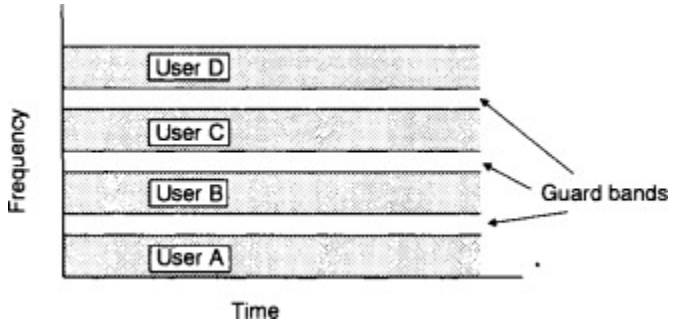
Frequency division multiple access

Principle : FDMA works on the principle of dividing the total bandwidth of the communication channel into a number of discrete segments and allocating each segment exclusively to a user.



FDMA is the most basic way of creating channels, by assigning users to non overlapping frequency bands, it was used in first and 2G cellular systems.. In a system with N users and a total bandwidth W, each user can be assigned a bandwidth of W/N.

Guard bands are used between each segment of the frequency band to prevent interference between users.

Number of Channels in FDMA

Let B_{total} be the total system bandwidth, B_{guard} be the guard band at edge and B_{ch} the single radio channel bandwidth. Then the number of channels in FDMA system :

$$N = B_{total} - 2B_{guard} / B_{ch}$$

The **advantage** of the FDMA system is its simplicity since once the channel capacity is divided amongst users each can operate independently of the other. Since each user has exclusive use of its allocated bandwidth there is no contention and therefore no wastage of bandwidth or delays caused by collisions and retransmissions.

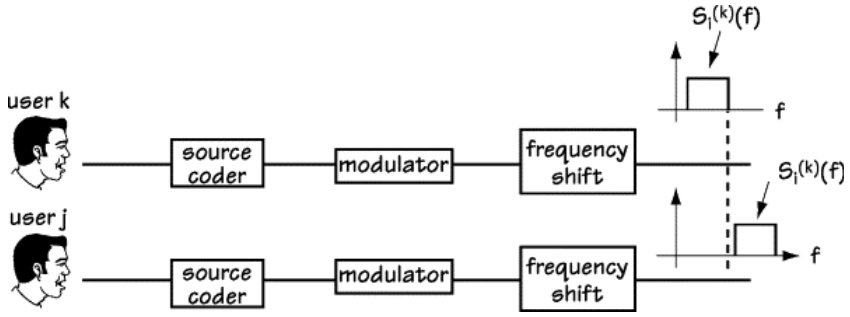
The **disadvantage** of FDMA systems is that there is a wastage of bandwidth, firstly caused by the guard bands and secondly due to the fact that users can only use their own allocated frequency bands. Therefore if a user needs more

information to transmit its given band lies idle, even though other users may have a considerable amount of information to send and are experiencing delays on their channel. FDMA is therefore best for use in systems where all users have a stream of data to send, and it is unsuitable for users with ‘bursty’ traffic, where contention systems, such as ALOHA, perform better.

Another **disadvantage** of fixed assignment systems, such as FDMA, is that the number of users cannot easily be changed. This would require the overall channel frequency band to be redivided amongst the new users.

FDMA is also not suitable for use in systems that require the broadcast of data to many users. Since each user is allocated a single frequency band, it sends on this band and the receiver also monitors it.

An example of FDMA :
There, we see user k sending his information at one frequency and user j sending her information at a different frequency. If you know who you want to listen to, you tune your receiver to pick up transmissions at the desired user’s frequency. This system satisfies Equation , because user k is 0 at the frequencies where user j is transmitting, and user j is 0 at frequencies where user k is transmitting. That makes $s_i^k(f)s_i^j(f) = 0$, therefore $s_i^k(f)s_i^j(f)df = 0$.



The use of FDMA is also shown in Fig. Here, we see that each user is given all the time they could ever want, but they can only communicate over a small frequency band.