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LOW POWER BASEBAND RECEIVER ARCHITECTURE USING STBC-OFDM FOR MOBILE WMAN

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ABSTRACT

This paper introduce a space-time block-coding orthogonal frequency-division multiplexing downlink baseband receiver for mobile wireless metropolitan area network. The introduced baseband receiver applied in the system with two transmit antennas and one receive antenna aims to provide high performance in outdoor mobile environments. It provides a simple and robust synchronizer and an accurate but hardware affordable channel estimator to overcome the challenge of multipath fading channels. In current 4G communication systems growing demand of multimedia services and the growth of internet related contents lead to increasing interest to high speed communications. Recently, space-time block-codes (STBC) have gained much attention as an effective transmit diversity technique to provide reliable transmission with high peak data rates to increase the capacity of wireless communication systems. Introduce a space-time block-coded orthogonal frequency-division multiplexing (STBC-OFDM) scheme for frequency-selective fading channels which does not require channel knowledge either at the transmitter or at the receiver the following of the Flexible mapper is being introduced instead of signal mapper since signal mapper uses only fixed QAM where as using the Flexible mapper We can choose any of the QAM mode (4, 16, 32 and 64).

***Keywords*—** Baseband receiver, channel estimator, space time block code orthogonal frequency division multiplexing (STBC-OFDM) system, WMAN.

I. INTRODUCTION

Portable internet services requires high data rate and mobile capability to provide various multimedia transmissions. Mobile World Wide Interoperability for microwave access (WiMAX) is an extension for providing mobility of wireless metropolitan area network (WMAN) [4]. It is based on an orthogonal frequency division multiple access (OFDMA) technique to support multiple access scheme and multiple input multiple output (MIMO) Systems over multipath fading channels. Space time block code orthogonal frequency division multiplexing (STBC-OFDM) systems with multiple antennas can provide diversity gains to improve transmission efficiency and quality of mobile wireless systems [1], [5], but accurate but accurate channel state Information (CSI) is required for diversity combining, coherent detection and decoding. Moreover, the system performance is also sensitive to the synchronization error. Therefore, high quality synchronization and channel estimation are two crucial challenges for realizing a successful STBC-OFDM system in outdoor mobile channels. The STBC-OFDM downlink baseband receiver for mobile WMAN is proposed and implemented. First, a novel match filter is proposed to precisely detect symbol boundary. Then, we use a two-stage channel estimator to accurately estimate CSI over fast fading channels [3]. Provision of a STBC-OFDM downlink baseband receiver architecture that is capable of high-speed transmission at high mobility. Integration of a simple and robust synchronizer and an accurate but hardware affordable channel estimator to overcome the challenge of outdoor fast fading channel. Implementation of a successful STBC-OFDM downlink baseband receiver for mobile WMAN [4]. STBC is a technique used in wireless communication to transmit multiple copies of data stream across a number of antennas and to exploit the various received versions of the data to improve the reliability of data-transfer. The fact that the transmitted signal must traverse a potentially difficult environment with scattering, reflection, refraction and so on and may then be further corrupted by thermal noise in the receiver copies efficient use of the spectrum by allowing overlap, The word orthogonal indicates that there is a precise mathematical relationship between the frequencies of the carriers in the systems. In a normal frequency-division multiplex system, many carriers are spaced apart in such a way that the signals can be received using conventional filters and demodulators. The OFDM transmission scheme has the following key advantages as makes efficient use of the spectrum by allowing overlap by dividing the channel into narrow band flat fading sub channels, OFDM is more resistant to frequency selective fading than single carrier systems.

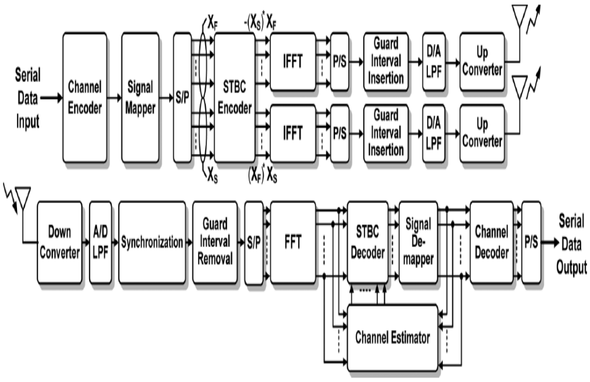

Fig.1: STBC-OFDM system with two transmit antennas and one Receive antennas

II. SYSTEM ARCHITECTURE

Source encoding, one purpose of the source encoder is to eliminate redundant binary digits from the digitalized signal the strategy of the channel encoder, on the other hand, is to add redundancy to the transmitted signal in this case so that errors caused by noise during transmission can be corrected at the receiver The process of encoding for protection against channel. The source encoding as shown in the Fig.1. In coding theory, decoding is the process of translating received messages into code words of a given code. There have been many common methods of mapping messages to code words. These are often used to recover messages sent over noise channel, such as a binary symmetric channel The constellation mapper take a bit stream as an input and maps it onto appropriate constellation symbols, according to the modulation method.

The constellation demapper takes packets of the received constellation points as an input, and outputs the corresponding soft decision bit stream the serial to parallel convertor is used for converting the serial data into parallel one and parallel to serial data is used for converting the parallel data into a serial one Guard interval insertion to decrease receiver complexity An analog-to-digital convertor (abbreviated ADC, A/D or A to D) is a device that converts a continuous physical quantity (usually voltage) to a digital number that represents the quantity's amplitude Up converter is a part to convert signal up for transmission.

Basically, mixer part for frequency upward conversion is called upconverter Down convertor is a part to convert RF signal down to IF or base band Before an OFDM receiver can demodulate the subcarriers, it has to perform at least two synchronization tasks. The first one is to find out where the symbol boundaries are and what the optimal timing instants are to minimize the effects of Inter Carrier Interference (ICI) and Inter Symbol Interference (ISI). The use of multi-amplitude signalling schemes in wireless OFDM systems requires the tracking of the padding radio channel. The paper addresses channel estimation based on time-domain channel statistics. Using a general model for a slowly fading channel,

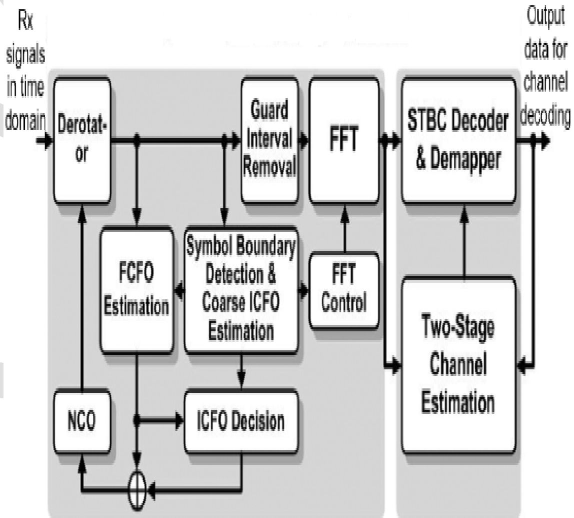

Fig.2: Architecture of the downlink baseband Receiver

Shows the architecture of the downlink baseband receiver. The receiver includes a symbol boundary detector, an integer carrier frequency offset (ICFO) estimator, and a fractional carrier frequency offset (FCFO) estimator, an FFT, a two-stage channel estimator, an STBC decoder, and a demapper as shown in Fig.2. Synchronization includes symbol timing, sample clock, and carrier frequency synchronization. The proposed synchronizer concentrates on the symbol boundary detection and the carrier frequency recovery loop An ISI free region of symbol timing detection is determined by the difference in length between the CP and the channel impulse response[2].

Since the introduced system has two transmit antennas, the signals transmitted from different antennas may arrive at the receiver with different delays due to multipath effect. Therefore, the decided boundary must locate in the common ISI free region to prevent the respective ISI effects from other symbols Carry Frequency Recovery The accurately estimated FCFO value can be used to correct the ICFO detection. When the estimated FCFO value locates in the strong region, the matching results have strong reliability to determine ICFO by detecting the peak value. When the estimated FCFO value locates in the weak region, there are two possible peaks in the matching results. Thus, the ICFO value will be adjusted by the information of the FCFO value and these two peaks A two-stage channel estimation method is used to realize a successful STBC-OFDM system in outdoor mobile channels in the initialization stage, the significant paths are identified during the preamble symbol time. In the tracking stage, the path gain variations in the identified path positions will be tracked in the following data symbol transmission two-stage channel estimation can highly improve the performance in outdoor mobile channels. In the following of the paper the signal Mapper and signal Demapper is being used where in this existing architecture only a fixed QAM is being choosen. Where as by using the Flexible mapper the following of the (4, 16, 32, 64) QAM modes can be choosen so that in the signal mapper and signal demapper only the fixed 16 QAM is being choosen so that its symbol can take 4 bits per symbol in transmitting data by Introducing the Flexible mapping we can choose any of the QAM mode on introducing the 64 QAM the symbol can take upto 6 bits in them so that higher transmission of the data is being taken by this Flexible mapper.

III. PROPOSED FLEXIBLE MAPPER

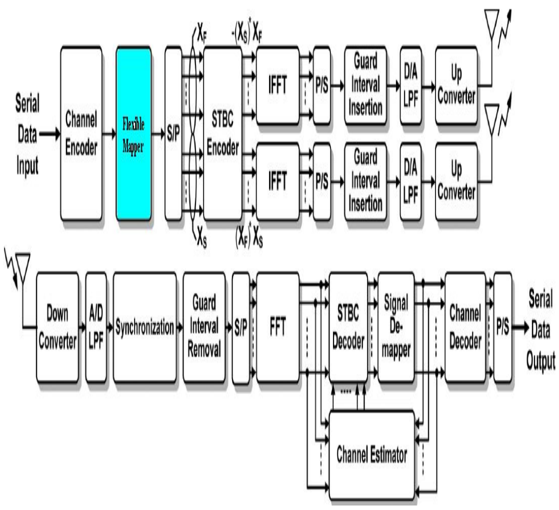

Fig.3: STBC-OFDM system with two transmit antennas and one Receive antennas with Flexible Mapper

Shows the figure of the STBC-OFDM system with two transmit antennas and one receiving antennas where the signal mapper is being replaced by the Flexible Mapper.

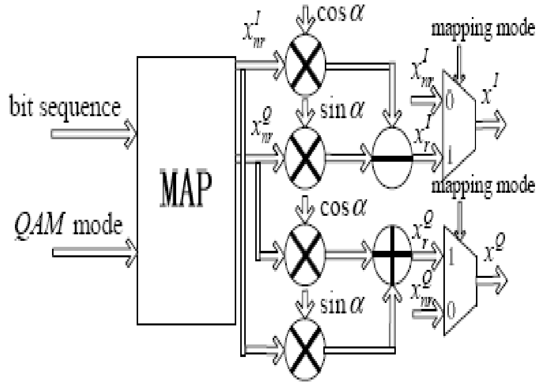

Fig.4: Architecture of Flexible Mapper

In the following of introducing the Flexible Mapper instead of using the signal mapper that it has more advantages than using of the signal mapper since signal mapper can be used only for fixed QAM (Quadrature Amplitude Modulation) in existing paper we use 16 QAM so that using of the 16 QAM only 4 bits can be accepted per symbol where as using of this Flexible Mapper the user can choose any type of the QAM mode for example (4, 16, 32, 64) QAM so we are introducing the 64 QAM mode so that it can able to accept upto 6 bits per symbols so it leads to higher transmission of datas. The description of this Flexible Mapper is being given by the Flexible mapper are dedicated to constellation of (QPSK,16 QAM, 32 QAM, 64 QAM). The QAM mode is being choosen by the user since it is a Flexible Mapper the four multipliers, one subtractor and one adder are applied to ther constellation points the two multiplexers are used to select the final output The example of signal space diagram for 16 QAM is being shown as follows

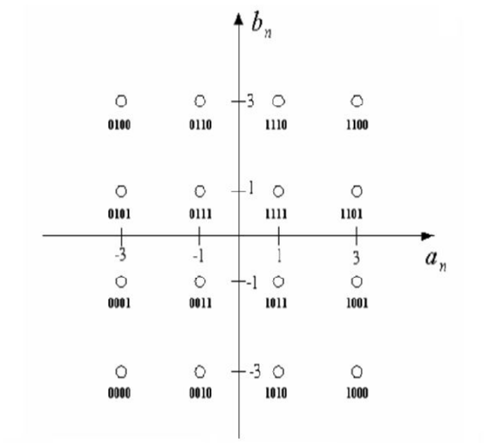

Fig.5: Example signal space diagram for 16 QAM

Where using of this 16 QAM the diagrametric representation shows the each of the symbols in them since it is an example of 16 QAM each symbol can able to accept upto 4 bits in them as shown in the figure.5. Example of the mapper with the 64 QAM is being shown as follows Where in the example of using the 64 QAM as shown in the figure 6 the each symbols can able accept upto 6 bits in them where as in the 16 QAM it can able to accept only 4 bits so by using of this 64 QAM it will be more usefull for highspeed transmission of data.

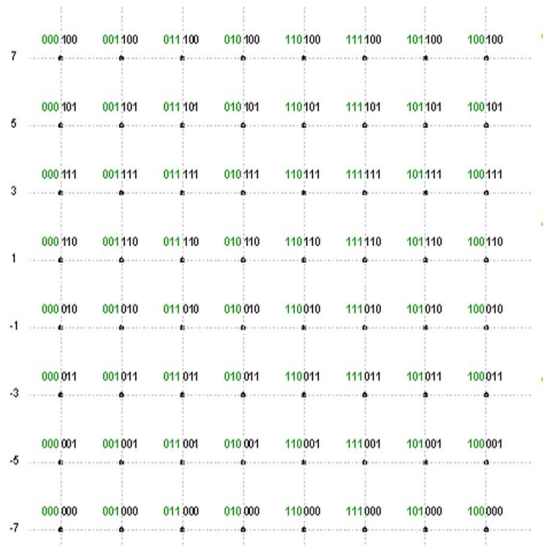

Fig.6: Example of 64 QAM

IV. SIMULATION RESULTS OF STBC-OFDM SYSTEM USING SIGNAL MAPPER AND SIGNAL DEMAPPER

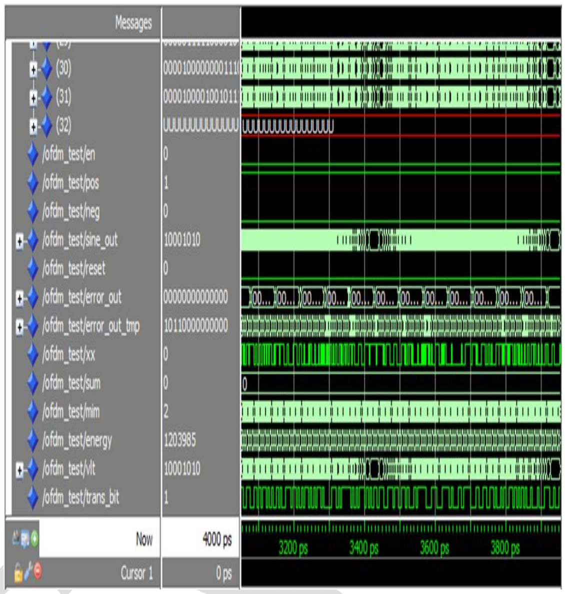

Fig.7.Transmission of data from transmitter

The following of the transmission of the data as shown in figure 7 where transmission of the data from the transmitter which is the transbit where input data is being transmitted from the transmitter.

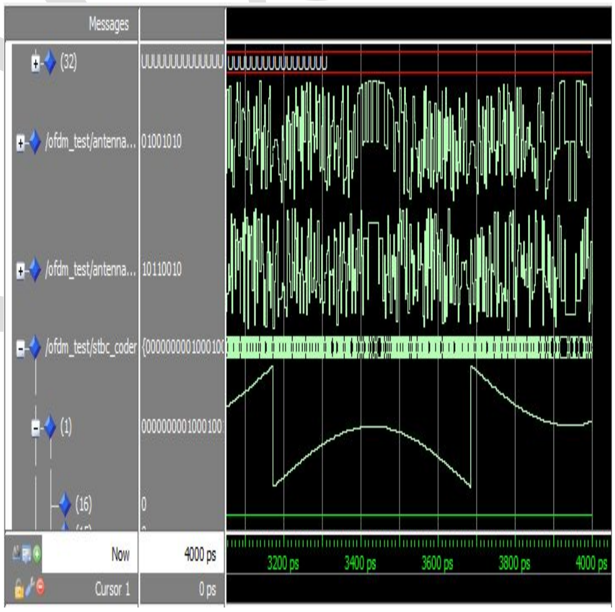

Fig.8. The STBC transmission of data from the transmitter.

In the following STBC transmission of data as shown in figure. 8 in which the multiple copies of data are being transmitted from the transmitter to the receiver where it is used for robust transmission of data it is used for securing data from reflection,refraction etc.

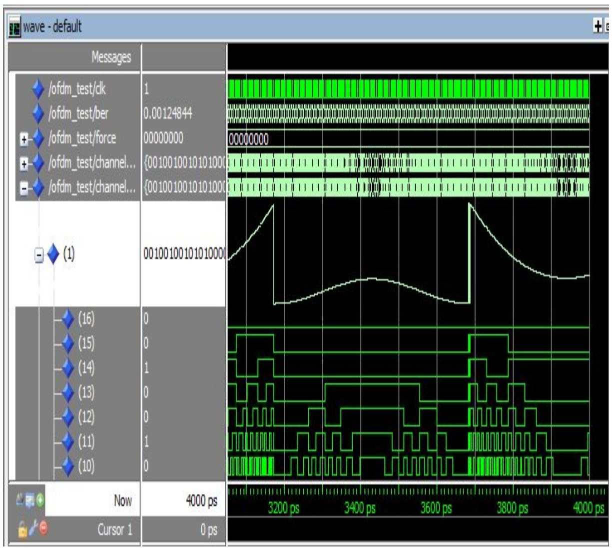

Fig.9. The channel estimator for finding the channel state information

The following of the figure. 9 shows the channel estimator where it is used for finding the channel state information

V.POWER, AREA AND DELAY TABLES

PowerPlay Power Analyzer Summary	
PowerPlay Power Analyzer Status	Successful - Mon Dec 30 09:03:42 2013
Quartus II Version	10.0 Build 218 06/27/2010 SJ Web Edition
Revision Name	gred
Top-level Entity Name	modem
Family	Cyclone II
Device	EP2C5F256C6
Power Models	Final
Total Thermal Power Dissipation	40.95 mW
Core Dynamic Thermal Power Dissipation	0.00 mW
Core Static Thermal Power Dissipation	18.02 mW
I/O Thermal Power Dissipation	22.93 mW
Power Estimation Confidence	Low: user provided insufficient toggle rate data

Table.1. the obtained power is 40.95 mW

Flow Summary	
Flow Status	Successful - Mon Dec 30 09:03:42 2013
Quartus II Version	10.0 Build 218 06/27/2010 SJ Web Edition
Revision Name	gred
Top-level Entity Name	modem
Family	Cyclone II
Met timing requirements	Yes
Total logic elements	2,785 / 4,608 (60 %)
Total combinational functions	2,315 / 4,608 (50 %)
Dedicated logic registers	1,747 / 4,608 (38 %)
Total registers	1747
Total pins	103 / 158 (65 %)
Total virtual pins	0
Total memory bits	7,040 / 119,808 (6 %)
Embedded Multiplier 9-bit elements	0 / 26 (0 %)
Total PLLs	0 / 2 (0 %)
Device	EP2C5F256C6
Timing Models	Final

Table.2. shows the obtained Area

Timing Analyzer Summary

Type	Slack	Required Time	Actual Time
Worst-case tsu	N/A	None	1.113 ns
Worst-case tco	N/A	None	6.890 ns
Worst-case th	N/A	None	0.774 ns
Clock Setup: 'clk'	N/A	None	191.72 MHz (period = 5.216 ns)
Total number of failed paths			

Table.3. Shows the obtained delay as 6.890 ns

VI.SIMULATION RESULTS OF USING FLEXIBLE MAPPER

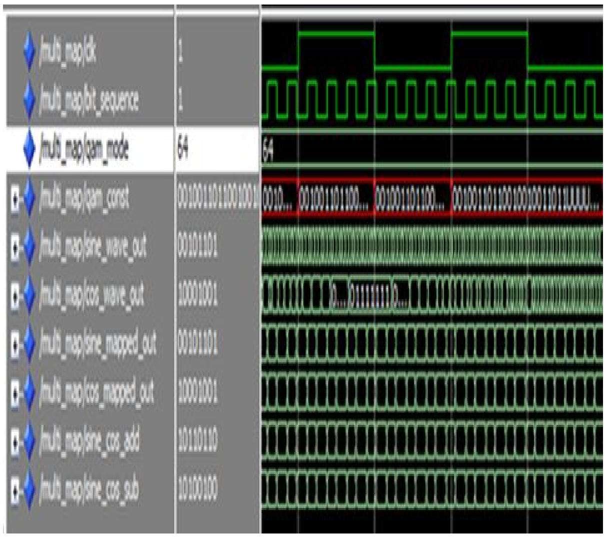

Fig.10.Simulation result of obtained Flexible mapper

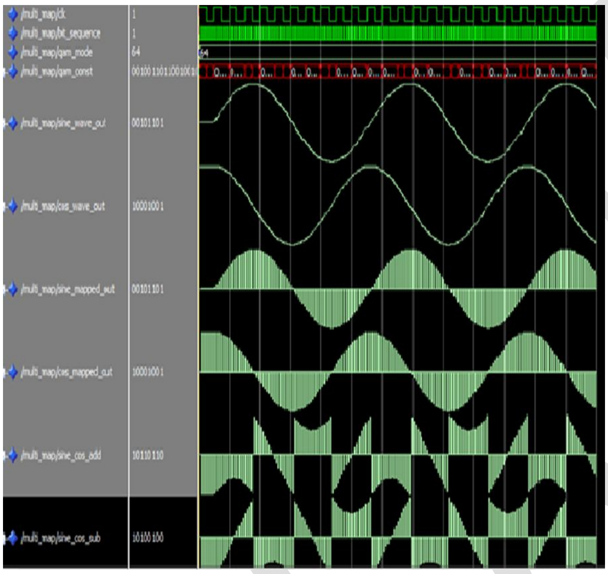

Fig.11. the wave form for obtained Flexible mapper

The following of the Flexible Mapper description where QAM mode is selected as 64 the sin-mapped out , cos-mapped out is the value obtained by multiply the bit sequence with the sin and cos modulation values the sin-cos Add is the value obtained by adding the sin-mapped out and cos-mapped out values the sin-cos subtract is the value obtained while subtracting the sin- mapped out and cos-mapped out value.

VII. CONCLUSION AND FUTURE WORK

The downlink baseband receiver for mobile WMAN that is applied in the STBC-OFDM system with two transmit antennas and one receive antenna. A simple symbol boundary detector, a carrier frequency recovery loop the two-stage channel estimator has significant performance improvement for successfully realizing the STBC-OFDM system in outdoor mobile environments it is used for improving the transmission efficiency. In the existing system the signal mapper is been used it can able to accept only fixed QAM in it the 16 QAM is been used. In the proposed flexible mapper it is dedicated to constellations of (QPSK, 16 QAM, 32 QAM, 64 QAM) where we use the 64 QAM which can accept more bits for each symbols than 16 QAM. So the proposed Flexible mapper is used for high data transmission efficiency. In the future work the Flexible Demapper will be used to improve the speed for further high speed data transmission.

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