

Multiple Access Techniques in Satellite Communication

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I. INTRODUCTION

Multiple Access Techniques are used for interconnecting large number of earth station terminals through satellite, using multiple accessing techniques one earth station can communicate with all other stations using the same satellite. Multiple Accessing techniques provide wide geography coverage capability. Concept of various multiplexing techniques are used for multiple access techniques like FDM, TDM hence the various multiple access techniques used in satellite communication are FDMA (Frequency Division Multiple Access), TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access).

II. Why Multiple Access Techniques?

- Allows interconnection among various earth stations through satellite.
- The interconnection allows communication among various satellites.
- Provides wide geography coverage capability.
- These allow best utilization of satellite channel.

III. FDMA (Frequency Division Multiple Access)

In FDMA satellite frequency is divided into bands, and hence small channels are made, and one user is allowed to use the band of infinite amount of time, this type of multiple access technique is termed as Frequency division multiple access, since the accessing is done on the basis of broken frequency bands.

FDMA can be divided into two ways:

1) Fixed Assignment Multiple Access (FAMA)

2) Demand Assignment Multiple Access

- Fixed Assignment Multiple Access: The sub channel assignments are fixed, that is allotment for every sub channel is same. This type of multiple access techniques is suitable for broadcast satellite communication.
- Demand Assignment Multiple Access: The sub channel allotment depends and changes with demand, hence according to user's demand this allotment changes. This type of multiple Access technique is suitable for point to point communication.

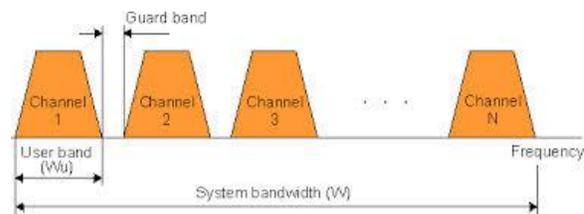
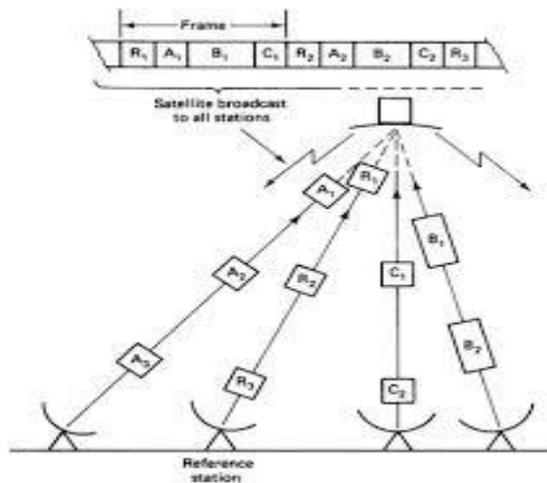


Fig. Principle of FDMA

Hence the entire bandwidth is divided and given to several channel separately, and a guard band is given so as to avoid overlapping of data.

IV. TDMA (Time Division Multiple Access)

According to this multiple earth stations transmits at the same frequency but in different time slots, that is entire frequency band is divided on the basis of time that is, one user will use the complete frequency band for a given time slot and another user will use the same frequency band for some other time slot hence like this TDMA is done.



TDMA burst structure:



TDMA frame efficiency:

$$\eta = 1 - \sum t/T_F$$

TDMA Frame Acquisition and Synchronisation:

It is very essential that the traffic stations while transmitting must transmit in the given time slot and similar goes with receiving, the aim is that the burst should not overlap with each other, this accuracy is achieved by using Frame acquisition and Frame Synchronisation.

Various timings in TDMA are Transmit Frame timing, Transmit burst timing, Receive frame timing and Receiving burst timing, and the processes of acquisition and synchronisation are receive frame acquisition, transmit frame acquisition, transmit frame synchronisation and receive frame synchronisation.

Doppler shift is used in various timings, this shift is used in various timings, on the basis of techniques for determining D_N , there are two kinds of synchronisation processes:

- 1) **Open Loop control Method** : D_N is determined by earth station directly from monitoring its own transmission.
- 2) **Closed Loop control Method**: In this bursts aren't received directly by transmitting stations but some other methods are used.

Hence there are several earth stations as shown in the above diagram, these transmit traffic bursts in a period time frame well known as TDMA frame, hence the earth stations can access the entire bandwidth of the transponder but during their time slot. There is a time termed as guard time between transmitting times of individual bursts such that bursts may not overlap.

TDMA can be of two ways :

- 1) **Fixed Assignment TDMA**
- 2) **Demand Assignment TDMA**
 - In Fixed Assignment TDMA frame is divided into time slots of fixed duration.
 - In Demand Assignment TDMA, the transmission time are demand based.

Number of voice channels n in a TDMA system is given by the expression:

$$n = (1/r) (R-NP/T)$$

r : Voice channel bit rate

T : Frame period

P : Number of digits in the preamble

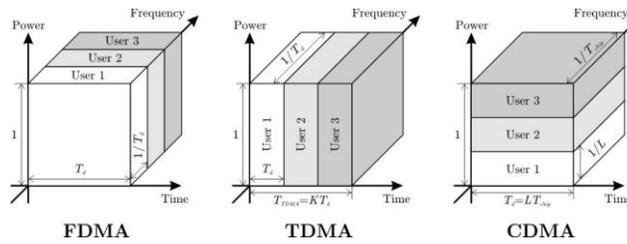
R : Satellite channel bit rate (power or band limited)

N : Number of bursts in a frame.

TDMA frame structure:

V. CDMA (Code Division Multiple Access)

CDMA uses digital format, in this several transmissions takes place simultaneously on the same frequency bandwidth. The user data at the transmitter side is combined with a code and is then transmitted and everything gets mixed in air and at the receiver's side the same code is used. Frequency reuse factor in CDMA is one.



VI. CONCLUSION

Since, we have limited bandwidth and infinite number of users hence multiple accessing technique is very essential so we have studied FDMA, TDMA and CDMA these are the widely used multiple accessing techniques in communication, hence by using these techniques satellite channel is best utilised and allows to widely cover geographical area.

REFERENCES

[1]. Satellite Communications by Dr. D.C. Agarwal
 [2]. Wireless Communications by Theodore S.Rappaport