

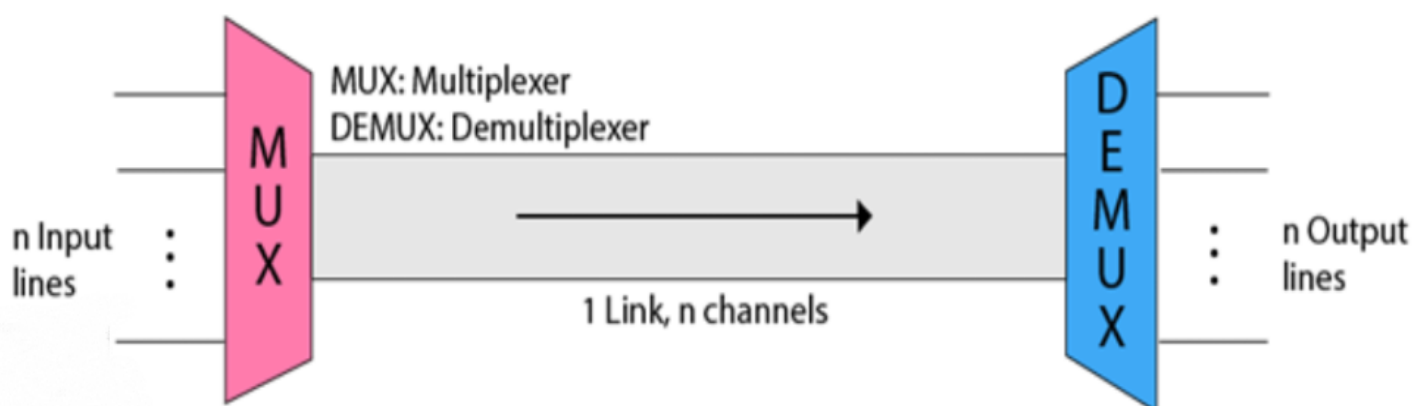
# Multiplexing

Multiplexing is a technique used to combine and send the multiple data streams over a single medium. The process of combining the data streams is known as multiplexing and hardware used for multiplexing is known as a multiplexer.

Multiplexing is achieved by using a device called Multiplexer (**MUX**) that combines  $n$  input lines to generate a single output line. Multiplexing follows many-to-one, i.e.,  $n$  input lines and one output line.

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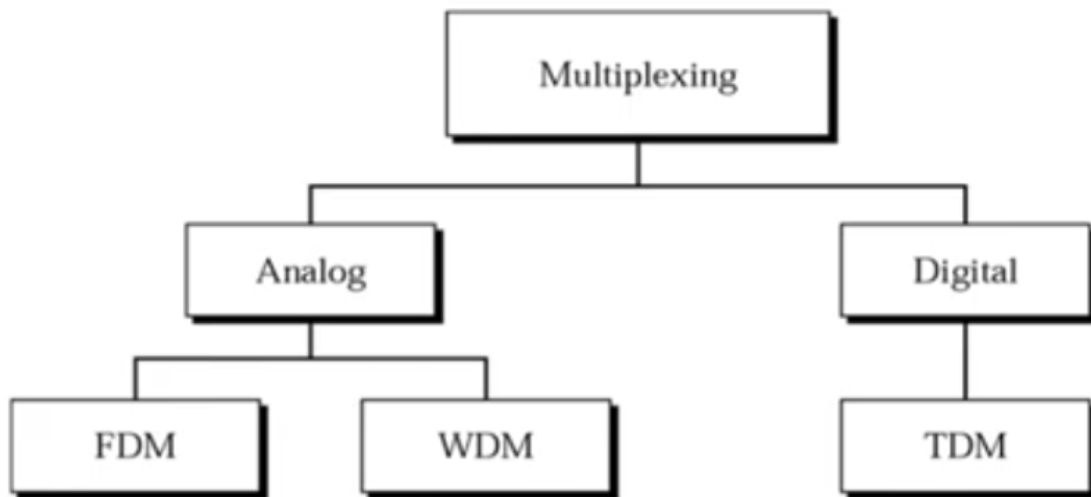
Demultiplexing is achieved by using a device called Demultiplexer (**DEMUX**) available at the receiving end. DEMUX separates a signal into its component signals (one input and n outputs). Therefore, we can say that demultiplexing follows the one-to-many approach.



When multiple senders try to send over a single medium, a device called Multiplexer divides the physical channel and allocates one to each. On the other end of communication, a De-multiplexer receives data from a single medium, identifies each, and sends to different receivers.

When multiple signals share the common medium, there is a possibility of collision. Multiplexing concept is used to avoid such collision.

## Types of Multiplexing

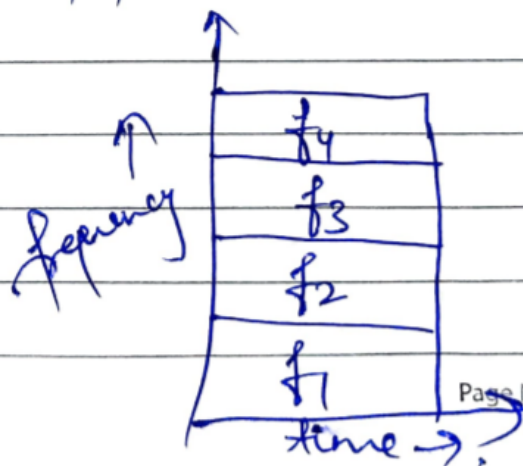


## FDMA (Frequency Division Multiplexing)

It is a technique by which the total bandwidth available in a communication medium is divided into a series of non-overlapping frequency bands, each of which is used to carry a separate signal.

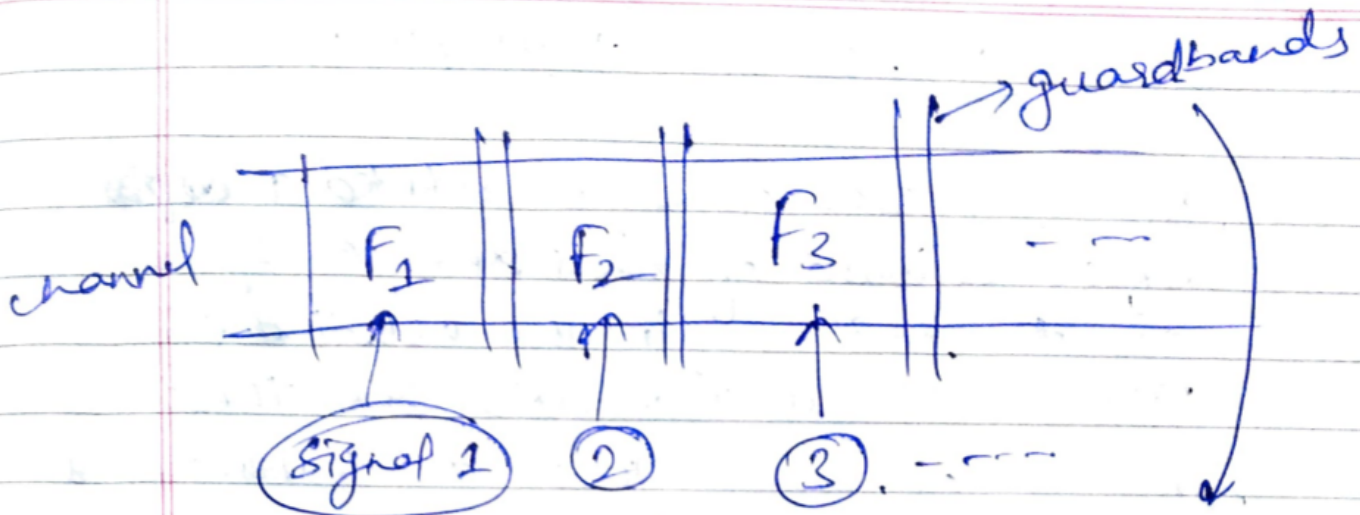
It combines more than one signal over a shared medium. Signals of different frequencies are combined for concurrent transmission.

In FDM, all the signals operate at the same time with different frequencies.



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so that frequencies of different signals do not interfere or results in reduction of interference

Adv.

- ① Simple to understand
- ② Implementation is easy

Disadvantage-

- ① Interference can happen even after using guardbands.  
Eg. Telephone connection crosstalk.

## **Applications of FDM**

- FDM is commonly used in TV networks.
- FDM is used for FM & AM radio broadcasting.

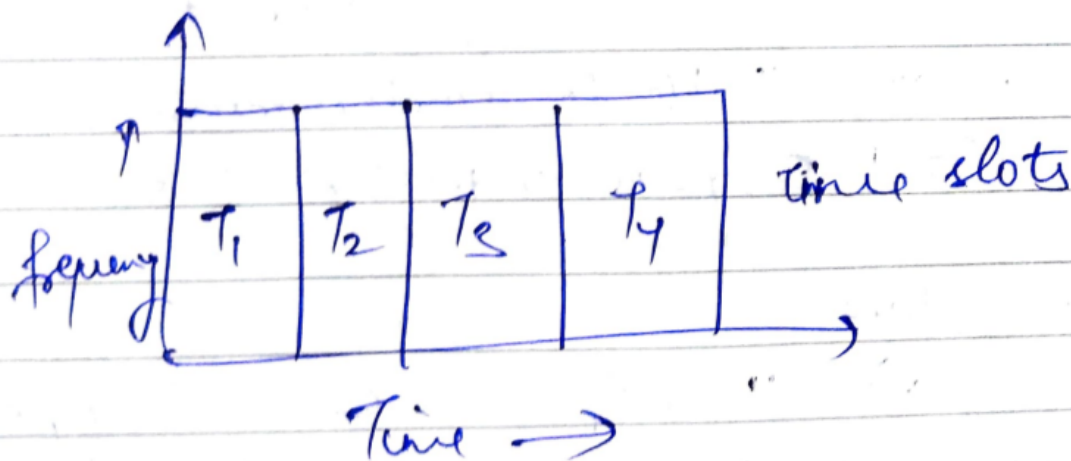


## Time Division Multiplexing

In TDM, each signal is allotted a ~~definite~~ definite amount of time and the signal can transmit within the allotted time.

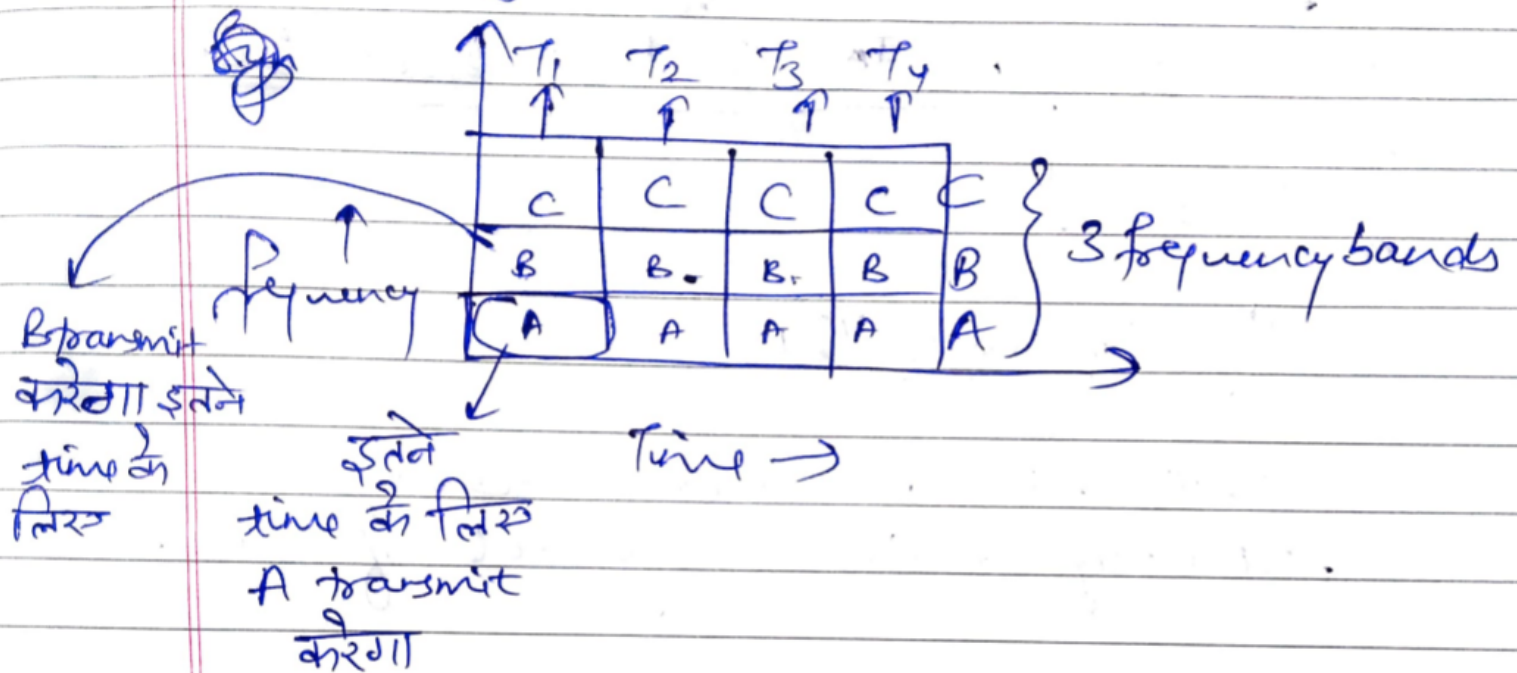
Time is divided into slots and these slots are so small that all transmissions appear to be parallel.

In TDM all the signals operate with same frequency at different times.



No guard bands are required in this Multiplexing tech.

We can divide these time slots into bands of frequency so as to increase its usability.



Earlier, whole time slot was allotted to one channel, but now time slot can be divided.

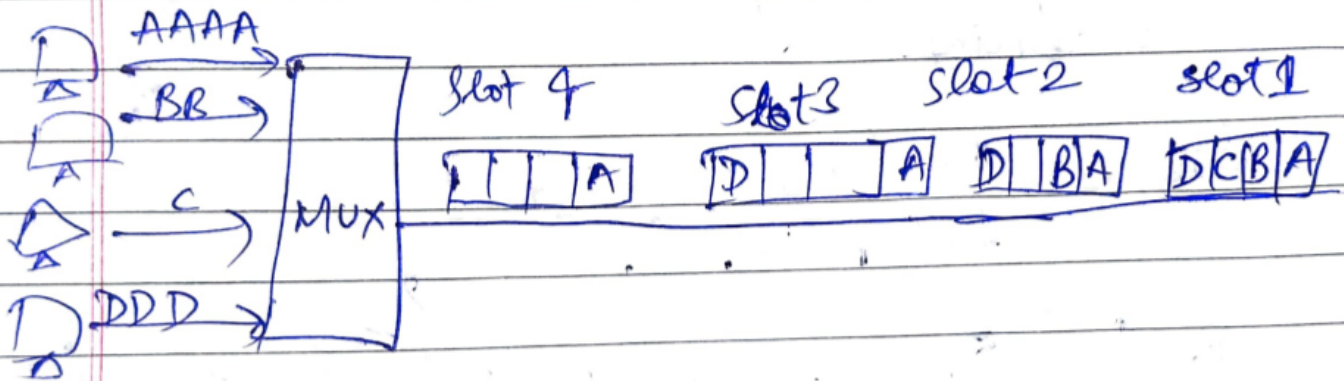
### Synchronous TDM -

The time slots are pre-assigned & fixed. This slot is even given if the source is not ready with data at the allotted time.



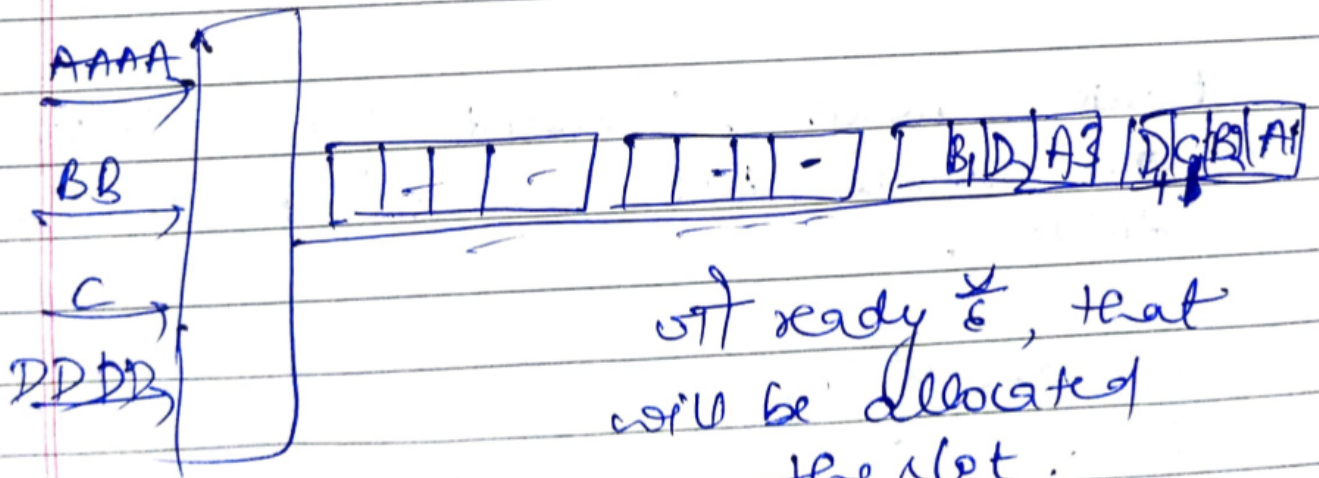
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In this case, the slot is transmitted empty



### Asynchronous TDM -

Slots are allocated dynamically depending on the ready state of source.



If ready, that will be allocated the slot.

11. TDM is used in Satelite Acess system.

12. TDM is used in Cellular Radio.

6. In Half Duplex Communication system, TDM or Time Division Multiplexing is used.

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## Wavelength Division Multiplexing

WDM is a technology that multiplexes a number of optical signals onto a single optical fiber by using different wavelengths. Two way communication is possible for Telecommunication companies

Figure 1 schematically shows a typical WDM transmission system. At the transmitter side, multiple optical transmitters – each emitting at a different wavelength – individually send signals and these signals are multiplexed by a wavelength multiplexer (MUX). The multiplexed signals are then transmitted over one main transmission line (**optical fiber** cable). At the receiver side, the signals are de-multiplexed by a wavelength de-multiplexer (DEMUX) and sent to multiple receivers.

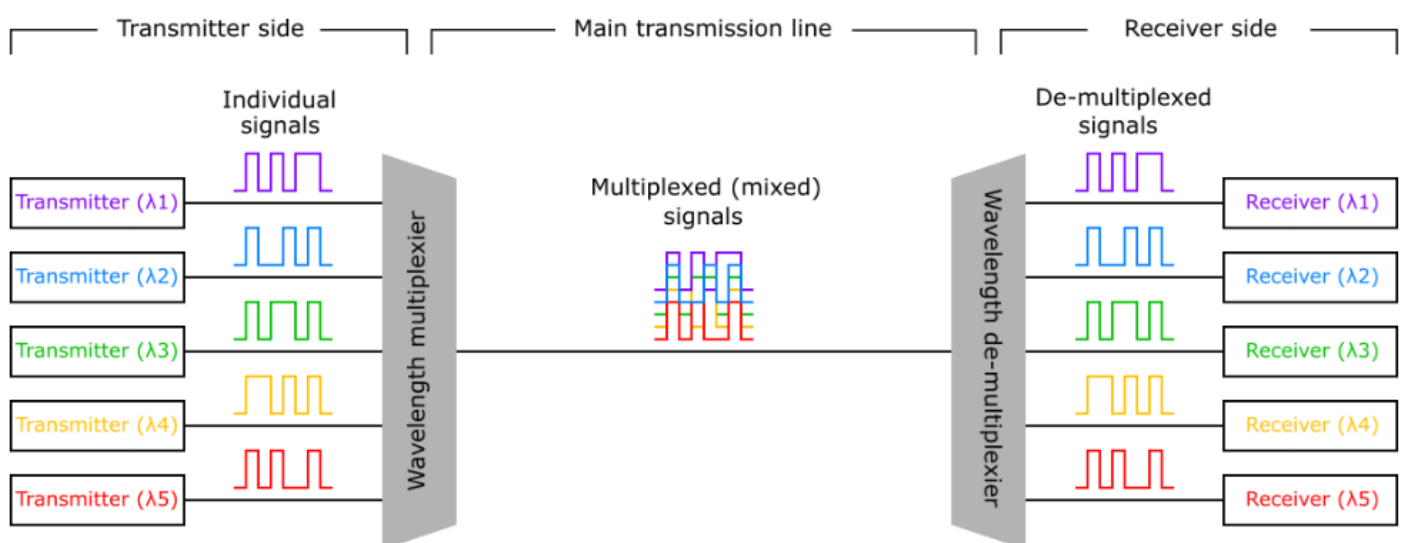


Figure 1: Schematic of WDM transmission system.