Computer Network

Lecture-15

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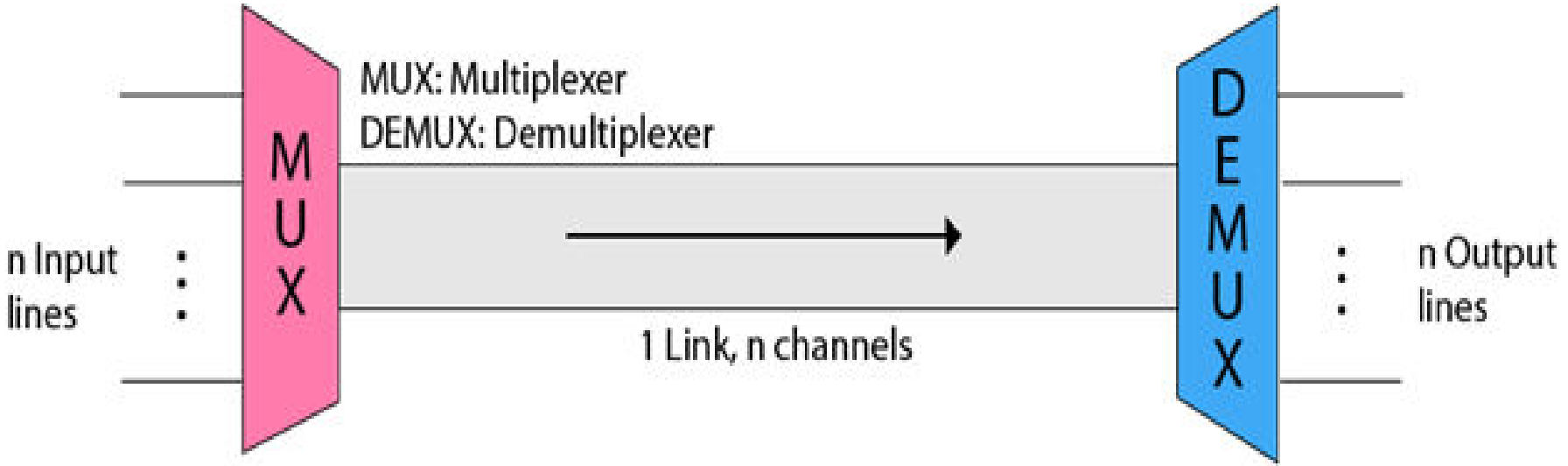
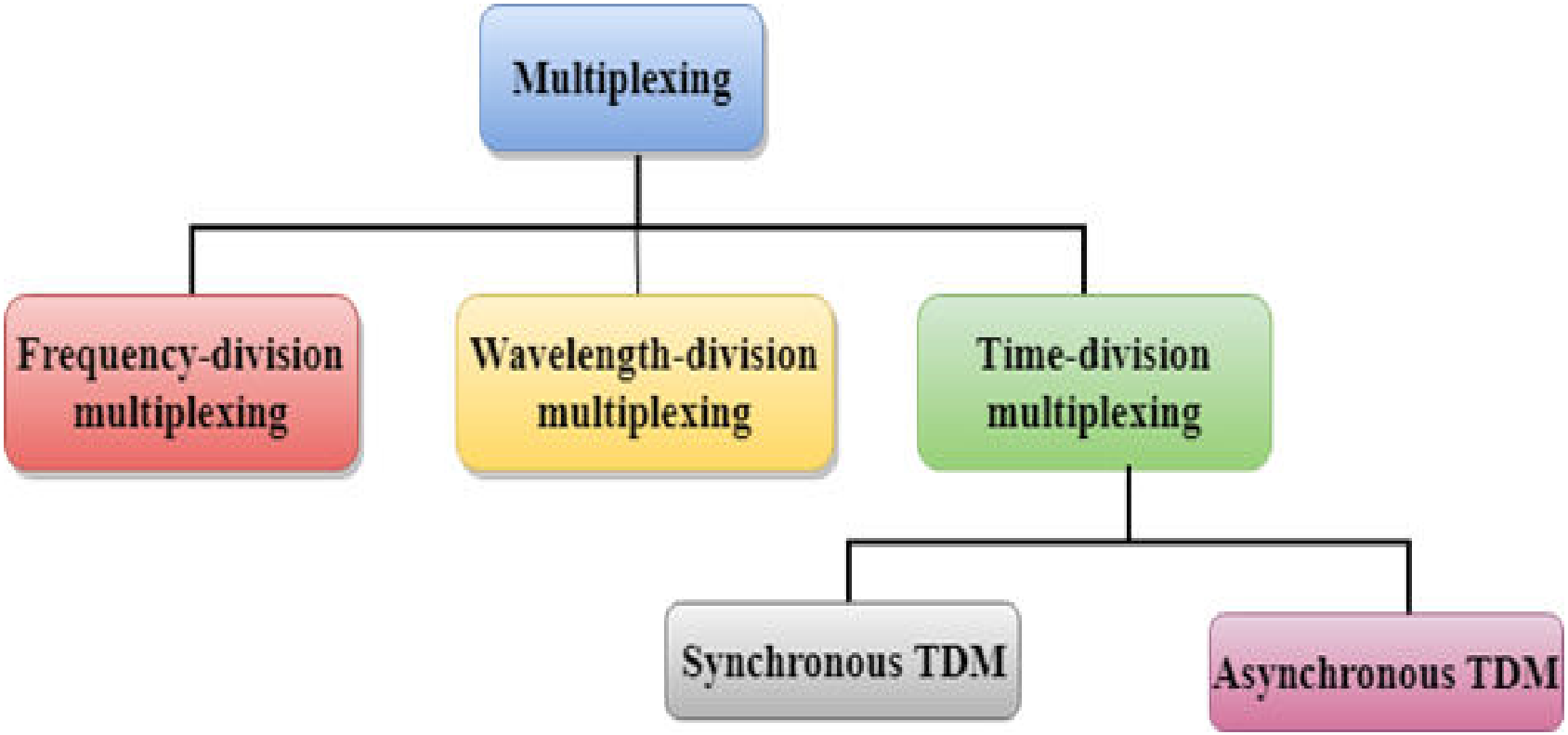
Multiplexing

- Multiplexing is a technique used to combine and send the multiple data streams over a single medium.
- 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.
- 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.



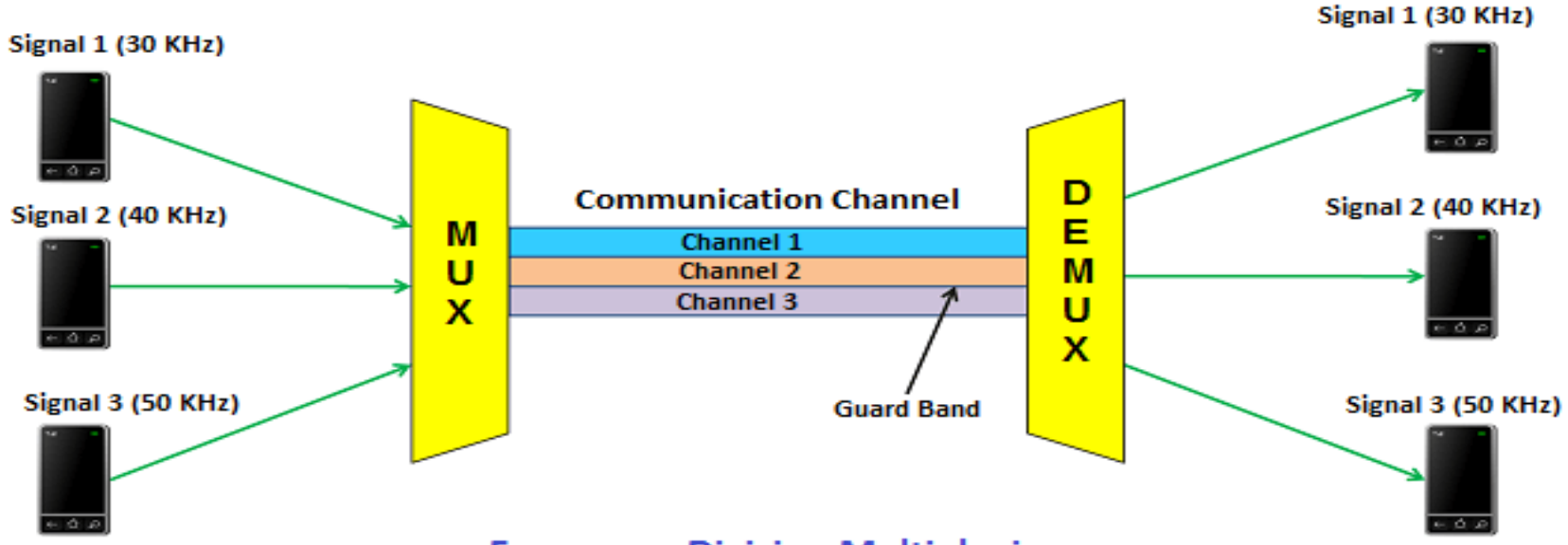
Multiplexing

There are three basic multiplexing techniques: frequency-division multiplexing, wavelength-division multiplexing, and time-division multiplexing. The first two are techniques designed for analog signals, the third, for digital signals.



Frequency-division Multiplexing (FDM)

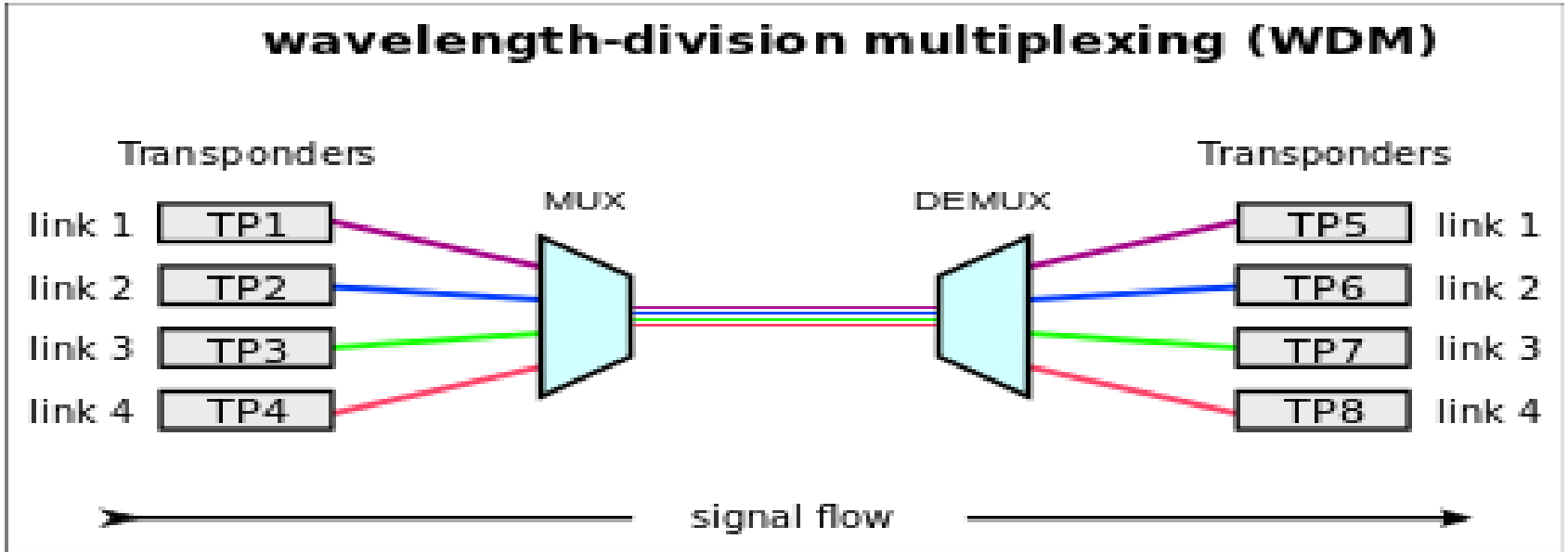
- Frequency Division Multiplexing is a technique in which the available bandwidth of a single transmission medium is subdivided into several channels.
- Frequency-division multiplexing (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted.
- The main aim of the FDM is to subdivide the available bandwidth into different frequency channels and allocate them to different devices.
- FDM is mainly used in radio broadcasts and TV networks.



Frequency Division Multiplexing

Wavelength Division Multiplexing (WDM)

- Wavelength Division Multiplexing is same as FDM except that the optical signals are transmitted through the fiber optic cable.
- WDM is used on fiber optics to increase the capacity of a single fiber.
- It is used to utilize the high data rate capability of fiber optic cable.
- It is an analog multiplexing technique.
- Multiplexing and Demultiplexing can be achieved by using a prism.
- One application of WDM is the SONET network in which multiple optical fiber lines are multiplexed and demultiplexed.



Time Division Multiplexing (TDM)

- It is a digital technique.
- In Frequency Division Multiplexing Technique, all signals operate at the same time with different frequency, but in case of Time Division Multiplexing technique, all signals operate at the same frequency with different time.
- In Time Division Multiplexing technique, the total time available in the channel is distributed among different users. Therefore, each user is allocated with different time interval known as a Time slot at which data is to be transmitted by the sender.
- A user takes control of the channel for a fixed amount of time.
- In Time Division Multiplexing technique, data is not transmitted simultaneously rather the data is transmitted one-by-one.
- In TDM, the signal is transmitted in the form of frames. Frames contain a cycle of time slots in which each frame contains one or more slots dedicated to each user.

Time Division Multiplexing (TDM)

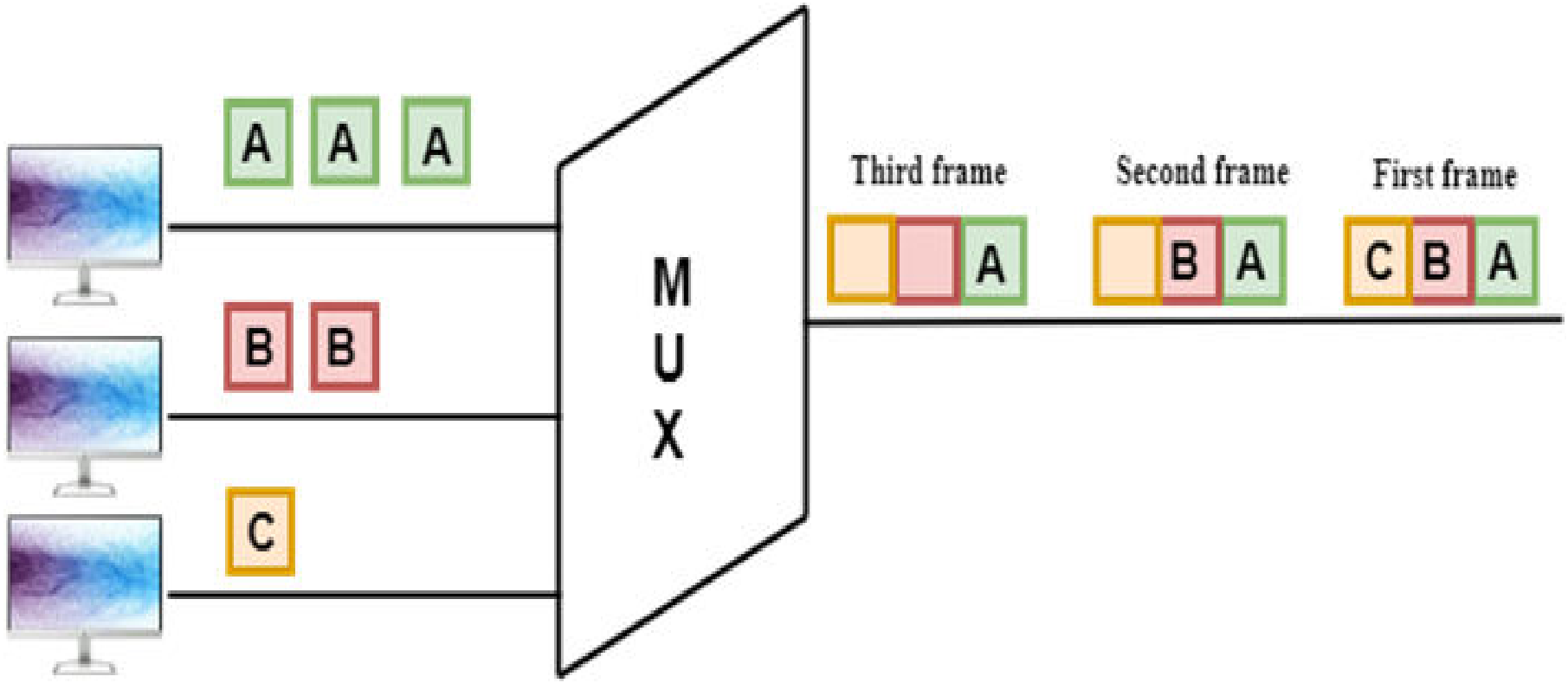
There are two types of TDM:

1. **Synchronous TDM**
2. **Asynchronous TDM**

Synchronous TDM

- A Synchronous TDM is a technique in which time slot is pre-assigned to every device.
- In Synchronous TDM, each device is given some time slot irrespective of the fact that the device contains the data or not.
- If the device does not have any data, then the slot will remain empty.
- In Synchronous TDM, signals are sent in the form of frames. Time slots are organized in the form of frames. If a device does not have data for a particular time slot, then the empty slot will be transmitted.
- The most popular Synchronous TDM are T-1 multiplexing, ISDN multiplexing, and SONET multiplexing.
- If there are n devices, then there are n slots.

Time Division Multiplexing (TDM)



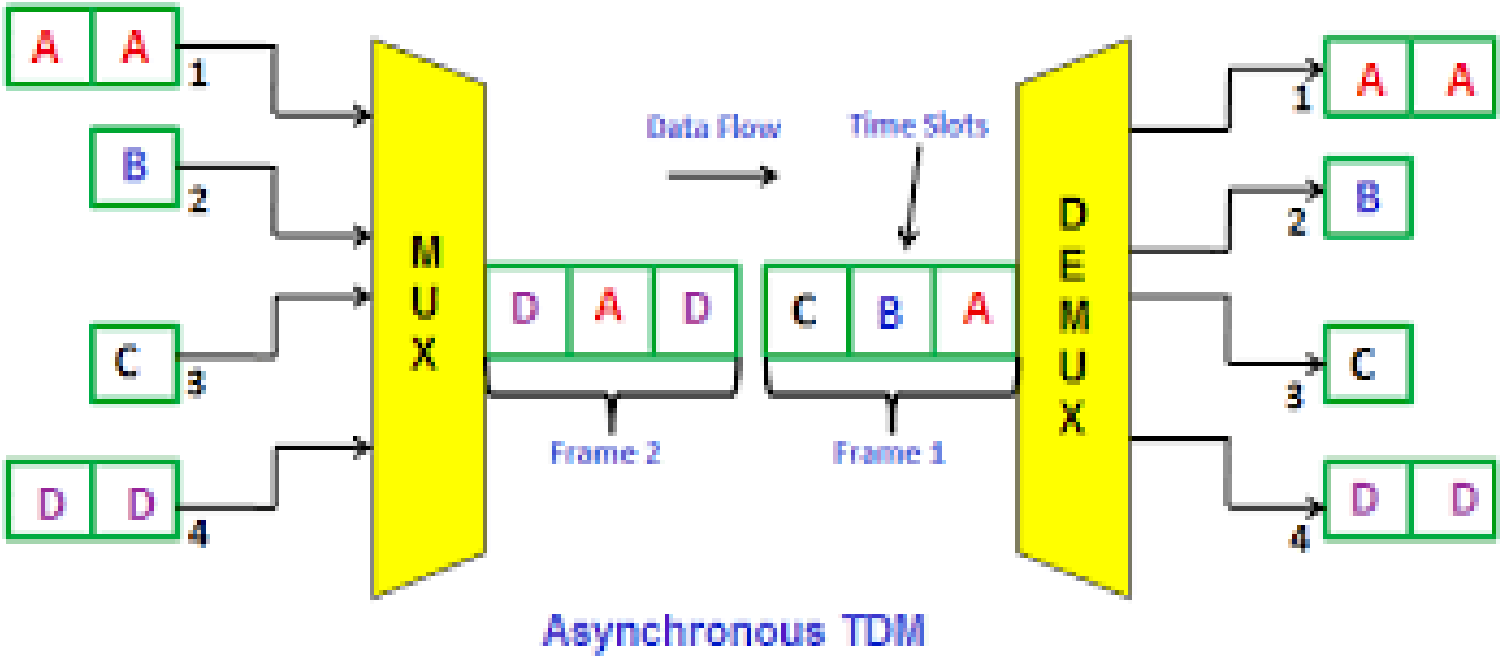
Multiplexing

Asynchronous TDM

- An asynchronous TDM is also known as Statistical TDM.
- An asynchronous TDM is a technique in which time slots are not fixed as in the case of Synchronous TDM. Time slots are allocated to only those devices which have the data to send. Therefore, we can say that Asynchronous Time Division multiplexor transmits only the data from active workstations.
- An asynchronous TDM technique dynamically allocates the time slots to the devices.
- In Asynchronous TDM, total speed of the input lines can be greater than the capacity of the channel.
- In Asynchronous TDM, each slot contains an address part that identifies the source of the data.

Multiplexing

- In Synchronous TDM, if there are n sending devices, then there are n time slots. In Asynchronous TDM, if there are n sending devices, then there are m time slots where m is less than n (m<n).
- The number of slots in a frame depends on the statistical analysis of the number of input lines.



Asynchronous TDM