Simulation of CDMA Technology

Rucha Dubbewar[1] Gaurav Kambli[2] Rakesh Vodnala[3] Roshan Kelaskar[4] Mrs. Vidya Kawtikwar[5]
[1,2,3,4]Student [5]Guide
[1,2,3,4,5]Department of Information and Technology
[1,2,3,4,5]Mumbai University Padmabhushan Vasantdada Patil Pratishthan's College Of Engineering Sion, Chunabhatti, Mumbai – 400022

Abstract— This paper studies CDMA simulation technology. CDMA spread spectrum signaling techniques have gained increasing importance over the past few years. Long used in military systems such as GPS, they are finding increased usage in the cellular communication market. CDMA uses revolutionary techniques to provide a superior cellular service to its subscribers making it the choice data transmission technique to dominate the data transmission market in the near future.

Key words: CDMA (Code Division Multiple Access), Walsh code, TDMA (Time Division Mulyiple Access), GSM (Global System for Mobile), Viberti, symbolic repetition

I. INTRODUCTION

Our Project has been divided into two modules; Transmitter and Receiver.

The transmitter has following components:

1) Source Encoder
2) Multiplexer
3) Channel coder
4) PN coder

The receiver has following components:

1) PN coder
2) Channel Decoder
3) Demultiplexer
4) Source Decoder

The transmitter takes the input from the user in textual format. Source encoding is then performed on this text to render the equivalent ASCII code by Multiplexing. Channel coding performs convolution, symbol repetition and block interleaving on the coding. Finally this output is XORed with the PN code, the output of which is transmitted to the receiver. At the receiver side, the code received from the transmitter undergoes a reverse process analogous to that at the transmitter. Thus the code is first XOR-ed with the PN code. Viterbi decoding is then applied to the output of XOR .DE multiplexing then checks the parity of the message, which is then source decoded to generate the plain text message.

II. EXISTING SYSTEM

Time division multiple access (TDMA) is digital transmission technology that allows a number of users to access a single radiofrequency (RF) channel without interference by allocating unique time slots to each user within each channel. The TDMA digital transmission scheme multiplexes three signals over a single channel. The current TDMA standard for cellular divides a single channel into six time slots, with each signal using two slots, providing a 3 to 1 gain in capacity over advanced mobile-phone service (AMPS). Each caller is assigned a specific time slot for transmission.

A. Advantages:

1) TDMA offers the ability to carry data rates of 64 kbps to 120 Mbps (expandable in multiples of 64 kbps).
2) TDMA also provides the user with extended battery life and talk time since the mobile is only transmitting a portion of the time (from 1/3 to 1/10) of the time during conversations.
3) TDMA installations offer substantial savings in base-station equipment, space, and maintenance, an important factor as cell sizes grow ever smaller.
4) TDMA is the most cost-effective technology for upgrading a current analog system to digital.

B. Disadvantages:

1) One of the disadvantages of TDMA is that each user has a predefined time slot. However, users roaming from one cell to another are not allotted a time slot. Thus, if all the time slots in the next cell are already occupied, a call might well be disconnected.
2) Another problem with TDMA is that it is subjected to multipath distortion. A signal coming from a tower to a handset might come from any one of several directions. It might have bounced off several different buildings before arriving
3) There is data loss due to interference.
4) Security in existing system in not achieved.
5) Limited variety of the handset, because at present the major mobile companies use CDMA technology.

III. PROPOSED SYSTEM

Our project is to simulate the CDMA system. It consists of the transmitter and the receiver, which are developed as two separate modules. The block diagram of the system is :

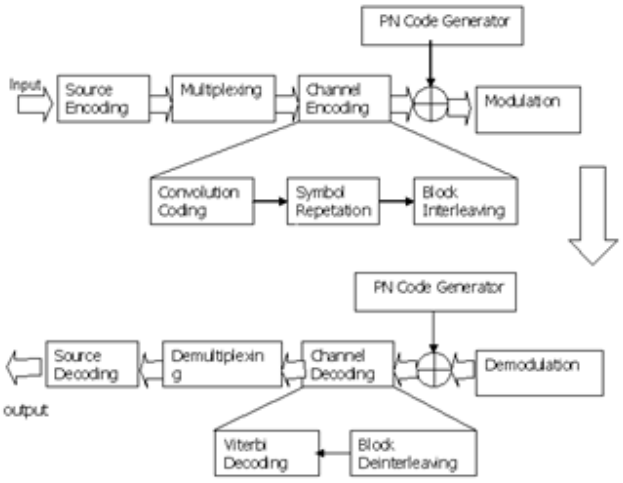

Fig 1.Block diagram of the CDMA technology

A. Transmitter:

The different sections of the transmitter as can be seen are:

1) Source Encoder
2) Multiplexer
3) Channel Coder
4) PN Coder

1) Source Encoder:

The source encoder takes as input the text message, which is passed by the user to the system. The message is then converted into a string of alphanumeric characters depending on the content of the message. An SQL database is then used to compare the characters to the contents in the database which then gives the code ASCII code for the character. This ASCII code is then passed to the next module which is the Multiplexer.

2) Multiplexer:

The multiplexer module takes as input the output of the source encoder .The CRC bits are appended to the message here. The polynomial used for the CRC bits is the first-degree polynomial, which is (x+1).This polynomial gives us the security of the parity bits. Thus, a one bit parity is appended to the message in this stage. The output of this stage is then passed to the next level, which is the Channel Coder.

3) Channel Coding:

Channel coding protects data against transmission errors to ensure adequate transmission quality (bit or frame error rate) Channel coding is power efficient Compared to the uncoded case, the same error rates are achieved with much less transmit power at the expense of a bandwidth expansion.

The channel coding includes three modules:

1) Convolutional Coding
2) Symbol Repetition
3) Block Interleaving
4) PN Code Generator

The output of the Channel Coder is combined with the PN Code. The PN code generator generates the PN Code. The Pseudorandom Noise (PN) Code that we use is the W5 Walsh Code.

4) PN Coder:

The PN code at the receiver is same as that used at the transmitter. Ideally the PN code should be unique to pair of users. Here, as we are simulating the actual system, we make use of the same PN code at the sender as well as the receiver. Thus we use the W5 Walsh code. This PN code is combined with the received message. The output thus obtained is then given to the Channel Decoder.

B. Receiver:

The receiver can be compartmentalized into:

1) PN Coder
2) Channel Decoder
3) Demultiplexer
4) Source Decoder

1) PN Coder:

The PN code at the receiver is same as that used at the transmitter. Ideally the PN code should be unique to pair of users. Here, as we are simulating the actual system, we make use of the same PN code at the sender as well as the receiver. Thus we use the W5 Walsh code. This PN code is combined with the received message. The output thus obtained is then given to the Channel Decoder.

2) Channel Decoder:

The Channel decoder has the following two parts:

- Block Deinterleaver
- Viterbi Decoder

3) Demultiplexer:

The demultiplexer takes as input, the output of the Channel Decoder. The polynomial, i.e. (x+1), which was used at the transmitter, is used here too. The parity of the input is computed by using the polynomial. This computed parity is checked against the received parity. If both the values are same, it implies no error has occurred otherwise there is an error. If there is no error then the parity bit is removed from the message and the rest of it is sent to the source decoder.

4) Source Decoder:

The source decoder compares the input message characters to the database. The corresponding characters are returned after the ASCII code is matched. Thus we get the plain text as the output of the Source decoder. This plain text message is presented to the user. Thus, the message that originated at the transmitter is successfully received at the receiver.

IV. ALGORITHMS

A. Convolutional Codes:

Convolutional codes are widely used to encode digital data before transmission through noisy or error-prone channels. During encoding, k input bits are mapped to n output bits to give a rate k/n coded bit stream. The encoder consists of a shift register of kL stages, where L is described as the constraint length of the code.

B. Symbol Repetition and Block Interleaving:

The output of the convolutional coder, i.e. O1 and O2 then undergo symbol repetition and block interleaving. The symbol repetition has two repetitions of the symbols as:

C. Walsh Code:

It is 64 chips long, having the chip rate of 1. 2288 Mcps this corresponds to a period of 52 micro sec. It runs at 1. 2288 mega chips per sec (Mcps), used in combination in the Forward and Reverse Link Channels. It provides us with reasonable amount of security along with a good speed.

D. Block Deinterleaving:

The advantage of block deinterleaving and symbol repetition is that, even though burst error occurs and some part of the message is lost in the path we can still recover the message correctly using the above process.

E. Vitrebi Decoding:

At the receiver, the bitstream can be decoded to recover the original data, correcting errors in the process. The optimum decoding method is maximum-likelihood decoding where the decoder attempts to find the closest "valid" sequence to the received bitstream. The most popular algorithm for maximum-likelihood decoding is the Viterbi Algorithm. The possible received bit sequences form a "trellis" structure and the Viterbi Algorithm tracks likely paths through the trellis before choosing the most likely path. The Viterbi algorithm was originally conceived as an error-correction scheme for noisy digital communication links, finding universal application in decoding the convolutional codes used in both CDMA and GSM digital cellular, dial-up modems, satellite, deep-space communications, and 802.11 wireless LANs. It is now also commonly used in speech recognition, keyword

spotting, computational linguistics, and bioinformatics. For example, in speech-to-text speech recognition, the acoustic signal is treated as the observed sequence of events, and a string of text is considered to be the "hidden cause" of the acoustic signal. The Viterbi algorithm finds the most likely string of text given the acoustic signal.

Current BA	C	BA	XY	Next BA
00	0	000	00	00
00	1	100	11	10
01	0	001	11	00
01	1	101	00	10
10	0	010	10	01
10	1	110	01	11
11	0	011	01	01
11	1	111	10	11

Table 1: Viterbi algorithm

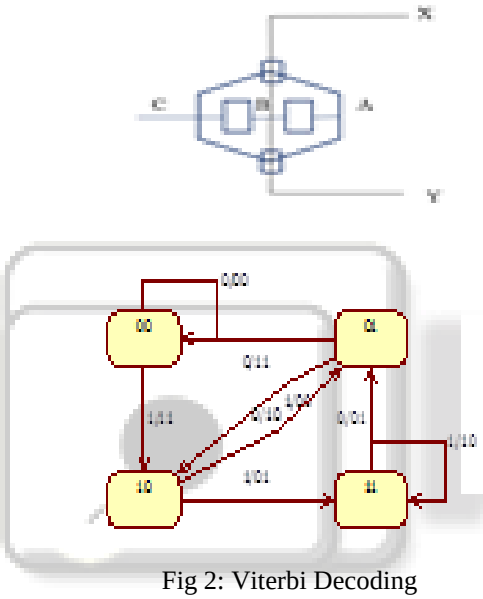

Fig 2: Viterbi Decoding

Viterbi Decoding is performed to detect and correct the errors and recover the original message from the given code. We make use of the state table to implement the Viterbi algorithm. As the probability of error in our system is very less, we require minimal security and hence the Viterbi algorithm is implemented in a make shift manner.The output of the Viterbi algorithm is given to the Demultiplexer. The combined code is transmitted to the receiver. At the receiver side the reverse processing of the message is done to recover the plain text that the user wanted to send to the receiver.

V. REQUIREMENT SPECIFICATION

A. *Hardware Requirement:*

1) Pentium IV or Above Processor

The Java Web Server 2.0 product is designed for corporate developers, independent software vendors, system managers and web masters who also need an easy-to-administer environment. Java Web Server 2.0 provides on-the-fly configuration.

2) 512 MB RAM

B. *Software Requirement:*

1) WINDOWS 7 OS.

2) JDK 1.6.0.

The Java 2 SDK is a development environment for building applications, applets, and components that can be deployed on implementations of the Java 2 Platform.The Java 2 SDK includes tools useful for developing and testing programs written in the Java programming language and running on the Java platform. These tools are designed to be used from the command line. Except for appletviewer, these tools do not provide a graphical user interface.

3) Tomcat Server.

Apache tomcat is an open source web server and servlet container developed by the Apache software foundation (ASF). It implements several Java EE specification including Java servlet, Java server pages, Java EL, and web sockets, and provides a pure Java HTTP web server environment for java code to run-in.

4) SQL Database Server:

Microsoft SQL Server is a database available for Windows NT, 2000 and XP servers. It represents a proprietary, single platform solution whose data is not easily transferable to other operating systems. Microsoft SQL Server 2000 includes several new features that make it an excellent database platform for large-scale online transactional processing (OLTP), data warehousing, and e-commerce applications.

5) Dragon Natural Speaking:

Dragon NaturallySpeaking lets you talk to your computer instead oftyping. As you talk, your words are transcribed onto your screen and into your documents or e-mail messages.Talking to a computer while it types what you say is called dictating. You can dictate into Microsoft® Word, Corel® WordPerfect®, e-mail programs,personal information organizers, and virtually any other program in which you normally type.

6) Java Servlets:

Servlets are Java technology's answer to CGI programming. They are programs that run on a Web server and build Web pages. Building Web pages on the fly is useful (and commonly done) for a number of reasons like The Web page is based on data submitted by the user. For example the results pages from search engines are generated this way, and programs that process orders for e-commerce sites do this as well. The data changes frequently. For example, a weather-report or news headlines page might build the page dynamically, perhaps returning a previously built page if it is still up to date.

7) Microsoft PowerPoint:

PowerPoint presentations consist of a number of individual pages or "slides". The "slide" analogy is a reference to the slide projector. A better analogy would be the "foils" (or transparencies/plastic sheets) that are shown with an overhead projector, although they are in decline now. Slides may contain text, graphics, sound, movies, and other objects, which may be arranged freely.

8) Microsoft Word:

A full-featured word processing program for Windows and Mac OS X from Microsoft. Available stand-alone or as part of the Microsoft Office suite, Word contains rudimentary

desktop publishing capabilities and is the most widely used word processing program on the market.

VI. RESULTS

Fig. 3: Results

VII. CONCLUSION

A. Summary:

1) CDMA Is Efficient:

CDMA requires fewer cell sites than the GSM and TDMA digital cell phone systems and provides three to five times the calling capacity. Providing more than 10 times the capacity of the analog cell phone system (AMPS), CDMA has become widely used in North America and is also expected to become the third-generation (3G) technology for GSM. For example, in the U.S., the Verizon and Sprint cell phone services are based on CDMA.

2) Spread Spectrum:

Unlike the other digital systems that divide the spectrum into different time slots, CDMA's spread spectrum technique overlaps every transmission on the same carrier frequency by assigning a unique code to each conversation. The often-used analogy for this is your ability to detect your own language in a room full of people speaking other languages.

3) More Secure:

CDMA transmission has been used by the military for secure phone calls. Unlike FDMA and TDMA, CDMA's wide spreading signal makes it difficult to detect and jam.

B. Future Scope:

- Text-to-voice: Voice input at the transmitter can be obtained as voice output at the receiver with the help of special software.
- Identification of sender and receiver: In case of more than one sender and receiver, we can provide the facility of identifying transmitter and intended receiver.
- MMS: Still and moving images can be transmitted using our software.

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