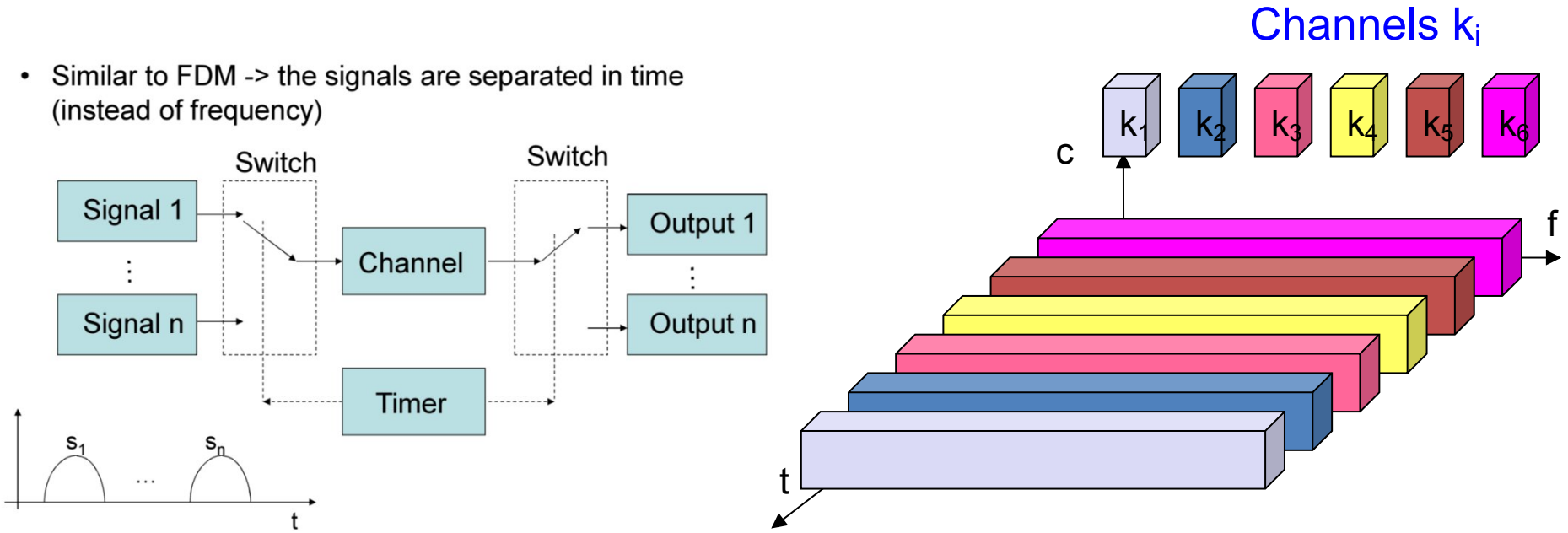
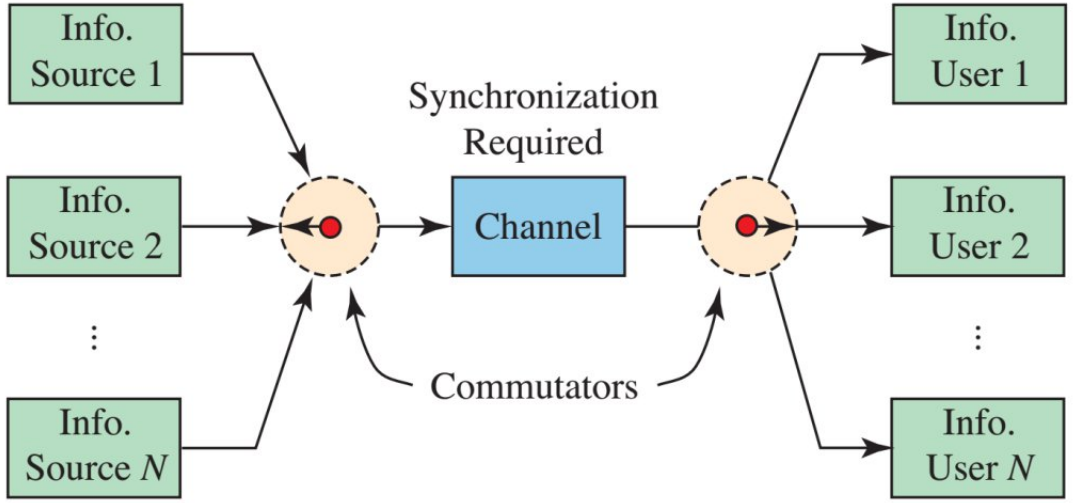
Time-division multiplexing (TDM) is the time interleaving of signals from several sources so that the information from these sources can be transmitted serially over a single communication channel.



TDM is a **digital multiplexing technique** for combining several low-rate digital channels into one high-rate one. Channel gets the whole spectrum for a certain amount of time. Advantages: only one carrier in the medium at any time throughput high even for many users but the disadvantages the precise synchronization necessary

Time division multiplexing can be applied to sampled analog signals directly or accomplished at the bit level



For equal bandwidth sources : $s1\ s2\ s3\ \ s1\ s2\ s3\ \ s1\ s2\ s3\ \ s1\ s2\ s3\ \ s1\ s2\ s3\ \ s1\ s2\ s3$ ....
Analog TDM (equal bandwidth sources)

Suppose that $m_1(t)$ has bandwidth $3B$ and sources $m_2(t)$, $m_3(t)$, and $m_4(t)$ each have bandwidth B, we could send the samples as

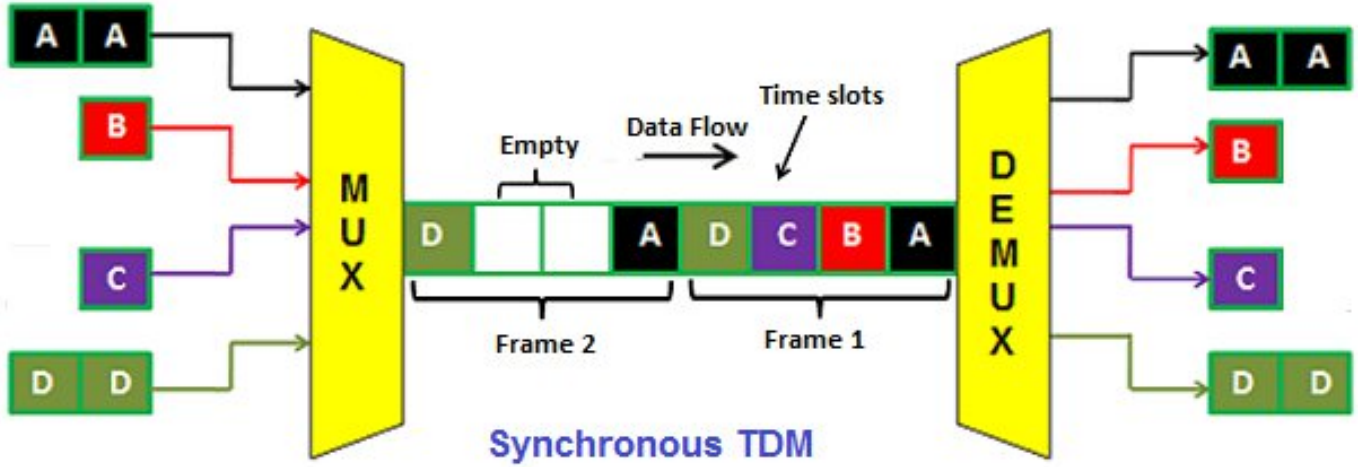
$$s_1\ s_2\ s_1\ s_3\ s_1\ s_4\ s_1\ s_2\ s_1\ \ldots$$

Types of TDM (Time Division Multiplexing)

Time Division Multiplexing is mainly classified into two types:

- Synchronous TDM (Time Division Multiplexing)
- Asynchronous TDM (Time Division Multiplexing)

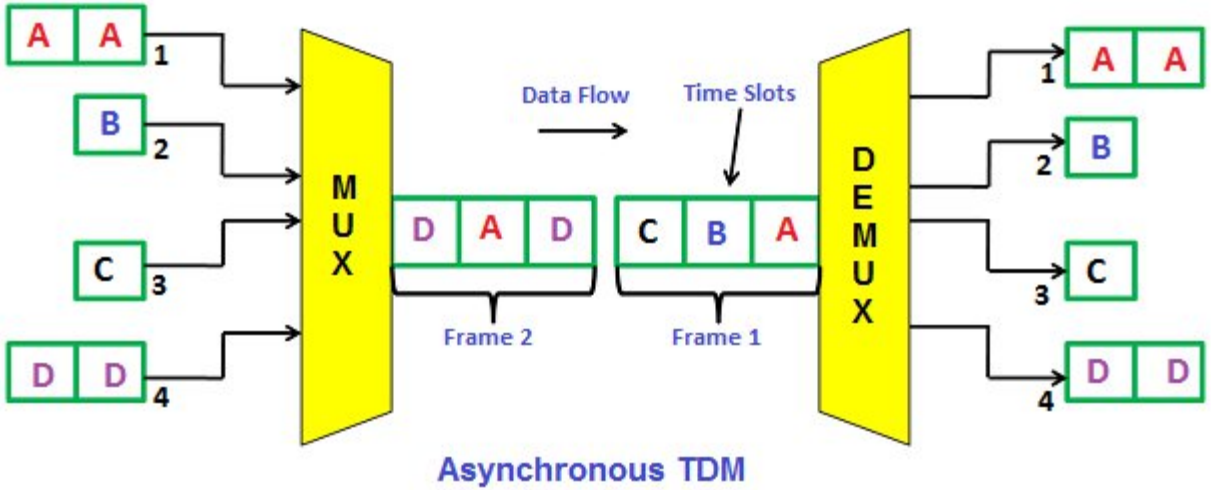
In synchronous time division multiplexing, each device (transmitter) is allotted with a fixed time slot, regardless of the fact that the device (transmitter) has any data to transmit or not. The device has to transmit data within this time slot. If the device (transmitter) does not have any data to send then its time slot remains empty.



As shown in the below figure, the various time slots are arranged into frames and each frame consists of one or more time slots dedicated to each device (transmitter). For example, if there are 3 devices, there will be 3 slots in each frame. Similarly, if there are 5 devices, there will be 5 slots in each frame.

The above figure shows 4 devices (transmitter A, transmitter B, transmitter C, and transmitter D) that have 4 dedicated time slots (time slot A, time slot B, time slot C and time slot D). The transmitter A data is sent at time slot A, transmitter B data is sent at time slot B, transmitter C data is sent at time slot C and transmitter D data is sent at time slot D. In the time frame 2, the transmitter B and C does not have any data to send so the time slot B and C remains empty. The main drawback of synchronous time division multiplexing is that the channel capacity is not fully utilized. Hence, the bandwidth goes wasted.

In Asynchronous time division multiplexing, the time slots are not fixed (I.e. time slots are flexible). The asynchronous TDM is also known as statistical time division multiplexing. In synchronous TDM, the number of time slots is equal to the number of devices (transmitters). But in Asynchronous TDM, the number of time slots is not equal to the number of devices (transmitters). The time slots in asynchronous TDM are always less than the number of devices (transmitter). For example, if we have X devices and Y time slots. Y should always be less than X (I.e. Y < X).



Asynchronous TDM

In the above figure, it is shown that the number of devices are 4 and time slots are 3. The timeframe 1 (all slots) is completely filled with data from devices A, B, and C. The timeframe 1 has only 3 time-slots. So the data from device D is filled in the next timeframe (I.e. timeframe 2) in timeslot 1. The data from devices A and D will be filled in timeslots 2 and 3 in timeframe 2. In asynchronous time division multiplexing, the multiplexer scans all the devices (transmitters) and accepts input only from the devices that have actual data to send and fills all the frames, and then sends it to the receiver. If there is not enough data to fill all the slots in a frame, then the partially filled frames are transmitted. In most of the cases, all the time slots in frames are completely filled.

Questions?

Thank you for

Listening & Attending