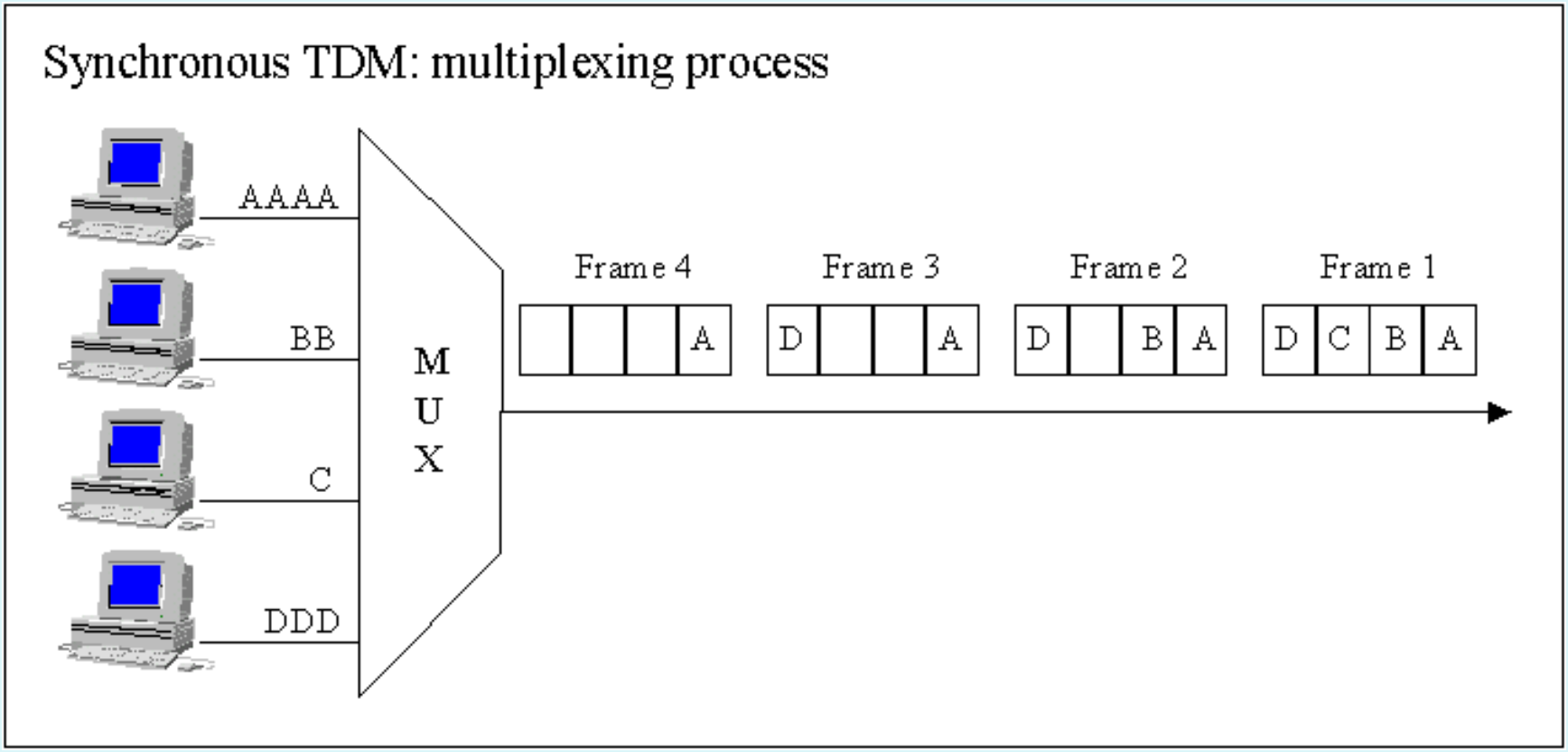


Logic diagram

TIME DIVISION MULTIPLEXING

- Used for digital signals or analog signals carrying digital data
- Data rate of the transmission medium must exceed the required data rate of all the signals
- Clock synchronization is one of the major issue in TDM systems as a small mismatch in the timing may ruin the utility of overall system

Synchronous TDM



Asynchronous TDM

Asynchronous TDM

- In this method, slots are not fixed. They are allotted dynamically depending on speed of sources, and whether they are ready for transmission.