CDMA

Code Division Multiple Access

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About the Tutorial

Code Division Multiple Access (CDMA) is a channel access method normally used by 3G radio communication technology as well as in some other technologies. The technicality of CDMA technology has given significant advantages over other parallel technologies in terms of spectrum efficiency and overall performance.

This is a brief tutorial that describes all the technical terms in a simple language to make it understandable for all the interested readers.

Audience

The tutorial is designed for all those readers who are planning or pursuing the CDMA course to make their career in this field. However, it is also meant for the common readers who simply want to understand — what is CDMA Technology?

Prerequisites

This tutorial provides a basic overview of CDMA in a user-friendly way. We have tried to keep it simple enough so that it would be useful to any reader. A general awareness of some basics of telecommunications is sufficient to understand the concepts explained in this tutorial.

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1. CDMA – Introduction

What is CDMA?

Code **D**ivision **M**ultiple **A**ccess (CDMA) is a digital cellular technology used for mobile communication. CDMA is the base on which access methods such as cdmaOne, CDMA-2000, and WCDMA are built. CDMA cellular systems are deemed superior to FDMA and TDMA, which is why CDMA plays a critical role in building efficient, robust, and secure radio communication systems.

A Simple Analogy

Let's take a simple analogy to understand the concept of CDMA. Assume we have a few students gathered in a classroom who would like to talk to each other simultaneously. Nothing would be audible if everyone starts speaking at the same time. Either they must take turns to speak or use different languages to communicate.

The second option is quite similar to CDMA — students speaking the same language can understand each other, while other languages are perceived as noise and rejected. Similarly, in radio CDMA, each group of users is given a shared code. Many codes occupy the same channel, but only those users associated with a particular code can communicate.

Salient Features of CDMA

CDMA, which is based on the spread spectrum technique has following salient features:

- In CDMA, every channel uses the full available spectrum.
- Individual conversations are encoded with a pseudo-random digital sequence and then transmitted using a wide frequency range.
- CDMA consistently provides better capacity for voice and data communications, allowing more subscribers to connect at any given time.
- CDMA is the common platform on which 3G technologies are built. For 3G, CDMA uses 1x EV-DO and EV-DV.

Third Generation Standards

CDMA2000 uses Frequency Division Duplexing-Multicarrier (FDD-MC) mode. Here, multicarrier implies N x 1.25 MHz channels overlaid on N existing IS-95 carriers or deployed on unoccupied spectrum. CDMA2000 includes:

- 1x —uses a spreading rate of 1.2288 Mcps.
- 3x —uses a spreading rate of 3 x 1.2288 Mcps or 3.6864 Mcps.

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- 1xEV-DO (1x Evolution – Data Optimized)—uses a spreading rate of 1.2288 Mcps, optimized for the data.
- WCDMA/FDD-DS — Wideband CDMA (WCDMA) Frequency Division Duplexing-Direct Sequence spreading (FDD-DS) mode. This has a single 5 MHz channel. WCDMA uses a single carrier per channel and employs a spreading rate of 3.84 Mcps.

CDMA Development Group (CDG)

The CDMA Development Group (CDG), founded in December 1993, is an international consortium of companies. It works together to lead the growth and evolution of advanced wireless telecommunication systems.

CDG is comprised of service providers, infrastructure manufacturers, device vendors, test equipment vendors, application developers, and content providers. Its members jointly define the technical requirements for the development of complementary systems CDMA2000 and 4G. Further, the interoperability with other emerging wireless technologies are meant to increase the availability of wireless products and services to consumers and businesses worldwide.

IMT-2000 System

	IMT-DS (Direct Sequence)	IMT-MC (Multi Carrier)	IMT-TC (Time Code)	IMT-SC (Single Carrier)	IMT-FT (Frequency Time)
Popular name	W-CDMA	CDMA2000	UTRA-TDD TD-CDMA TD-SCDMA	UWC-136	DECT
Access method	CDMA-FDD	CDMA-FDD	CDMA-TDD	TDMA-FDD	TDMA-TDD
Organization Partners	ARIB/TTC CWTS ESTI T1 TTA	ARIB/TTC CWTS TIA TTA	CWTS ESTI T1 TTA	TIA	ESTI
Body of Technical Spec production	3GPP(FDD)	3GPP2	3GPP(TDD) CWTS	IS-136	DECT

Approved in 2000 as ITU-R M.1457

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2. CDMA – Channels

CDMA channels can be broadly categorized as Forward channel and Reverse channel. This chapter explains the functionalities of these channels.

Forward Channel

The Forward channel is the direction of the communication or mobile-to-cell downlink path. It includes the following channels:

I. Pilot Channel

Pilot channel is a reference channel. It uses the mobile station to acquire the time and as a phase reference for coherent demodulation. It is continuously transmitted by each base station on each active CDMA frequency. And, each mobile station tracks this signal continuously.

II. Sync Channel

Synchronization channel carries a single, repeating message, which gives the information about the time and system configuration to the mobile station. Likewise, the mobile station can have the exact system time by the means of synchronizing to the short code.

III. Paging Channel

Paging Channel's main objective is to send out pages, that is, notifications of incoming calls, to the mobile stations. The base station uses these pages to transmit system overhead information and mobile station specific messages.

IV. Forward Traffic Channel

Forward Traffic Channels are code channels. It is used to assign calls, usually voice and signaling traffic to the individual users.

Reverse Channel

The Reverse channel is the mobile-to-cell direction of communication or the uplink path. It consists of the following channels:

I. Access Channel

Access channel is used by mobile stations to establish a communication with the base station or to answer Paging Channel messages. The access channel is used for short signaling message exchanges such as call-ups, responses to pages and registrations.

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II. Reverse Traffic Channel

Reverse traffic channel is used by the individual users in their actual calls to transmit traffic from a single mobile station to one or more base stations.

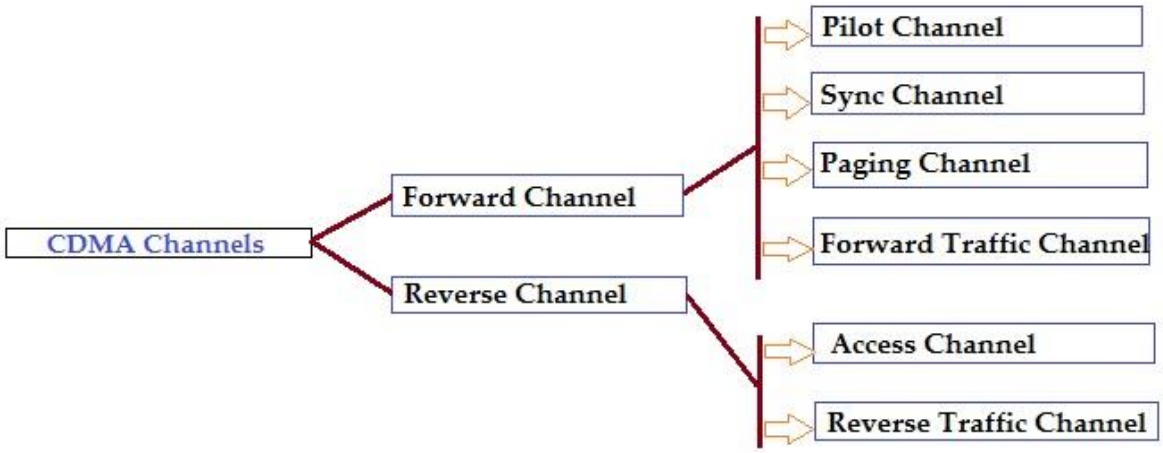

Figure: CDMA Channels

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