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Comparative Study of TDMA and CDMA Technology

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Abstract: Since the mid-1990s, the cellular industry has witnessed high growth. The rapid growth in cellular telephone subscribers has demonstrated that wireless communication is a developing and useful voice and data transport. New standards and technologies are being implemented to allow wireless networks to provide access to several users efficiently. In any cellular system it is requiredto have a technique that can handle multiple users at any given time. There are a number of requirements that any multiple access technology must be able to meet: 1.) Ability to handle several users without mutual interference, 2.) Ability to be able to maximize the spectrum efficiency, 3.) Must be robust, enabling ease of handover between cells.This paper compares two multiple access techniques: "TDMA" vs. "CDMA"
Keywords: Multiple access techniques, TDMA, CDMA.

I.   INTRODUCTION

In any cellular system or cellular technology, it is required to have a method that enables several multiple usersaccessit and use it simultaneously. As cellular technology has progressed, different multiple access schemes have been used. TDMA, FDMA, CDMA are three major access technique, that is used in wireless communication system. 1G (analog cellular systems) systems use analog Frequency Modulation (FM) and have Frequency Division Multiple Access (FDMA) media access control architecture.2G cellular systems use digital modulation and processing techniques. Time Division Multiple Access (TDMA)-based and Code Division Multiple Access (CDMA)-based standards are used in 2G. 3G network supports voice calling, mobile internet, video calls, and it uses CDMA based standards.

II.   TDMA (TIME DIVISION MULTIPLE ACCESS)

TDMA systems divide the radio spectrum into time slots. And in each slot only one user is allowed to either transmit or receive. It allows different users to share same frequency by dividing the signal into time slots. Each user gets a time slot successively. A channel may be thought of as a particular time slot that reoccurs every frame, where N time slots comprise a frame. TDMA is a kind of Time-division multiplexing, but instead of having one transmitter connected to one receiver, there are multiple transmitters.
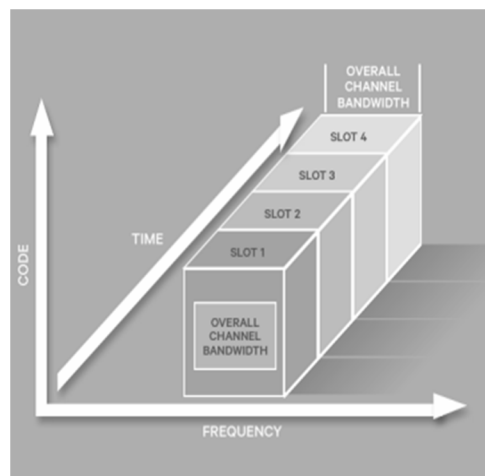

Fig.1 TDMA scheme where each channel occupies a cyclically repeating time slot.

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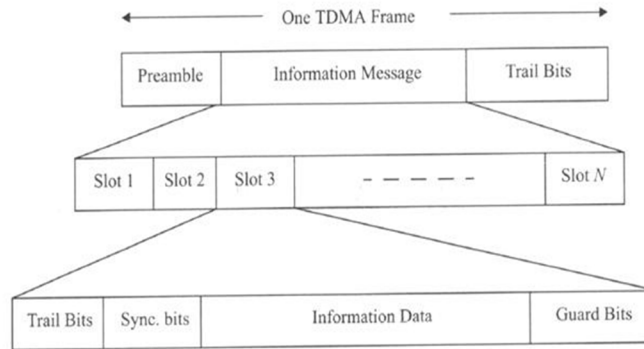

Fig.2 TDMA frames structure.

It can be seen that a frame consists of a number of slots. Each frame is made up of a preamble, information message and trail bits. In TDMA/TDD, half of the time slots in the frame information message would be used for the forward link channels and half would be used for reverse link channels. In TDMA/FDD systems, an identical or similar frame structure would be used for forward or reverse transmission, but carrier frequencies will be different for both the channel. TDMA frame preamble contains the address and synchronization information that both the base station and the subscriber use to identify each other. Guard times is used to allow the synchronization of the receivers between different slots and frames.

III.   CDMA (CODE DIVISION MULTIPLE ACCESS)

CDMA is a spread spectrum technique, where many transmitters can send signal simultaneously through single channel.
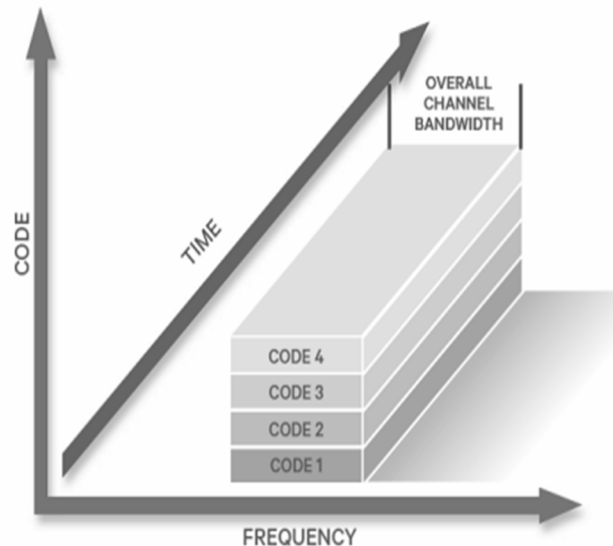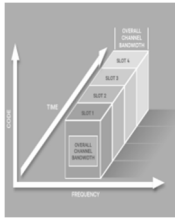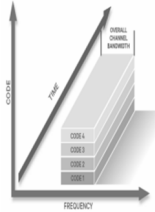

Fig.3 CDMA technique

In CDMA systems, the narrowband message signal is multiplied by a very large bandwidth signal called the spreading signal. The spreading signal is a pseudo-noise code sequence that has a chip rate which is greater than the data rate of the message. Each user has its own pseudorandom codeword which is orthogonal to all other code words. The receiver performs a time correlation operation to detect only the specific desired codeword. All other code words appear as noise due decorrelation. For detection of the message signal, the receiver needs to know the codeword used by the transmitter. In CDMA near-far problems occur where transmitters share transmission frequencies and transmission time. Near-far problem is a condition in which a receiver captures a strong signal and thereby makes it impossible for the receiver to detect a weaker signal.

101

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IV.   TDMA VS. CDMA

S.no	Parameters	TDMA	CDMA
1	Technique	In this technique, time of the channel is shared by multiple users	In this technique, time as well as bandwidth of the channel is shared by multiple users
2	Structure		
3	Interference effect	Interference between users of adjacent time slots generated because of incorrect synchronization	Far-near problems occur in CDMA. But frequency hopping effect is less
4	Signal separation	Synchronization in the time domain	Code words plus special receivers
5	Codeword	No code is required	Code words or signature waveforms are required
6	Advantages	1. Data transmission for users of a TDMA is not continuous, but occurs in bursts. This results in low battery consumption. 2. Because of discontinuous transmissions, the handoff process is much simpler for subscriber unit, since it is able to listen for other base stations during idle time slots.	1. It has a very high spectral capacity that it can accommodate more users per MHz of bandwidth. 2. Multi path fading may be substantially reduced because the signal is spread over a large spectrum.
7	Disadvantages	1. Guard times are required 2. synchronization is difficult	1. complex receivers 2. needs more complicated power control for senders

V.   CONCLUSION

CDMA has three times the capacity of TDMA. CDMA is the first technology to use soft handoff, which allows a handset to communicate with different base stations simultaneously. In contrast to CDMA, TDMA users experience interruption when signal is handed off, resulting in higher interference during handoff and increased call drops. CDMA has higher immunity to interference. With better advancements and qualities in CDMA, it has several disadvantages such as the system is little complicated, the overall performance degrades with the increase in number of users.

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