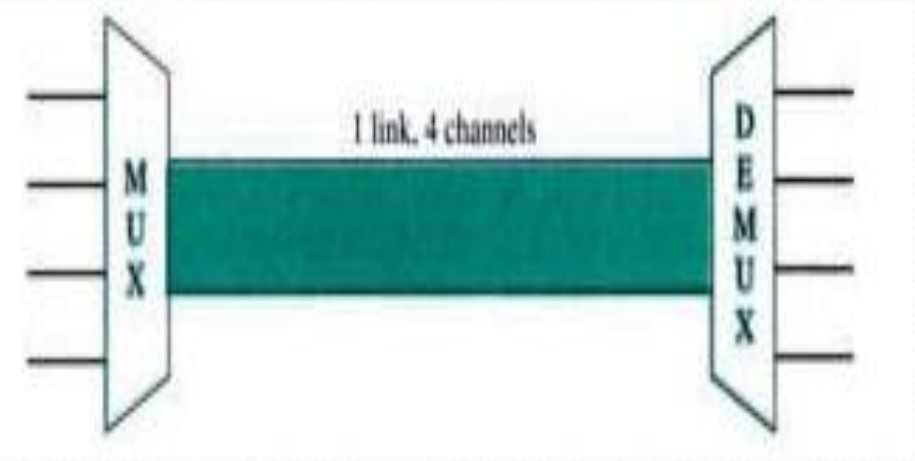
Multiplexing

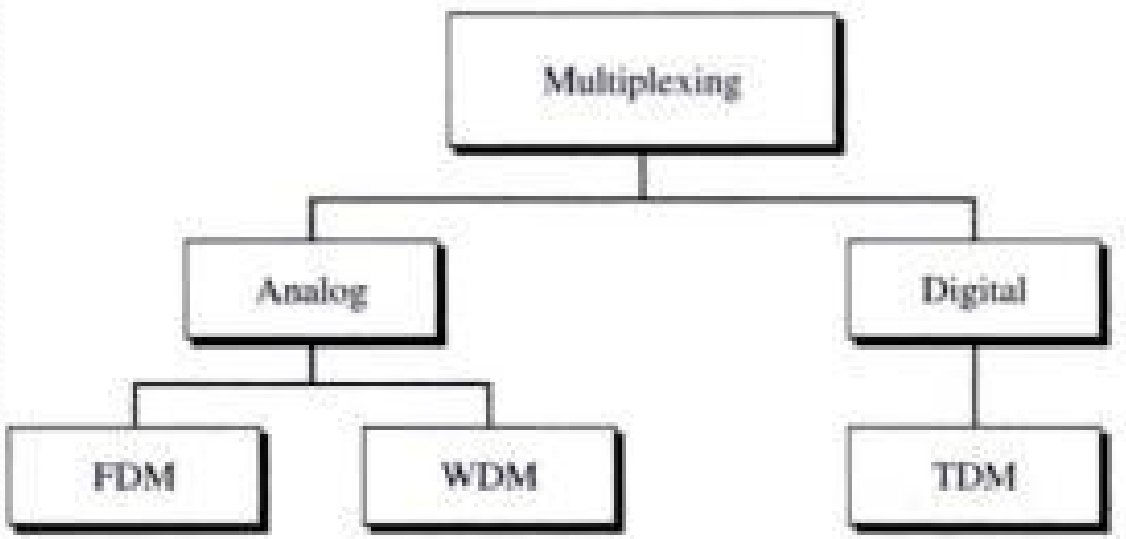
MULTIPLEXING is the technique that allows the simultaneous transmission of multiple signals across a single data link.

Need of multiplexing

Whenever the bandwidth linking two devices is greater than the BW required by the devices, link can be shared.

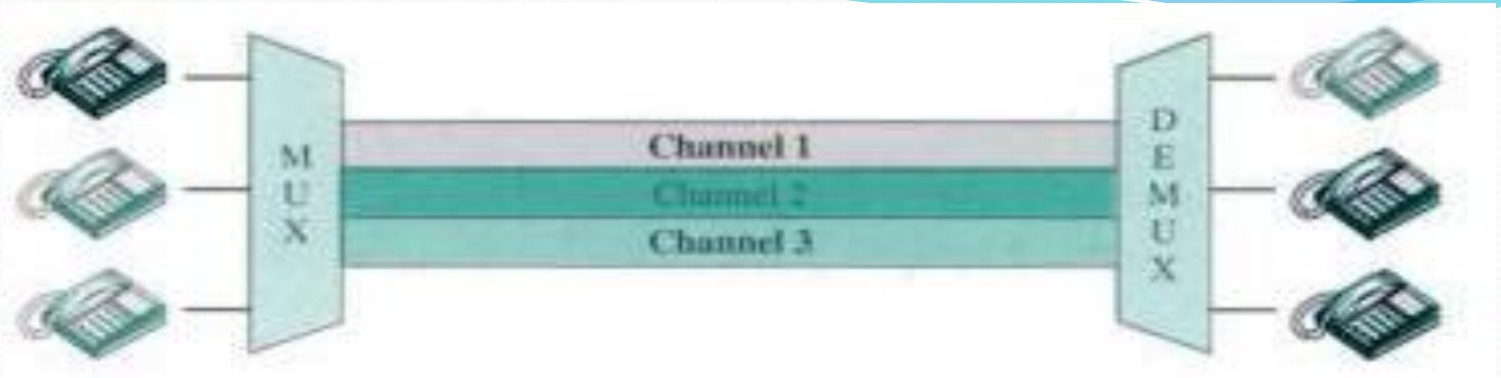
- In a multiplexed system, n lines share the BW of one link.
- Four lines on the left direct their transmission to Multiplexer, which combines them to single stream.
- At receiving side, it is fed to Demultiplexer, and directs them to their corresponding lines.




Multiplexing
Analog
Digital
FDM
WDM
TDM

FDM

- It can be applied when BW of link in hertz is greater than the combined BW of the signals to be transmitted.
- Signals generated by each sending device modulate different carrier frequencies.
- Modulated signals are then combined into a single composite signals that can be transported by a link.
- Channels must be separated by strips of unused BW (guard band) to prevent from signal overlapping.

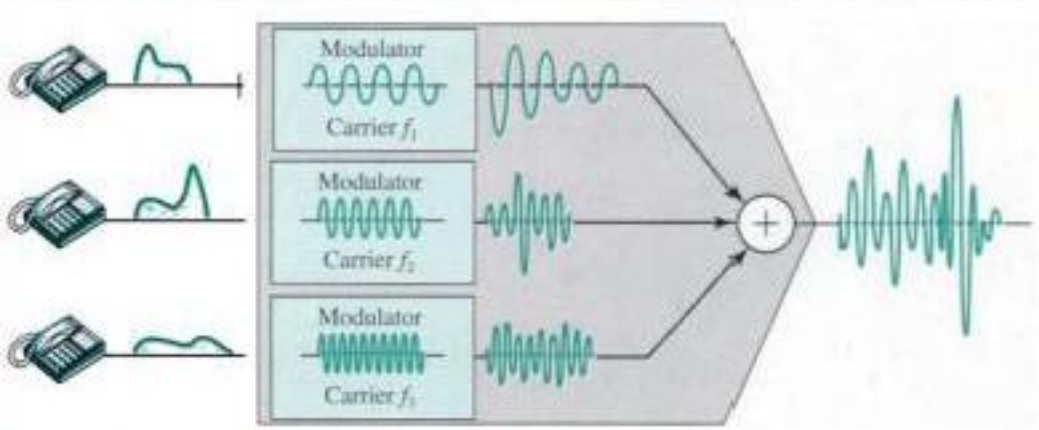


Transmission path is divided into three parts, each representing a channel to carry one transmission.

Imagine a point where three lanes merge to form three lane highway. Each of the three lanes correspond to a lane of highway.

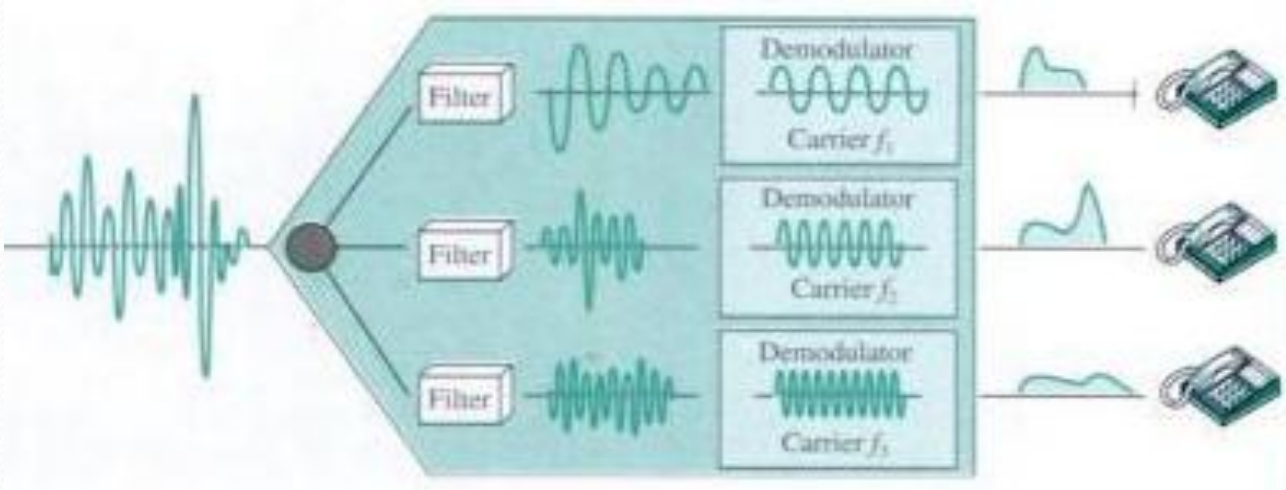
Each car merging on the highway, still belongs to its own lane and can travel without interfering with the cars in the other lane.

Multiplexing process



FDM is an analog process and we are showing here with the help of three telephones as input devices. Each telephone generates a signal of a similar frequency range. Inside the Mux, these similar frequency signals are modulated on different carrier frequencies, f1, f2, f3. the resulting modulated signals are then combined into a single composite signal that is sent out over a media link that has enough BW to accommodate it.

Demultiplexing process

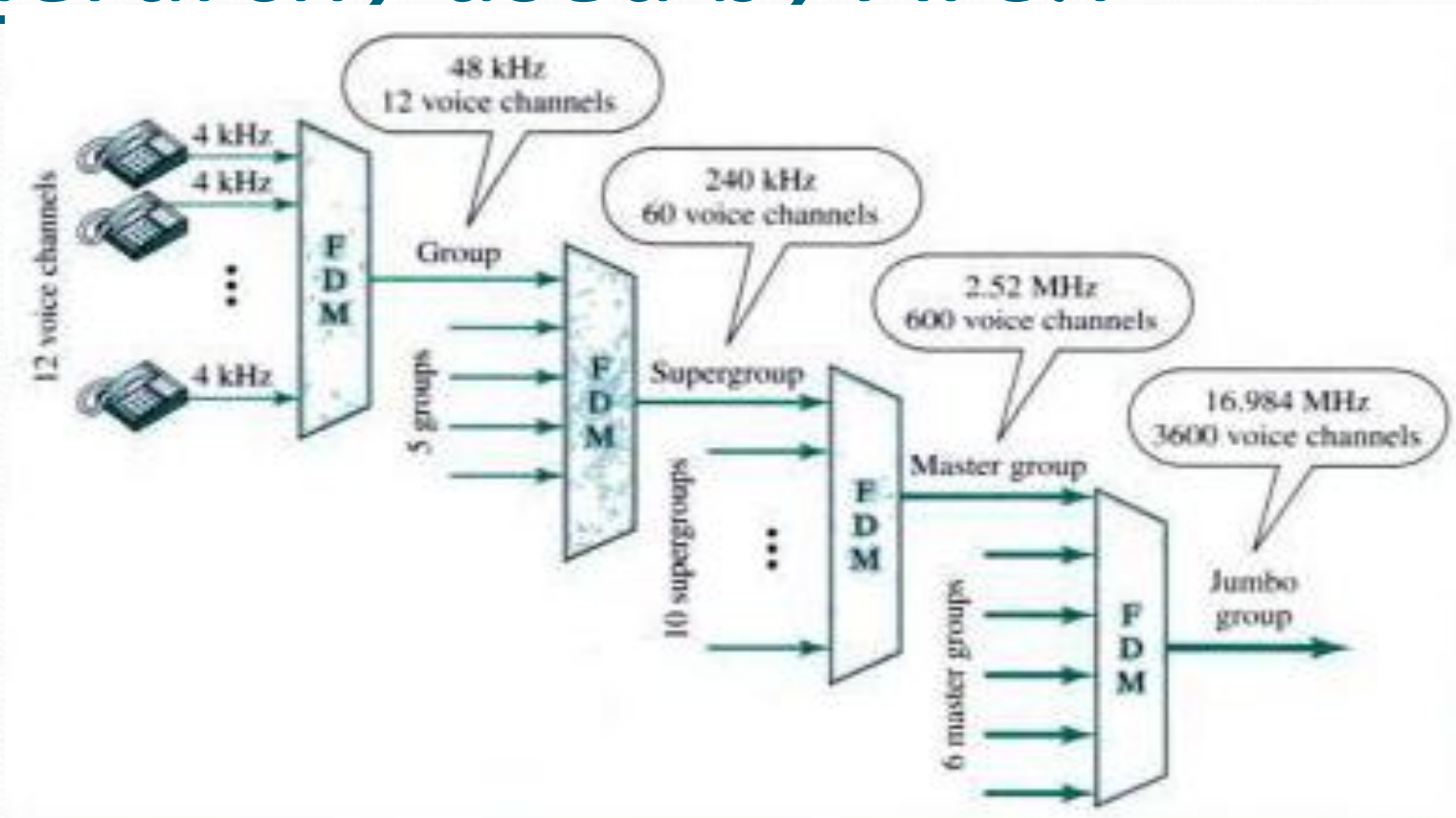


It uses a series of filters to decompose the multiplexed signal into its constituent component signals. Individual signals are then passed to a demodulator that separates from their carriers and passes them to the waiting receivers.

The analog hierarchy

- To maximize the efficiency of the infrastructure, telephone companies have traditionally multiplexed signals from lower BW lines onto higher BW lines.

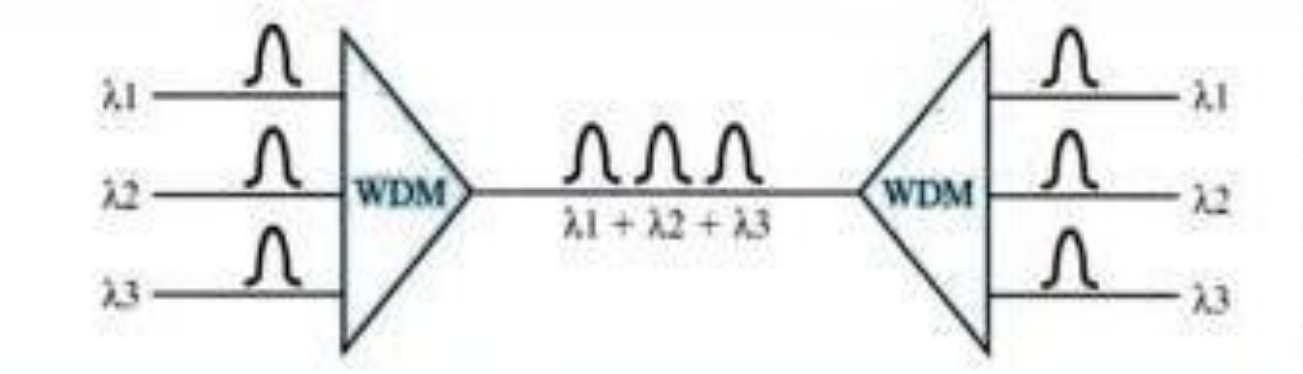
Hierarchy used by AT&T



Applications of FDM

- FM, AM radio broadcasting.
- Television broadcasting.

Conceptual view of multiplexer and demultiplexar

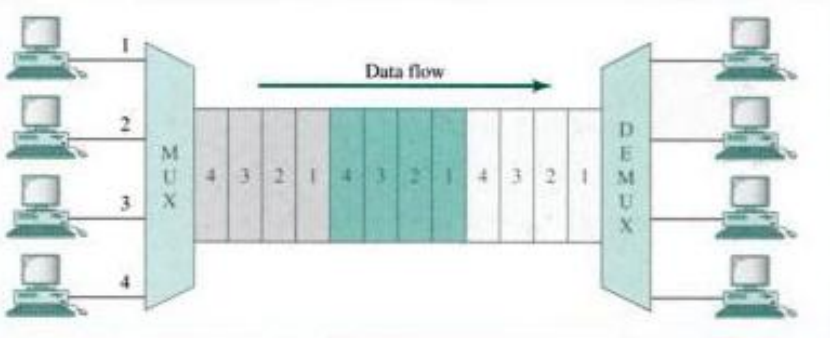


Very narrow bands of light from different sources are combined to make a wider band of light. At the receiver, the signals are seperated by the demultiplexer.

Time divison multiplexing (TDM)

It is a digital process that allows several connections to share the high bandwidth of a link. Instead of sharing a portion of BW, time is shared.

Each connection occupies a portion of time in the link.



Portions of the signals 1,2, 3, 4 occupy the link sequentially.