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Multiple Access Techniques: A New Generation Mobile System

KEYWORDS: Multiple Access, Multiple Access Techniques, Duplexing

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ABSTRACT *The use of technology increases in a very quick way. Day by day technology changes. Without technology a person cannot imagine their life. A person life is completely depending upon the technology. Most of the work in human life becomes easy because of technology. A person can now talk to each other within or outside the country through various sources given by technology that are mobile phones. Laptops etc. Now in this era of technology a person cannot live without the use of technology. In a day to day life a person uses some common things which are the result of technology like laptops, mobile phone, televisions etc. it can be say that a person life depend upon the technology. Technology changes very rapidly. This paper is also deals with one of the technology related factor that is multiple access techniques. Basically multiple access means more than one transmission occur in a particular geographical area. All the wireless communication systems are multiple access system. The main purpose of the paper is to study the three important multiple access techniques that are Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA).*

INTRODUCTION

Multiple access may be defined as more than one transmission occurs in a geographical area. Basically multiple access allows many of the mobile users to share finite amount of radio spectrum simultaneously. All the wireless communication systems are multiple access system. Before explaining the techniques it is very important to explain some concepts that are used in these techniques that are Frequency division Duplexing and Time Division Duplexing.

Frequency division Duplexing (FDD): In this two bands of frequencies are available for every user that are forward band and reverse band. In this frequency duplexer needed. Here frequency separation between forward band and reverse band is constant.

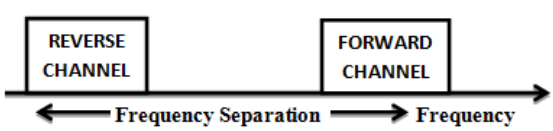

Figure 1 shows the concept of TDD

Time Division Duplexing (TDD): This uses time for forward and reverse link. Here multiple users share a single radio channel. In this type of duplexing there are two time slots that are forward time slot and reverse time slot.No duplexer is required here

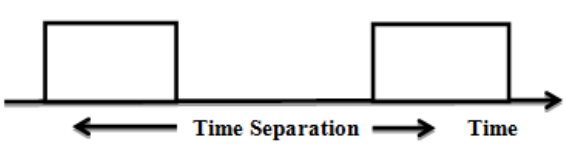

Figure 2 shows the concept of TDD

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MULTIPLE ACESS TECHNIQUES

Frequency Division Multiple Access (FDMA): FDMA was the first technique that was used in satellite. FDMA is a continuous data scheme so no synchronization is needed. FDMA was used to shift the frequency from low to high. FDM-FM-FDMA is defined as the technique when FDM-FM RF carrier was send to satellite and there it uses FDMA so that to share with other transponders. FDMA is simple in design and easy to use rather than using TDMA. In this technique of multiple access individual channels to individual users has assigned. These channels are assigned only after the demand of users who request for the service. In this technique during the call period no other user can share the same frequency band.

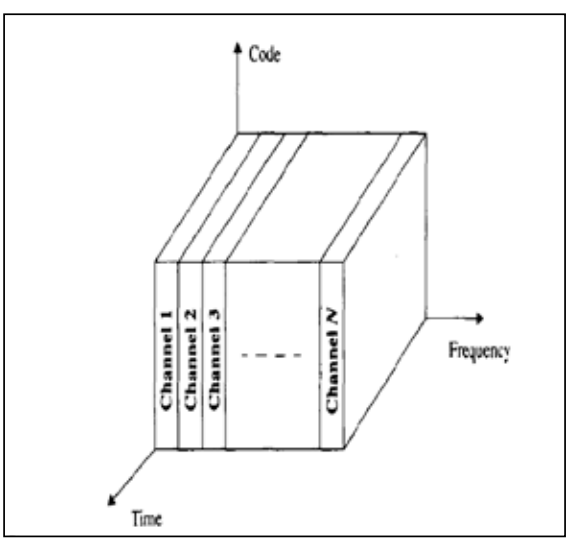

Figure 3 shows the concept of FDMA

The most important advantage of FDMA is that filters are used in this. The reasons behind using the filters are to distinguish between different signals. The most important requirement for a filter is that it must have a roll-off characteristic which means how quickly filter can change its attenuation. The requirement of FDMA is that it must have guard bands so that there is less chances of interference.

The main disadvantage of FDMA is that if FDMA channel is not in use than it remains free so there is wastage of bandwidth.

Intermodulation: This is one of the major limiting factor in FDMA that limits its performance. It is defined as the RF radiations that are undesired and interfere with other channels.

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Number of channels in FDM is given as:
N = (B – 2Bg) / Bc
Whereas N = no. of channels
B=total spectrum
Bg = guard band
Bc = channel bandwidth

Time Division Multiple Access (TDMA): This system divides the radio spectrum into time slot. In each slot only one user is allowed to transmit or receive. Basically TDMA is defined as the one of the technique in which every user is provided with a unique time slot. It is one of the burst and buffer method. This technique divides radio spectrum into different time slots. It is the technique used only with the digital system as this technique causes a delay in transmission.

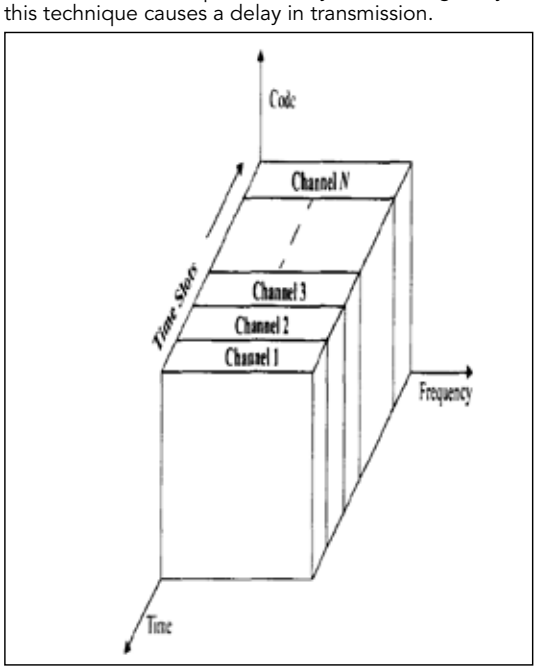

Figure 4 shows the concept of TDMA
The disadvantage of the TDMA is that it cannot be used with narrow signals. It is one of the discontinuous transmission schemes as data rate in slot continuous so synchronization is needed in case of TDMA.

In TDMA handoff is very easy because of non-continuous data transmission scheme. Handoff means when mobile moves from one cell to another and received the signal from other BTS (base transceiver station).

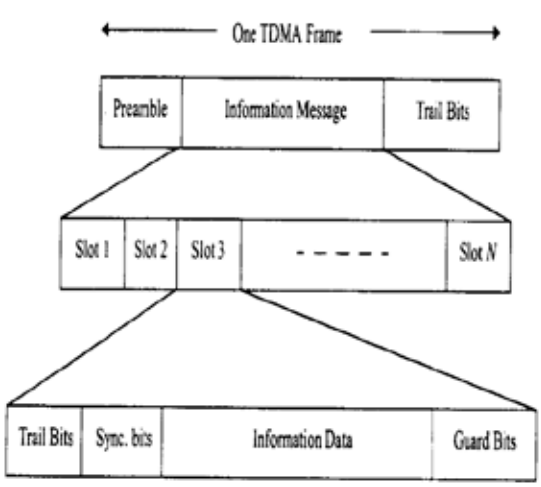

Figure 5 shows the TDMA structure.

Efficiency of TDMA is given as:
Bt = Tf * R
Whereas Bt= total no. of bits per frame
Tf = frame duration
R = channel bit rate

Code Division Multiple Access (CDMA): This plays a very important role in all the technologies such as 3G etc. CDMA is defined as the technique in which all the users can see on same frequency and at same time slot. In this technique there is spreading signal which is the multiplication of message signal and large bandwidth signal. Spreading signal is defined as the pseudo code sequence that has very high chip rate. In this technique every user has its own PN code. CDMA uses the co channel cells technique. It provides soft hand off or soft handover which means MAKE BEFORE BREAK.

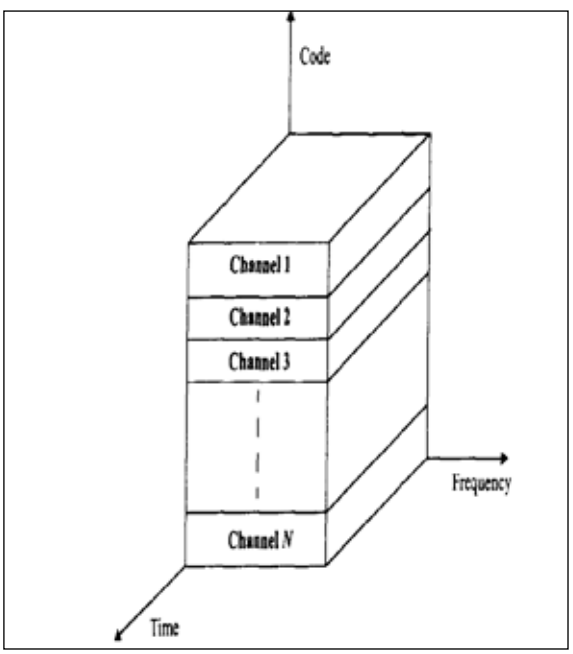

Figure 6 shows the concept of CDMA
The most important advantage of CDMA is Soft handover. CDMA has soft capacity limit. In this technique of multiple access a RAKE receiver is used to improve reception by collecting delayed time versions.

The main disadvantage of using CDMA is that there is a problem of Jamming. Jamming is defined as that which occurs as spreading codes are not orthogonal which means perpendicular. This technique is also called spread spectrum.

Spread spectrum Principle: This principle says that:

- The bandwidth provided to every station must be large than the bandwidth that is needed.
- The spreading of the original bandwidth say 'B' to the bandwidth 'Bss' must done with the help of the process which is independent of original signal.

Types of Spread Spectrum: There are two types of Spread Spectrum that are Direct Sequence Spread Spectrum (DS-SS) and Frequency Hoping Spread Spectrum (FH-SS)

Direct Sequence Spread Spectrum (DS-SS): This is defined as the method in which codes are used to spread signal on a large bandwidth and then reconstruct on destination side by using same codes that are used on source side. Direct sequence spread spectrum is mostly used in satellite communication. In simple words it is defined as expansion of bandwidth.

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Frequency Hoping Spread Spectrum (FH-SS): This is defined as that in which the carrier frequency changes in random way inside a channel. The information or data divides into small and then transmitted on carrier frequency. In this at one time signal modulates one carrier frequency and at another time signal modulates different carrier frequency. The main advantage of this technique is that it provides high security and also reduces the chances of fading. It is mainly used in Bluetooth system. This is of two types Fast Frequency Hoping System and Slow Frequency Hoping System.

Fast Frequency Hoping System: If the rate of change of carrier frequency is more than that of symbol rate than this is known as Fast Frequency Hoping System.

Slow Frequency Hoping System: If the channel changes at a rate less than or equal to symbol rate than this is known as Slow Frequency Hoping System.

CONCLUSION

In the modern era of technology the use of technology increased day to day life. Most of the work of the person depends upon the things made with the use of technology. So it is very important to be aware of the technologies used. The main purpose of the paper is to discuss the important technology related to wireless systems that is multiple access systems and there important techniques which are used in the recent era of technology. The main objective is to discuss the multiple access techniques that are Frequency Division Multiple Access (FDMA), Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA). These techniques used in various wireless systems. This study concludes that every person should aware of the technology development and the recent technologies used in this era.

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