

Multiplexing

In telecommunication and computer networks, **multiplexing** (also known as **muxing**) is a method by which multiple analog message signals or digital data streams are combined into one signal over a shared medium. The aim is to share an expensive resource. For example, in telecommunications, several telephone calls may be carried using one wire.

The multiplexed signal is transmitted over a communication medium communication channel, which may be a physical transmission medium. The multiplexing divides the capacity of the high-level communication channel into several low-level logical channels, one for each message signal or data stream to be transferred. A reverse process, known as DE multiplexing, can extract the original channels on the receiver side.

A device that performs the multiplexing is called a multiplexer (MUX), and a device that performs the reverse process is called a de-multiplexer (DEMUX).

Types of multiplexing

Multiplexing technologies may be divided into several types, all of which have significant variations:

Space division multiplexing (SDM)

Frequency division multiplexing (FDM)

Time division multiplexing (TDM)

Code division multiplexing (CDM)

Space-division multiplexing

In wired communication, space-division multiplexing simply implies different point – to – point wires for different channels. Examples include an analogue stereo audio cable, with one pair of wires for the left channel and another for the right channel, and a multi pair telephone cable.

In wireless communication, space-division multiplexing is achieved by multiple antenna elements.

Frequency-division multiplexing

When the carrier is frequency, FDM is used. FDM is an analog technology. FDM divides the spectrum or carrier bandwidth in logical channels and allocates one user to each channel. Each user can use the channel frequency independently and has exclusive access of it. All channels are divided in such a way that they do not overlap with each other. Channels are separated by guard bands.

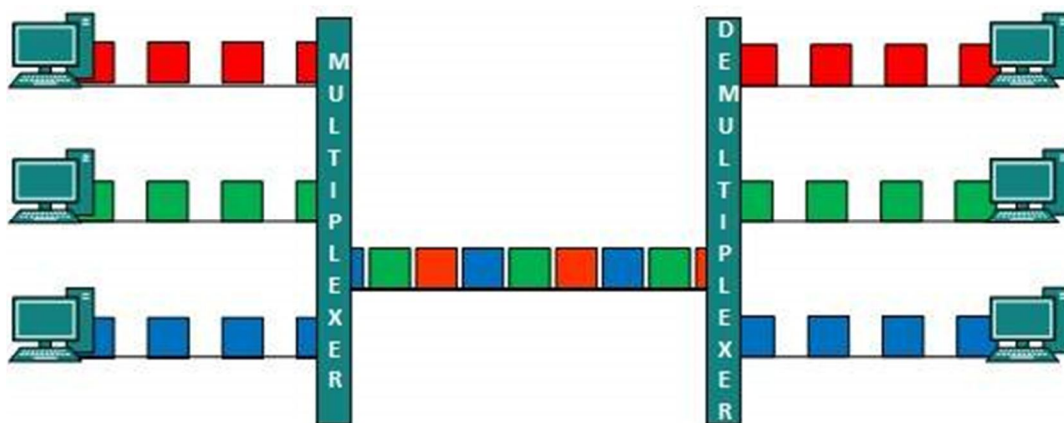
FDM achieves the combining of several digital signals into one medium by sending signals in several distinct frequency ranges over a single medium.

One of FDM's most common applications is cable television. Only one cable reaches a customer's home but the service provider can send multiple television channels or signals simultaneously over that cable to all subscribers without interference. Receivers must tune to the appropriate frequency (channel) to access the desired signal.

Time-division multiplexing

TDM is applied primarily on digital signals but can be applied on analog signals as well. In TDM the shared channel is divided among its user by means of time slot. Each user can transmit data within the provided time slot only. Digital signals are divided in frames, equivalent to time slot i.e. frame of an optimal size which can be transmitted in given time slot.

TDM works in synchronized mode. Both ends, i.e. Multiplexer and De-multiplexer are timely synchronized and both switch to next channel simultaneously.



When channel A transmits its frame at one end, the De-multiplexer provides media to channel A on the other end. As soon as the channel A's time slot expires, this side switches to channel B. On the other end, the De-multiplexer works in a synchronized

manner and provides media to channel B. Signals from different channels travel the path in interleaved manner.

Code-division multiplexing

Code Division Multiplexing (CDM) or spread spectrum is a class of techniques where several channels simultaneously share the same frequency spectrum, and this spectral bandwidth is much higher than the bit rate form is frequency hopping, another is direct sequence spread spectrum.

In the latter case, each channel transmits its bits as a coded channel-specific sequence of pulses called **chips**. Number of chips per bit, or chips per symbol, is the spreading factor. This coded transmission typically is accomplished by transmitting a unique time-dependent series of short pulses, which are placed within chip times within the larger bit time.

All channels, each with a different code, can be transmitted on the same fiber or radio channel or other medium, and asynchronously de-multiplexed.

Code Division Multiplex techniques are used as a channel access scheme, namely Code Division Multiple access (CDMA), e.g. for mobile phone service and in wireless networks, with the advantage of spreading inter cell interference among many users.