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Digital Video Broadcasting Terrestrial in TD-SCDMA Compatible OFDM Systems

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ABSTRACT: Digital Video Broadcasting Terrestrial (DVB-T) based OFDM transmission and receptions are investigated. The subject of interference in communications systems is as old as communications itself. The subject of interference received special attention each time people concentrated on the usage of wireless systems on a large scale, as during the decade of 1970–1980 with the implementation of satellite systems and from 1995 until today with the large-scale applications of mobile systems. As the extension for the cellular mobile communication system, the TD-SCDMA compatible OFDM system is very essential for the integration of the third generation mobile communications system. The air interface of the system is compatible with TD-SCDMA, time division duplexing (TDD) mode. As the other CDMA-based systems In the process of interference cancellation we minimized the rate of interference in open channel. Channel coding plays a very important role in OFDM systems performance, channel or signal to noise ratio in each carrier. OFDM system consisting of two transmitters and a single receiver. Simple Alamouti space time code is used. An Mary PSK modulation is used to modulate the symbols across an OFDM channel.. SER performance of the above systems is carried out with emphasis on the modulation scheme and number of carriers. The design process simulates in MATLAB

Keywords. Digital Video Broadcasting, OFDM, TD-SCDMA.

I. INTRODUCTION

Orthogonal Frequency division Multiplexing (OFDM) has been applied widely in wireless communication systems due to its high data rate transmission capability with high bandwidth efficiency and its robustness to multi path delay. OFDM introduces Cyclic Prefix (CP), which eliminates the Inter-Symbol-Interference (ISI) between OFDM symbols [1] and its high data rates are available without having to pay for extra bandwidth [2]. With these advantages, OFDM is widely accepted in numerous wireless standards such as Digital Video Broadcasting (DVB), Digital Audio Broadcasting (DAB), Wireless Metropolitan Area Network (WMAN) and Wireless Local Area Network (WLAN). For efficient design of coherent receiver, channel estimation plays a vital role [3]. Efficient demodulation can be achieved by using dynamic channel estimation because the radio channel is frequency selective and time-varying for wideband mobile Communication systems. Channel estimation refers to the estimation of transmitted signals bits using the corresponding received signals bits [4]. Mainly there are three types of channel estimation, which are as follows: i) Blind ii) Non-blind and iii) Semi-blind. In blind technique, there is no need for transmitted data for channel estimation. It saves the training overhead and also excellent for applications where bandwidth is limited. On the other hand it has the drawback of being extremely computationally intensive. Non-blind channel estimation is another approach in which some portion of known information is transmitted to the receiver, which is then used for channel estimation. It has better results as compared to blind estimation.

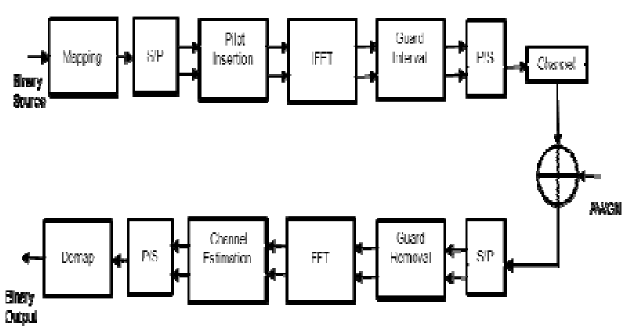

Fig. 1. Typical OFDM Base band Transceiver.

II. TD-SCDMA

TD-SCDMA is a joint venture between the Chinese Academy of Telecommunications Technology (CATT) and Siemens Information and Communication Mobile Group (Siemens IC Mobile). The concept for TD-SCDMA was originally submitted to the International Telecommunications Union (ITU) as a separate candidate submission for IMT-2000, but since then has also been incorporated into the Universal Terrestrial Radio Access - Time Division Duplex (UTRA TDD) proposal. The Chinese Ministry of Information Industry and Chinese Wireless Telecommunication Standard group (CWTS) were also instrumental in submitting this new technology for international review, but most of the technical information was originated by the previous two sources. [14], As stated in their objectives, the IMT-2000 project was instituted to promote support for harmonizing international frequency spectrums and developing compatible mobile telecommunications systems. This goal has not yet been fully realized, but the international community has narrowed development of 3G te.

III. MOBILE SATELLITE SYSTEM (MSS)

The channel characterization of a mobile satellite communication which is an important and fast growing arm of wireless communication plays an important role in the transmission of information through a propagation medium from the transmitter to the receiver with minimum barest error rate putting into consideration the channel impairments of different geographical locations like urban, suburban, rural and hilly. The information transmitted from satellite to mobile terminals suffers amplitude attenuation and phase variation which is caused by multi path fading and signal shadowing effects of the environment. These channel impairments are commonly described by three fading Phenomena which are Rayleigh fading, Racian fading and Log-normal fading which which characterizes signal propagation in different environments. They are mixed in different proportions by different researchers to form a model to describe particular channel. Characterizes signal propagation in different environments. They are mixed in different proportions by different researchers to form a model to describe a particular channel. The mobile communication system is better than terrestrial system because it provides the better coverage, only three or four GEO are required to cover whole area of earth, so it saves installation cost, for the base stations and wire. The other advantage of MSS over normal terrestrial system is there are many remote areas where humans are unable to reach such as where the cannibals live or, or area captured by terrorists we can use The regular time intervals allow a mobile to accurately detect changes in the propagation delay and to adjust its transmission time such that its signal may arrive synchronously with other users in the same cell. Although this is possible for FDD operation as well, it is more easily implemented in TDD [9].

IV. SERIAL TO PARALLEL CONVERSION

The input serial data stream is formatted into the word size required for transmission, e.g. 2 bits/word for QPSK, and shifted into a parallel format. The data is then transmitted in parallel by assigning each data word to one carrier in the transmission.

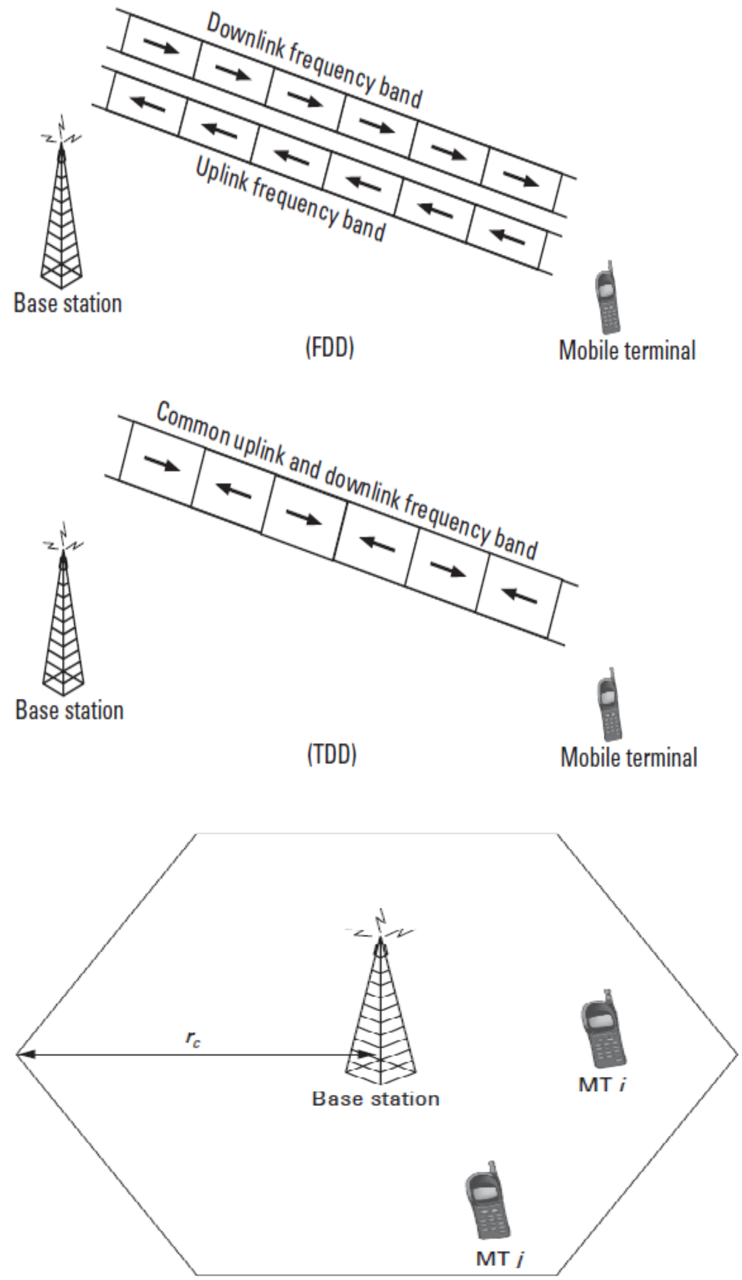

Fig. 2. Base station.

V. OFDM SYSTEMS

The idea was to use parallel data streams and FDM with overlapping sub channels to avoid the use of high-speed equalization and to combat impulsive noise, and multi path distortion as well as to fully use the available bandwidth. The initial applications were in the military communications.

Weinstein and Ebert [5] applied the discrete Fourier transform (DFT) to parallel data transmission system as part of the modulation and demodulation process. In the 1980s, OFDM has been studied for high speed modems [6], digital mobile communications [8] and high-density recording [7]. Various fast modems were developed for telephone networks [12]. In 1990s, OFDM has been exploited for wideband data communications over mobile radio FM channels [14], wireless LAN [11] wireless multimedia communication [15], high-bit-rate digital subscriber lines (HDSL) [6], asymmetric digital subscriber lines (ADSL) [9], very high speed digital subscriber lines (VHDSL) [13], [7], digital audio broadcasting (DAB) [8] and HDTV terrestrial broadcasting [10]. In a classical parallel data system, the total signal frequency band is divided into N non overlapping frequency sub channels. Each sub channel is modulated with a separate symbol and then the N sub channels are frequency-multiplexed. It seems good to avoid spectral overlap of channels to eliminate interchannel interference. However, this leads to inefficient use of the available spectrum. To cope with the inefficiency, the ideas proposed from the mid-1960s were to use parallel data and FDM with overlapping sub channels, in which, each carrying a signaling rate b is spaced b apart in frequency to avoid the use of high-speed equalization and to combat impulsive noise and multi path distortion, as well as to fully use the available bandwidth. OFDM has received increased attention due to its capability of supporting high-data-rate communication in frequency selective fading environments which cause inter-symbol interference (ISI) [8]. Instead of using a complicated equalizer as in the conventional carrier systems, the ISI in OFDM can be eliminated by adding a guard interval which significantly simplifies the receiver structure. However, in order to take advantage of the diversity provided by the multi-path fading, appropriate frequency interleaving and coding is necessary. Therefore, coding becomes an inseparable part in most OFDM applications and a considerable amount of research has focused on optimum encoder, decoder, and inter leaver design for information transmission via OFDM over fading environments, e.g. [9]-[2]. Different coding schemes like Hamming coding, RS coding, Convolutional coding, Turbo coding have been studied and compared. A combination of the coding schemes is also implemented and simulated like RS-Convolutional coding, RS-Turbo coding. At last Space Frequency coding is studied which performs well in a frequency selective channel.

Rayleigh fading: In a radio link, the RF signal from the transmitter may be reflected from objects such as hills, buildings, or vehicles. This gives rise to multiple transmission paths at the receiver. The relative phase of multiple reflected signals can cause constructive or destructive interference at the receiver. This is experienced over very short distances (typically at half wavelength distances), thus is given the term fast fading. These variations can vary from 10-30dB over a short distance

Inverse Fourier Transform: After the required spectrum is worked out, an inverse Fourier transform is used to find the corresponding time waveform. The guard period is then added to the start of each symbol.

Table1.Typical Urban Reception (Tu6) For Dvb-T Application.

No of FFT points (N_{FFT})	2048 (2K-Mode)
Length of Cyclic Prefix (N_G)	512
Total no of Subcarriers (N_{OFDM})	2560
Total no of Symbol (N_{SYS})	100
Pilots Spacing (N_F)	4
Numbers of Pilots (N_P)	512
Pilot Arrangement	Comb Type
Data per OFDM Symbol	1536
Signal Constellation (M)	16-QAM
CE Techniques	LS,MMSE and DFT
Bandwidth	8 MHz
Interpolation	Linear and Spline Cubic
Number of Channel Taps	6
RMS Delay Spread (τ_{rms})	$1.05*10^{-6}$ sec

OFDM SIMULATION PARAMETERS

Table 2. Typical Attenuation in a radio channel.

Description	Typical Attenuation due to Shadowing
Heavy built-up urban center	20dB variation from street to street
Sub-Urban area(fewer large buildings)	10dB greater signal power than built up urban center
Open rural area	20dB greater signal power than sub-urban areas
Terrain irregularities and tree foliage	3-12dB signal power variation

Guard Period: The guard period used was made up of two sections. Half of the guard period time is a zero amplitude transmission. The other half of the guard period is a cyclic extension of the symbol to be transmitted. This was to allow for symbol timing to be easily recovered by envelope detection. However it was found that it was not required in any of the simulations as the timing could be accurately determined position of the samples. After the guard has been added, the symbols are then converted back to a serial time waveform. This is then the base band signal for the OFDM transmission.

VI. OFDM SIMULATION PARAMETERS

The configuration used for most of the simulations performed on the OFDM signal. An 800-carrier system was used, as it would allow for up to 100 users if each were allocated 8 carriers. The aim was that each user has multiple carriers so that if several carriers are lost due to frequency selective fading that the remaining carriers till allow the lost data to be recovered using forward error correction. For this reason any less then 8 carriers per user would make this method unusable. Thus 400 carriers or less was considered too small. However more carriers were not used due to the sensitivity of OFDM to frequency stability errors. The greater the number of carriers a system uses, the greater it required frequency stability. For most of the simulations the signals generated were not scaled to any particular sample rate, thus can be considered to be frequency normalized. Three carrier modulation methods were tested to compare their performances. This was to show a trade off between system capacity and system robustness. DBPSK gives 1 b/Hz spectral efficiency and is the most durable method, however system capacity can be increased using DQPSK (2 b/Hz) and D16PSK (4 b/Hz) but at the cost of a higher BER. The modulation method used is shown as BPSK, QPSK, and 16PSK on all of the simulation plots, because the differential encoding was considered to be an integral part of any OFDM transmission.

Table:3. OFDM system parameters used for simulations.

Parameter	Value
Carrier Modulation used	BPSK,QPSK,16PSK
FFT size	2048
Number of carrier used	800
Guard Time	512 samples (25%)
Guard Period Type	Half zero signal, half a cyclic extension of the symbol

VIII. RESULTS

It was found that the SNR performance of OFDM is similar to a standard single carrier digital transmission. This is to be expected, as the transmitted signal is similar to a standard Frequency Division Multiplexing (FDM) system. Figure shows the results from the simulations. The results show that using QPSK the transmission can tolerate a SNR of >10-12 dB. The bit error rate BER gets rapidly worse as the SNR drops below 6 dB. However, using BPSK allows the BER to be improved in a noisy channel, at the expense of transmission data capacity. Using BPSK the OFDM transmission can tolerate a SNR of >6-8 dB. In a low noise link, using 16PSK can increase the capacity. If the SNR is >25 dB 16PSK can be used, doubling the data capacity compared with QPSK.

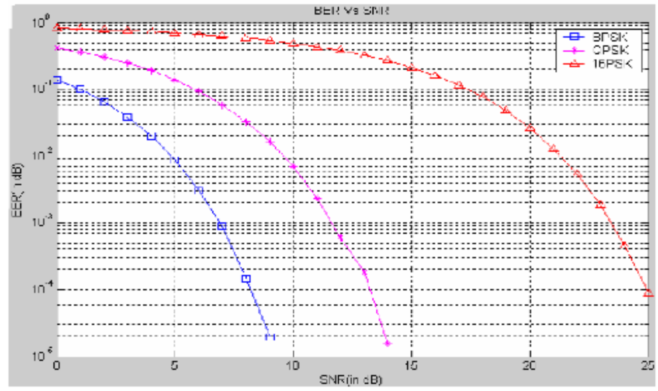

Fig. 3. BER versus SNR for OFDM using BSPK, QPSK and 16PSK.

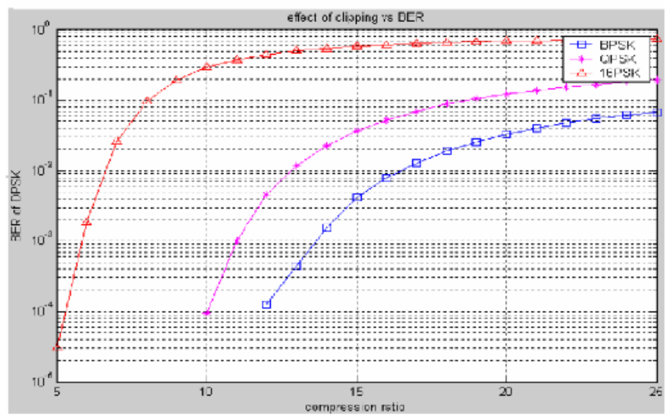

Fig. 4. Effect of peak power clipping for OFDM.

IX. CONCLUSION

OFDM systems OFDM system. The implementation of OFDM model is presented. The capability of OFDM in Rayleigh faded channels have been analyzed. This thesis analyzes OFDM system and the effect of channel coding in reducing BER. Along with this soft decoding and decoding with CSI is also studied. Besides, performance of convolutional codes Turbo codes in OFDM systems is compared and compared. Besides, the performance of convolution and turbo codes in OFDM systems is compared. This chapter summarizes the work in this paper, specifying the limitations of the study and provides some pointers to future development.

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