Multiple Access Techniques

The techniques used to access a satellite, so that the frequency spectrum and power are shared efficiently between a large number of users. A multiple access scheme must be able to optimize the following parameters:

- Satellite radiated power,
- RF spectrum,
- Connectivity,
- Adaptability to traffic and network growth,
- Handling of different types of traffic,
- Economics,
- Ground station complexity,
- Secrecy for some applications.

A trade-off analysis is necessary because a single technique cannot optimize all these parameters.

Examples:

- The provision of communications to a large number of low cost mobile terminals. → The accessing scheme should be simple, robust, flexible in order to enable sharing of the spectrum between a large number of mobiles and accommodates addition of more mobiles to the network.
- The provision of communication to a few large earth stations, each with heavy traffic. → The accessing scheme can be complex, optimizes the use of the available bandwidth and satellite power.

Multiple Access Schemes

- FDMA   (Frequency Division Multiple Access)
- TDMA   (Time Division Multiple Access)
- CDMA   (Code Division Multiple Access)

Frequency Division Multiple Access

The bandwidth BT is divided into n segments which are assigned to all n earth stations in the network according to their traffic requirements. The FDMA scheme is shown in the following figure.
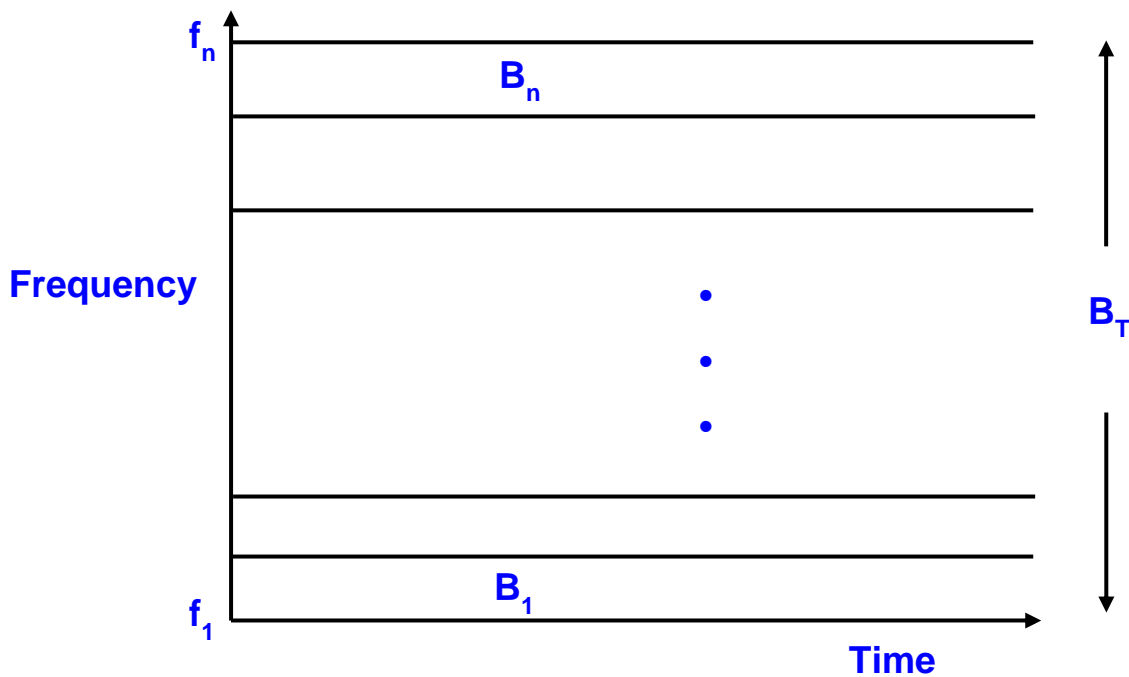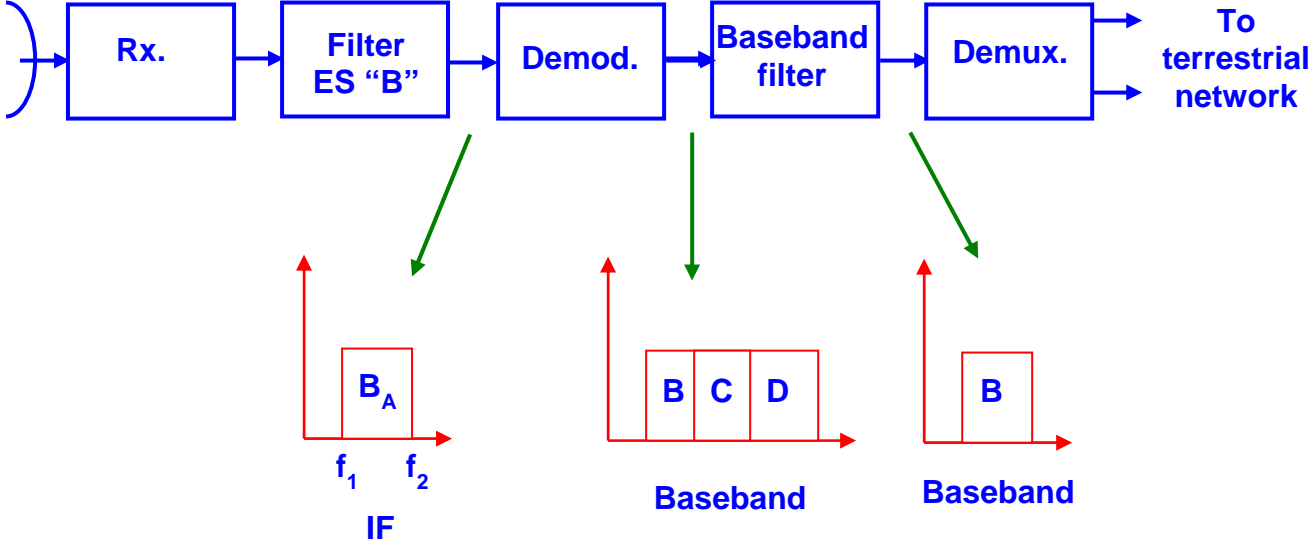

Principles of FDMA are explained with the help of a communications route between two earth stations A and B.
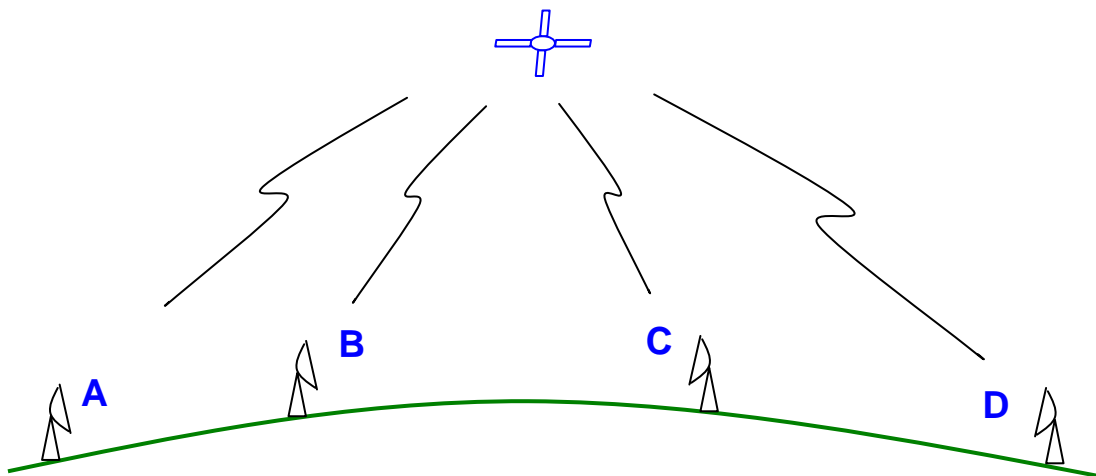
A communication route between two earth stations (A and B) in the network is shown in the following figure.
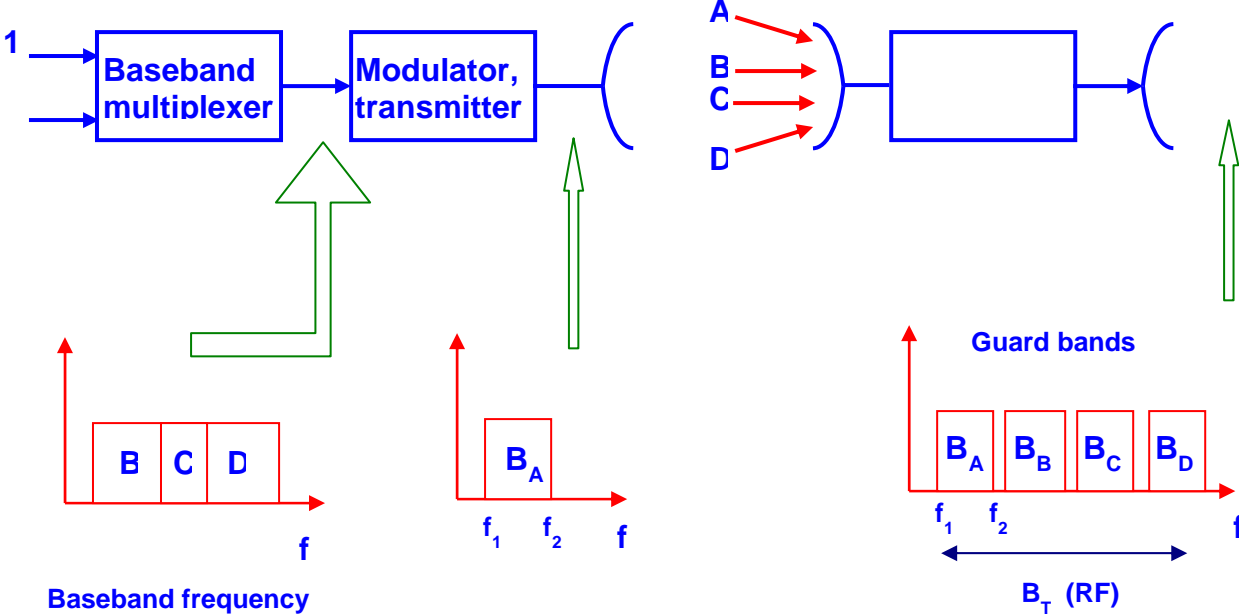
Transmitter : Earth Station A

Receiver : Earth Station A

FDMA may be divided into two main categories:

1. Multiple channel per carrier $\rightarrow$ (MCPC)
2. Single channel per carrier $\rightarrow$ (SCPC)

The previous example is for MCPC system.

Baseband filter in earth station receiver corresponds to a specific transmitting station. Any change in traffic requires the retuning of this filter.

$\therefore$ Change in traffic are difficult to implement. MCPC is further categorized according to the type of baseband.

e.g   FDM / FM / FDMA
    or   TDM / PSK / FDMA.

Single Channel per Carrier   (SCPC)

When traffic is low, e.g. service to remote areas, MCPC becomes wasteful of bandwidth because most of the channels remain unutilized for a significant part of the time. SCPC is used in this case.

In SCPC, each carrier transmits a single channel. SCPC may be pre-assigned or demand-assigned.

Pre-assigned $\rightarrow$ e.g. 5 – 10 channels are permanently assigned to an earth station.

Demand-assigned $\rightarrow$ a pool of frequencies is shared by earth stations. The earth station requests a channel from a pool manager.

Main features of FDMA

Advantages:

1. Using well established technology.
2. No need for network timing.
3. No restriction regarding the type of baseband or the type of modulation.

Disadvantages:

1. Inter-modulation noise in the transponder leads to interference with other links – satellite capacity reduction.
2. Lack of flexibility in channel allocation.
3. Requires up-link power control to maintain quality.
4. Weak carrier tend to be suppressed.