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Data Communication CS601 Lecture No 19

Lecture Prepared By

Muhammad Abid Ali

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CS601 Lecture No 19 Topic 89 to 100

Multiplexing

Simultaneous transmission of multiple signals across a single data link MCQS

In telecommunications and computer networking, multiplexing (sometimes contracted to muxing) is a method by which multiple analog or digital signals are combined into one signal over a shared medium.

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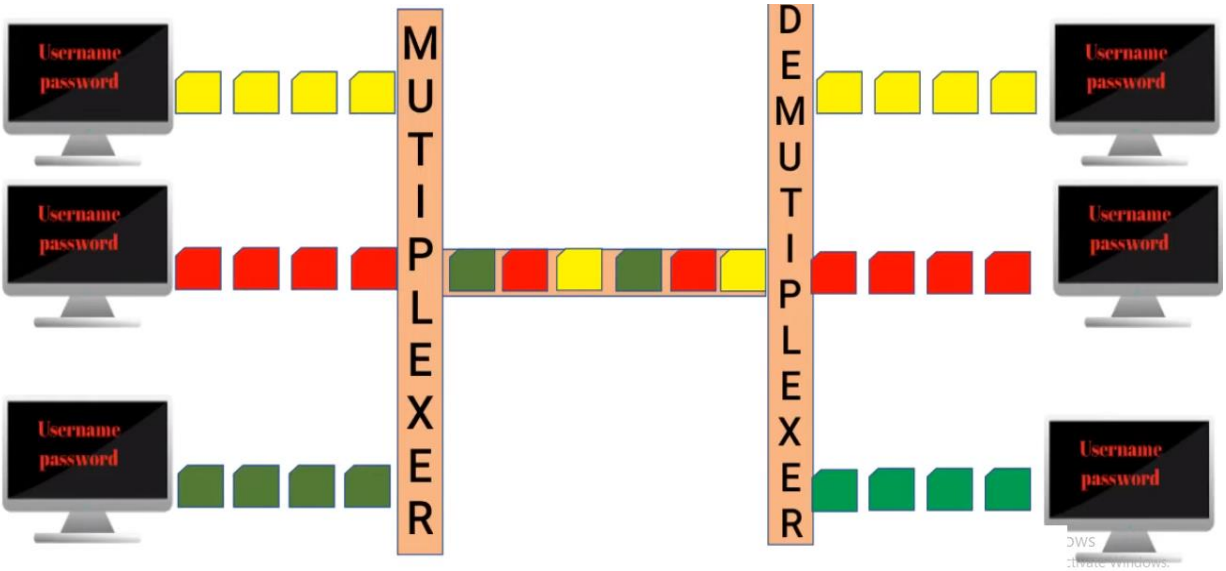
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The aim is to share a scarce resource. For example, in telecommunications, several telephone calls may be carried using one wire. Multiplexing originated in telegraphy in the 1870s, and is now widely applied in communications. In telephony, George Owen Squier is credited with the development of telephone carrier multiplexing in 1910.

The multiplexed signal is transmitted over a communication channel such as a cable. The multiplexing divides the capacity of the communication channel into several logical channels, one for each message signal or data stream to be transferred. A reverse process, known as demultiplexing, extracts the original channels on the receiver end.

A device that performs the multiplexing is called a multiplexer (MUX), and a device that performs the reverse process is called a demultiplexer (DEMUX or DMX).

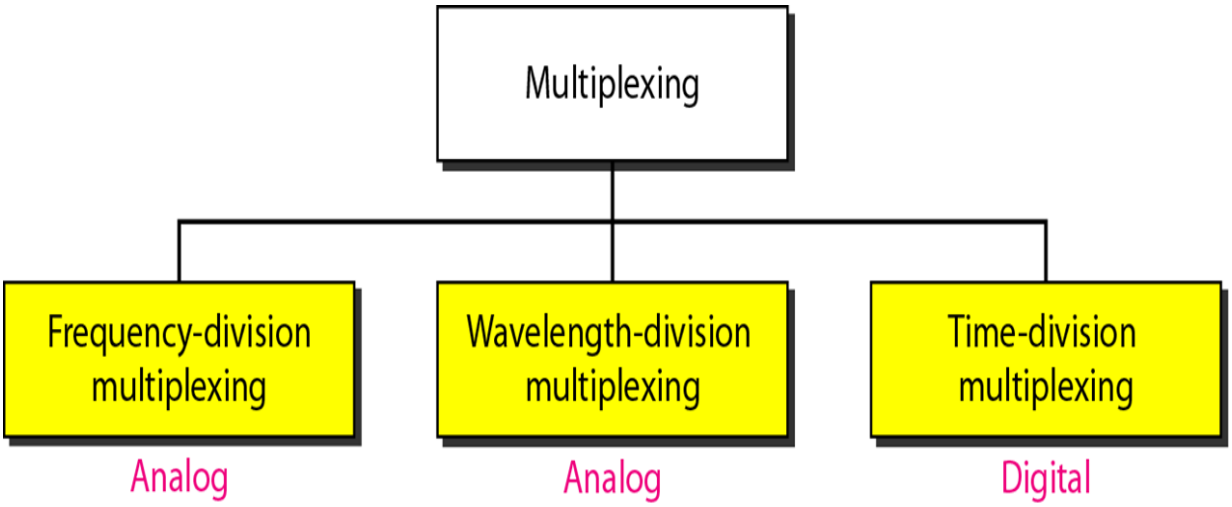
Inverse multiplexing (IMUX) has the opposite aim as multiplexing, namely to break one data stream into several streams, transfer them simultaneously over several communication channels, and recreate the original data stream.



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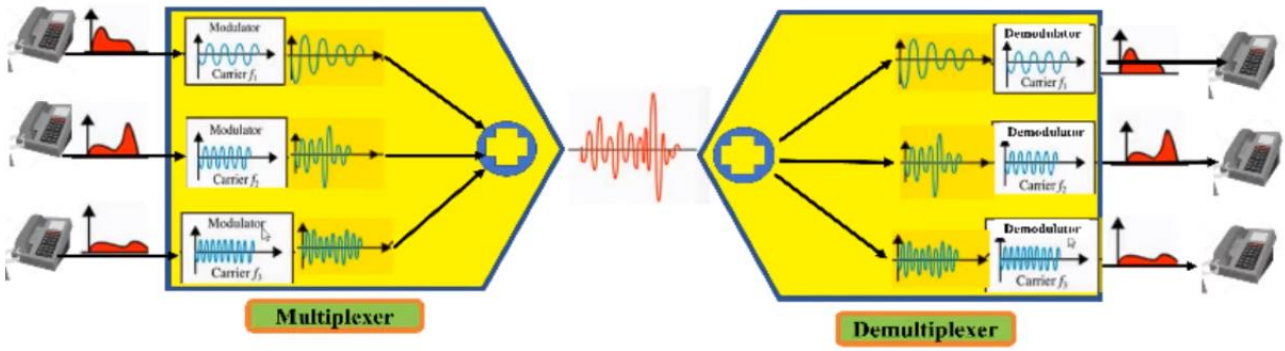
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Frequency-Division Multiplexing

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.

Frequency-division multiplexing

is an analog technology that supports the transmission of multiple communications over a single carrier by shifting each communication to a unique frequency range. A related technology for fiber channels is known as wavelength division multiplexing. This technology requires that each communication be transmitted as unique wavelength (i.e. color) of light along the shared fiber optic channel.

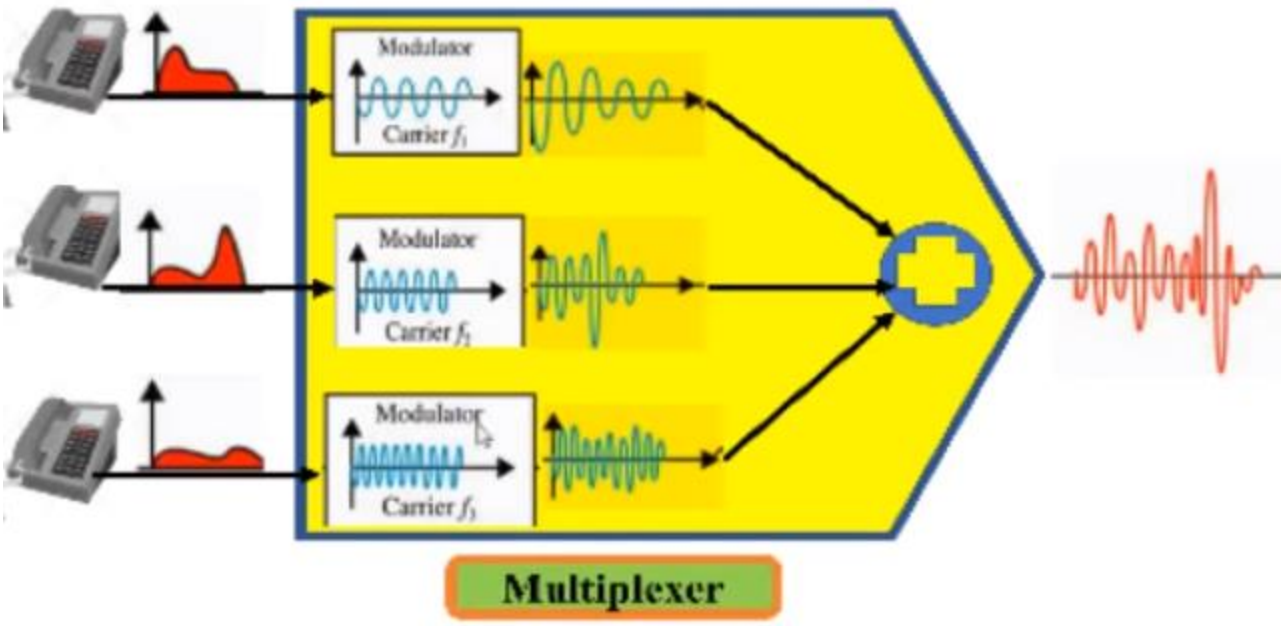


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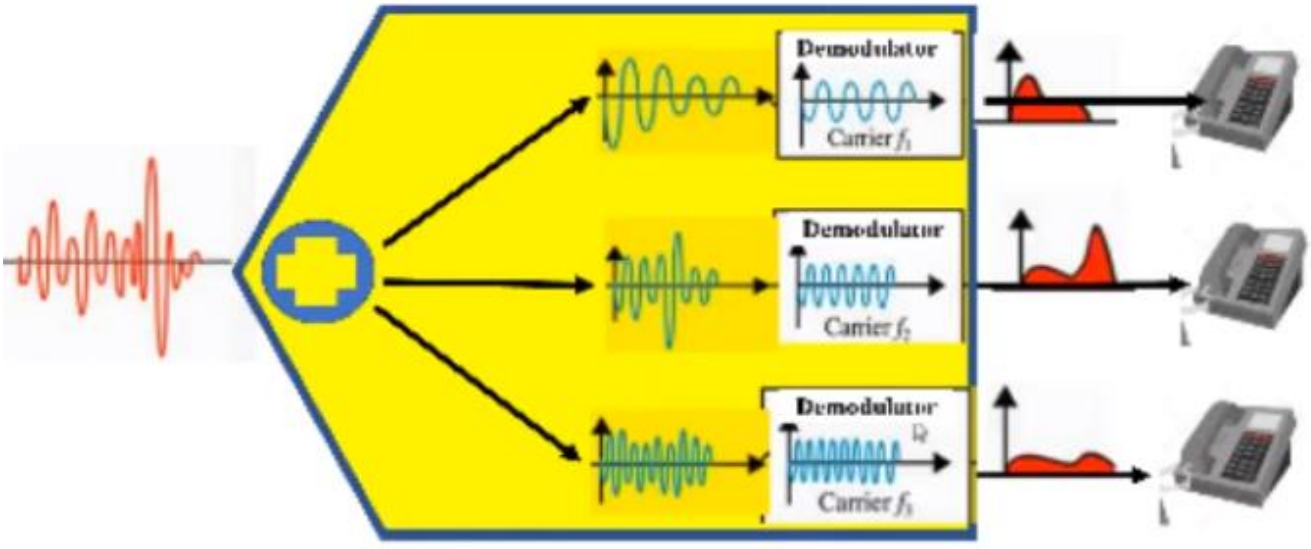
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Multiplexer



Demultiplexer

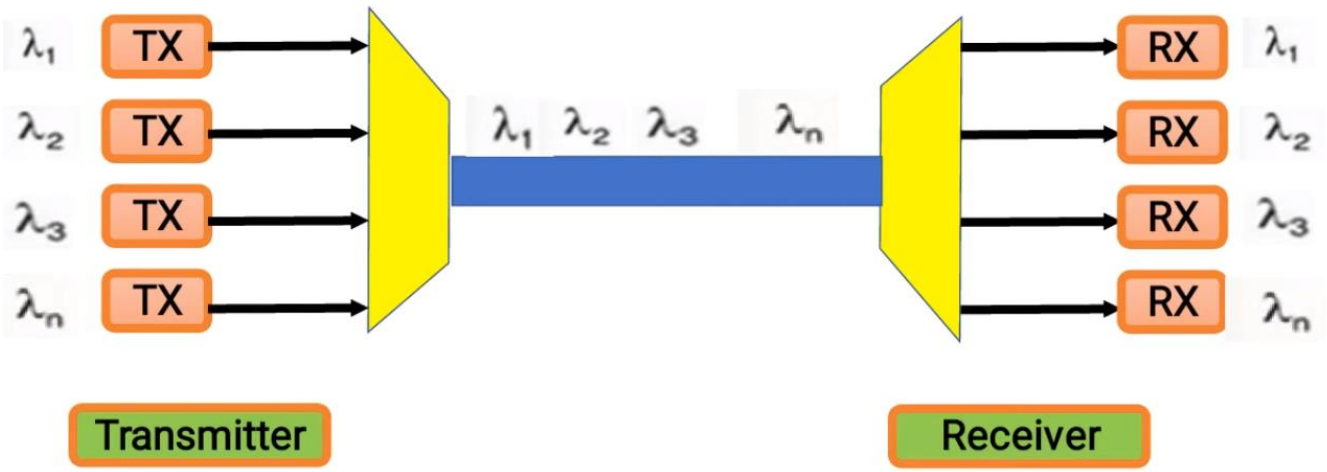
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Wavelength-Division Multiplexing

Wavelength division multiplexing (WDM) is a technique of multiplexing multiple optical carrier signals through a single optical fiber channel by varying the wavelengths of laser lights. WDM allows communication in both the directions in the fiber cable.



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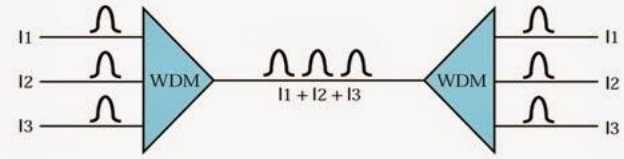
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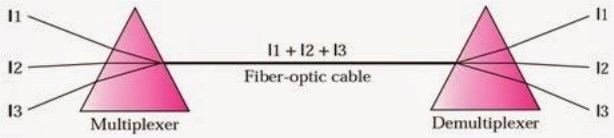


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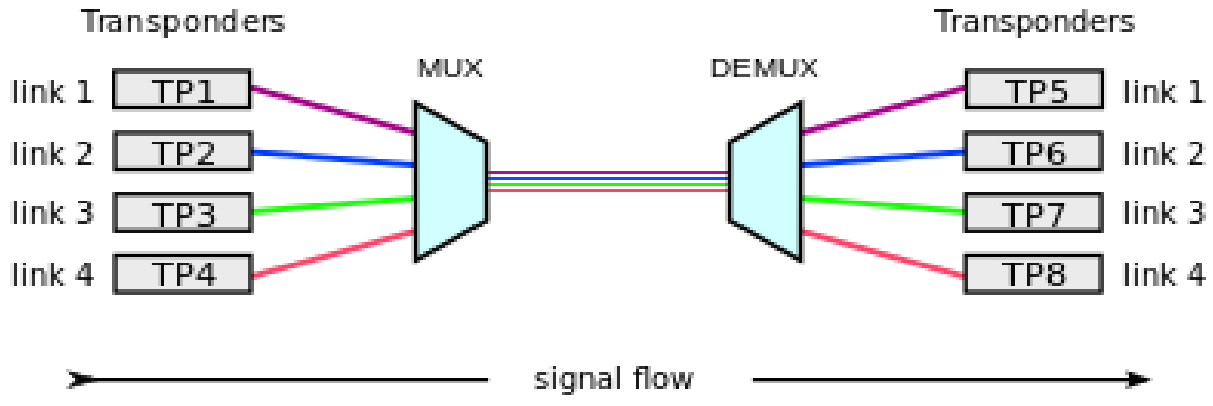
WAVE DIVISION MULTIPLEXING (WDM)

- An analog multiplexing technique to combine optical signals
- Multiple beams of light at different frequency
- Carried by optical fibber
- A form of FDM
- Each color of light (wavelength) carries separate data channel
- Commercial systems of 160 channels of 10 Gbps now available





wavelength-division multiplexing (WDM)



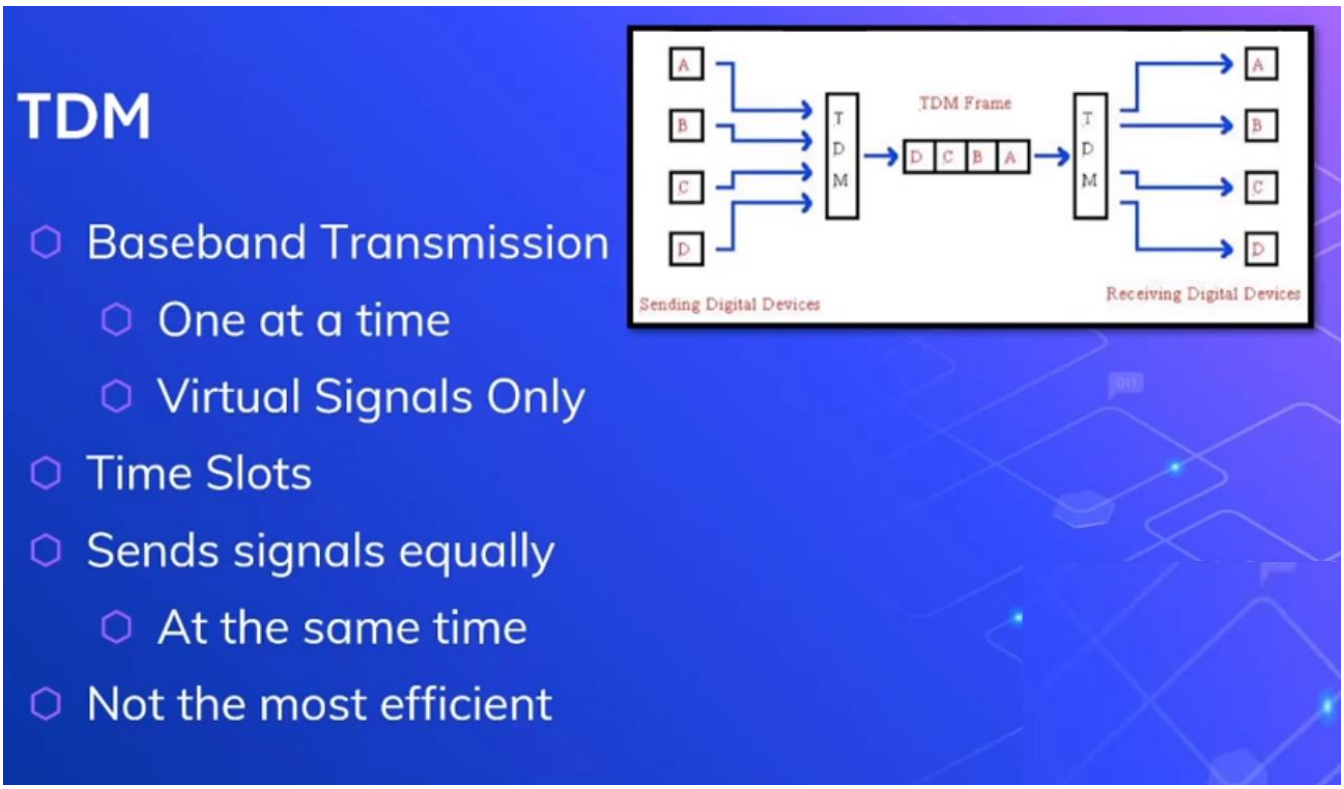
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Time-Division Multiplexing

Digital process that allows several connections to share the high bandwidth of a link

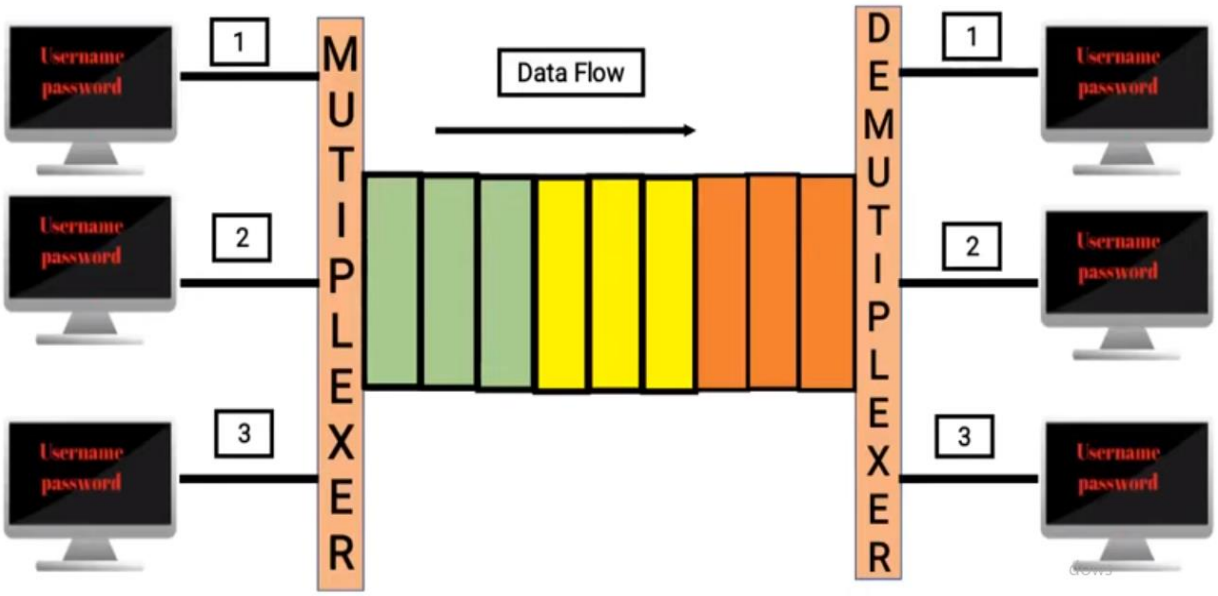


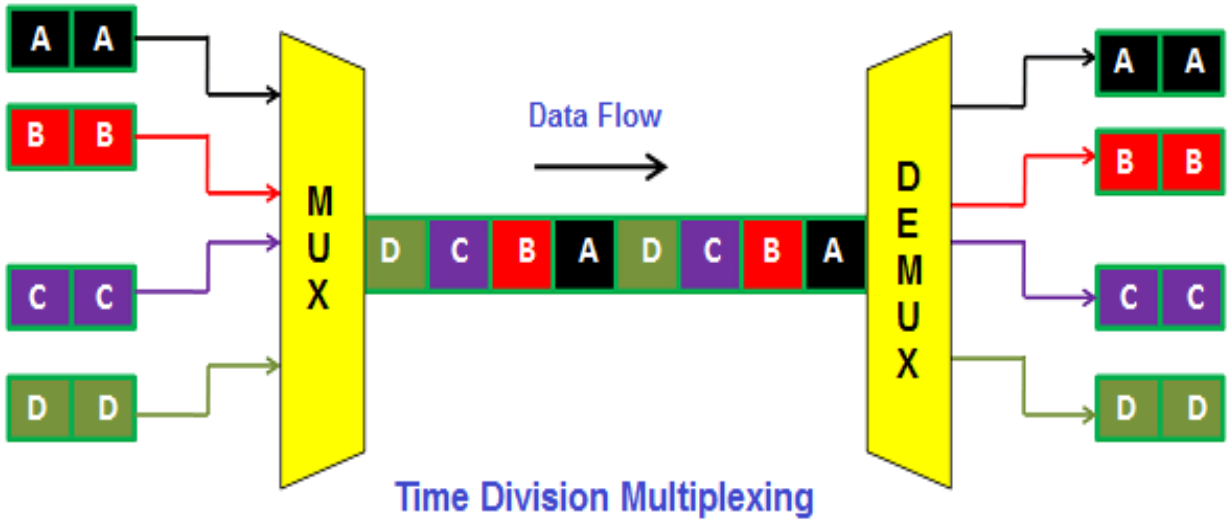
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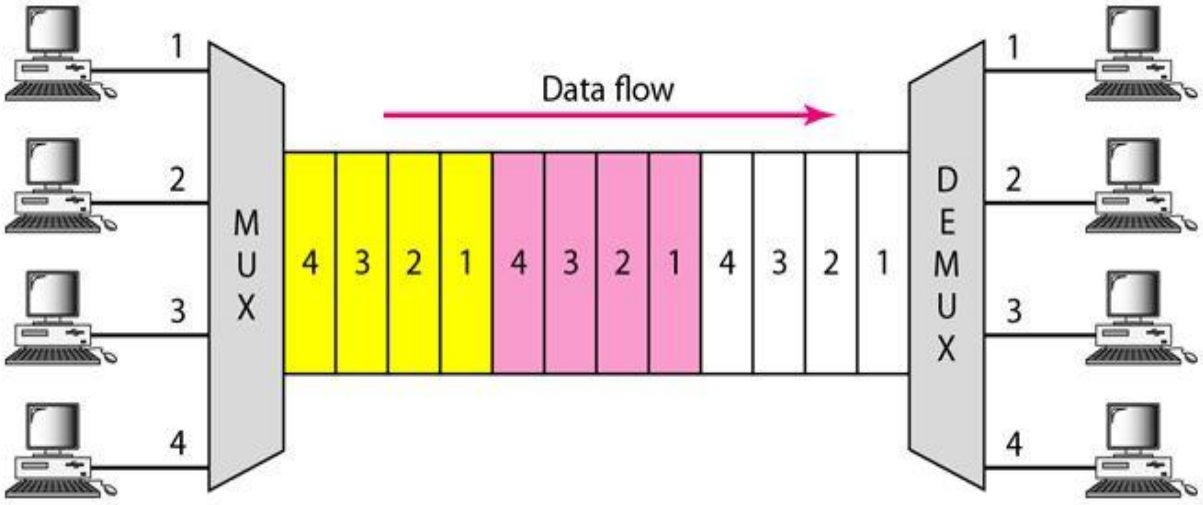




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Time-Division Multiplexing

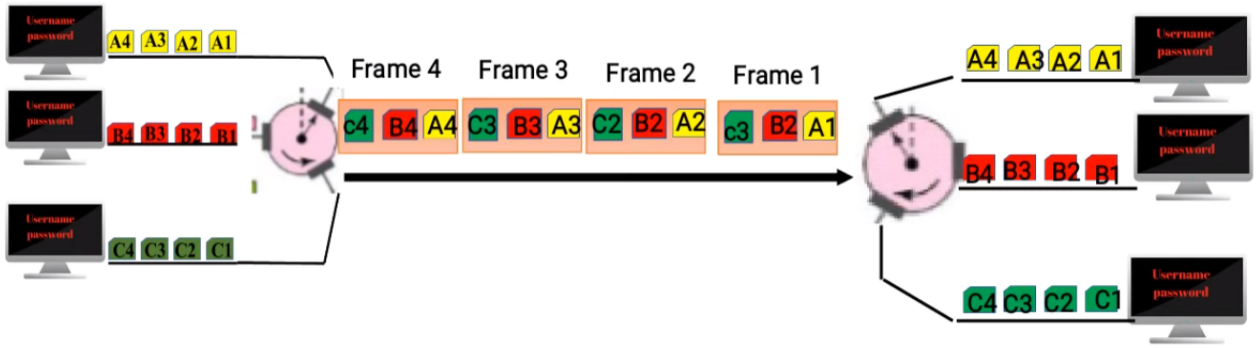
- **Synchronous TDM**
- **Statistical TDM**

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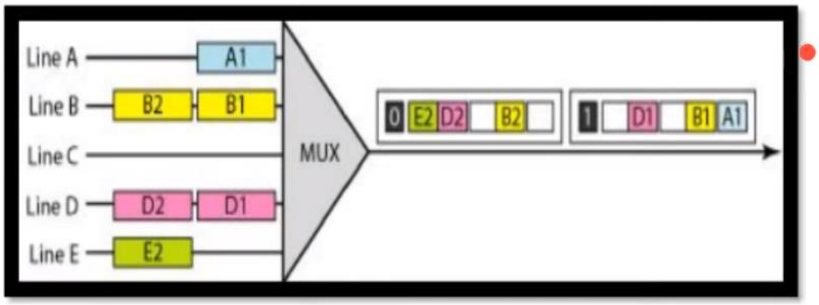
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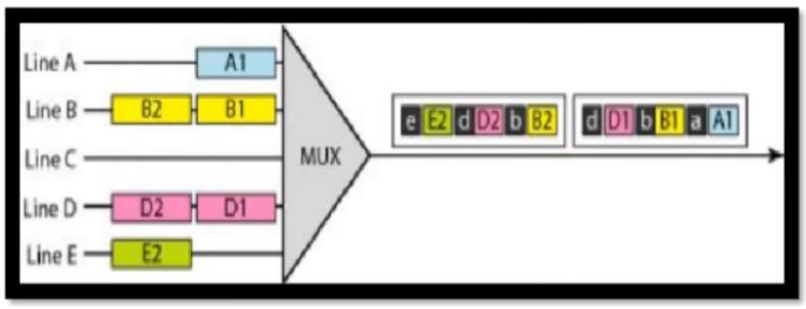
Synchronous TDM



Empty slots If a source does not have data to send, the corresponding slot in the output frame is empty.

Synchronous TDM





Statistical TDM

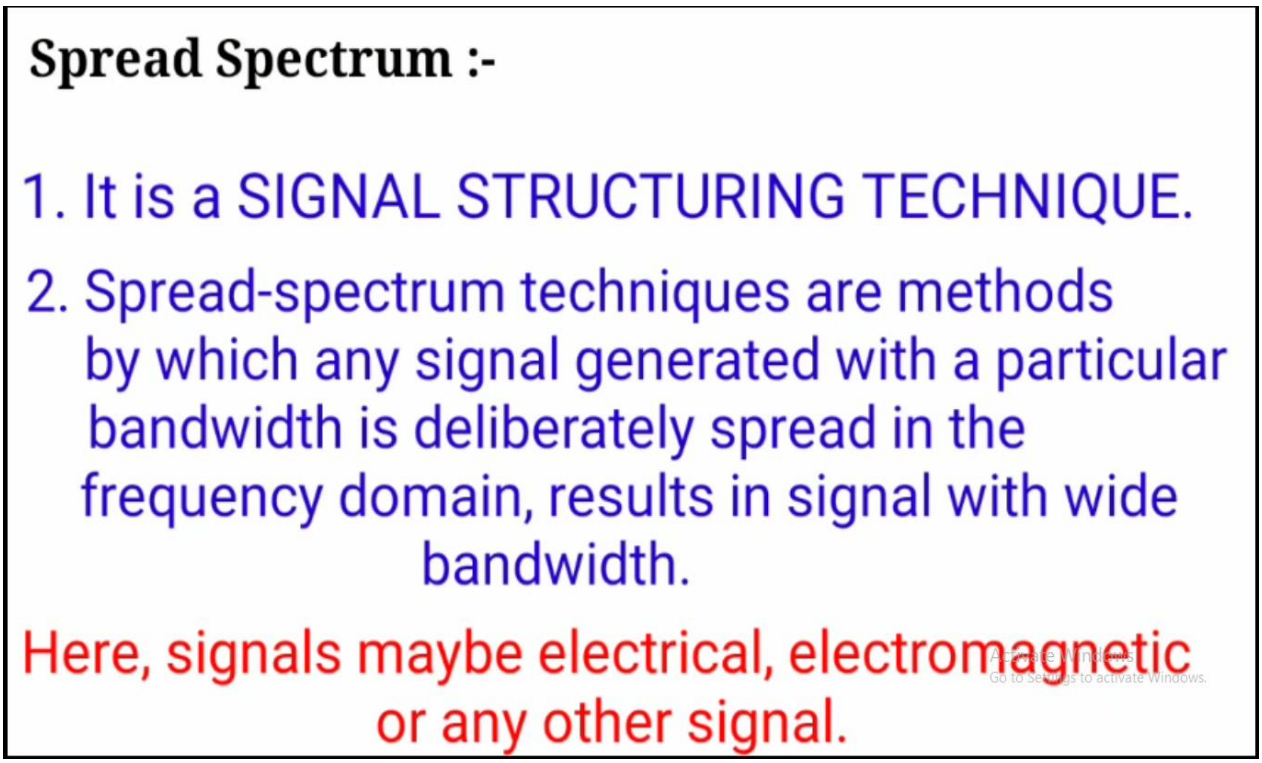
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SPREAD SPECTRUM

Spread spectrum is **a form of wireless communications in which the frequency of the transmitted signal is deliberately varied**. This results in a much greater bandwidth than the signal would have if its frequency were not varied.



What is spread spectrum & Types?

Spread Spectrum can be categorized into two types:

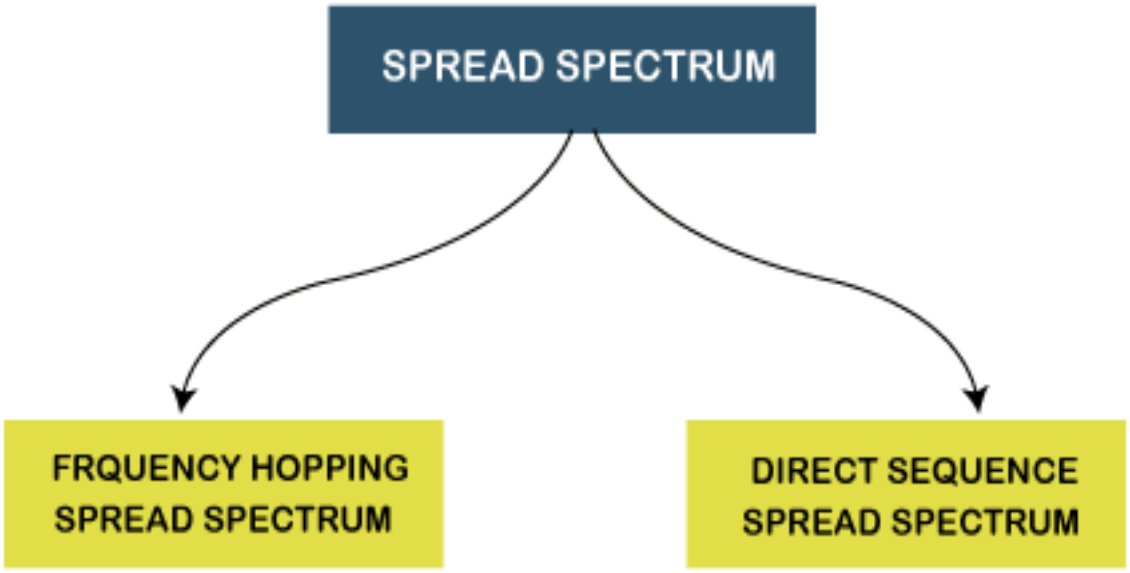
Frequency Hopping Spread Spectrum (FHSS)

Direct Sequence Spread Spectrum (DSSS)

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DSSS

- **DSSS also expands the bandwidth of the original signal, but the process is different**
- **We replace each data bit with 'n' bits using a spreading code**
- **Each bit is assigned a code of 'n' bits, called chips, where the chip rate is 'n' times that of the data bit**

What is the difference between FHSS and DSSS?

FHSS and DSSS, which stand for Frequency Hopping Spread Spectrum and Direct Sequence Spread Spectrum, are two spread spectrum techniques. The main difference is in how they spread the data into the wider bandwidth. **FHSS utilizes frequency hopping while DSSS utilizes pseudo noise to modify the phase of the signal**.

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