International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug. 2012 pp-1968-1971 ISSN: 2249-6645

Implementation and Performance Analysis of MIMO Digital Video Broadcasting-T2

A. Ramya[1], Prof. Mrs. B. Devi [2]
II- ME (Communication Systems), Assistant HOD/ECE
SNS College of Technology, Coimbatore (dt), Tamilnadu, India

***Abstract*:** The Digital Video Broadcasting second generation (DVB – T2) system transmitter and receiver are to be implemented and simulated using MATLAB. The existing system uses the Multiple Input Single Output processing unit (MISO) technology as a means of transmission. The proposing system is the implementation of the DVB – T2 system with the support of multiple antenna transmission and multiple antenna reception. Multiple Input Multiple Output–Orthogonal Frequency Division Multiplexing (MIMO-OFDM) is implemented in order to support the multiple antenna transmission and reception. Here MISO processing unit has been replaced by the MIMO processing unit. In DVB-T2 system transmitter section, reduce the peak to average power ratio to make transmission cheaper. DVBT2 also supports service specific robustness levels so that both fixed and portable devices will be used. MIMO systems can deliver both higher data throughput and greater robustness by taking advantage of the additional signal paths between a transmitter and a receiver.

***Keywords*:** DVB, Constellation, Alamouti scheme, MIMO, OFDM.

I. Introduction

Digital Video Broadcasting Terrestrial (DVB – T) is the most popular and successful standard for Digital Terrestrial Television (DTT). For TV broadcasting most of the governments at present are moving to analog switch off. Even though the digital broadcast standards have been available for many years for both terrestrial as well as over satellite and cable, there has not been much benefits in migration for the users. On the other hand the demand for High Definition TV (HDTV) has been increased with the recent changes in television formats. These services are at present already used for delivery over Digital Video Broadcasting-Satellite (DVBS) and over cable. But to achieve it overDVB-T is difficult. The governments and the industries can get attractive possibilities with the usage of new HDTV services and migration from analog to digital. In order to increase the performance of DVB-T services, new opportunities have been provided by the DVB-T2 along with changes in channel coding and encoding compression. Hence without increasing the radio bandwidth HDTV services can be provided. There has been a wide interest all around the world for HDTV services and before now the services have been planned and implemented. The migration of encoding of video streams, thechange of multiplexing techniques and the implementation of the new mechanisms in the radio layer is essential in order to make the services to succeed and also to deliver more digital bandwidth and better forward error recovery. The Digital Video Broadcasting –Terrestrial second generation (DVB-T2) uses the Orthogonal Frequency Division Multiplexing(OFDM) modulation which is similar to the DVB-T system. A toolkit is provided with different numbers of carrier such as 1k, 2k, 4k, 8k, 16k, 32k, 16k and 32k extended modulation constellations such as Quadrature Phase Shift Keying (QPSK), 16-QAM (Quadrature Amplitude Modulation), 64-QAM, and 256-QAM. Bose-Chaudhuri-Hocquengham (BCH) and Low density parity check (LDPC) coding are used by DVB-T2 for the case of error protection. Under certain conditions in order to provide additional robustness a new technique has been introduces called as the Rotated Constellations. DVB-T2 system has proposed with Multiple Input Single Output (MISO) transmission technology which has multiple transmitting antenna and single receiving antenna.Increasing number of users uses the High Definition (HD) television its need better transmission technology that can satisfied the user demands. MIMO (Multiple Input Multiple Output) is one of the technologies which can satisfy. In this MIMO transmission multiple antennas can be used for both transmitting and receiving.

The aim of this project are implementing and simulating the transmitter of DVB – T2 system with integration of MIMO – OFDM and also to reduce the Peak to Average Power Ratio. The MATLAB simulator is going to be used for implementation and simulation of DVB – T2 system with MIMO – OFDM.

II. Dvb-T2 System Architecture

The diagram shown below represents the generic model of the T2system. The input given to the Pre-processor indicated by TS or GS stands for one or more MPEG-2 Transport streams and one or more Generic streams. From the diagram we can say that the Input Pre-processor is not a part of the T2 system but it contains the Service splitter or the demultiplexer for separating the services of the transport streams into system inputs for the T3. These are then passed on to the individual PLPs (Physical Layer Pipes).The total input data capacity of one T2 frame over its duration should not exceed the total available T2 data capacity.

International Journal of Modern Engineering Research (IJMER)
www.ijmer.com Vol.2, Issue.4, July-Aug. 2012 pp-1968-1971 ISSN: 2249-6645

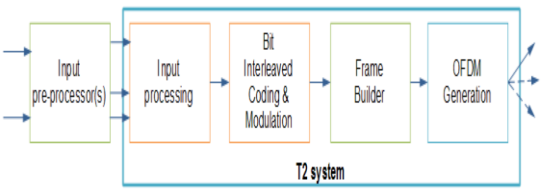

Fig 1: DVB-T2 Architecture block diagram

A.MIMO PROCESSING

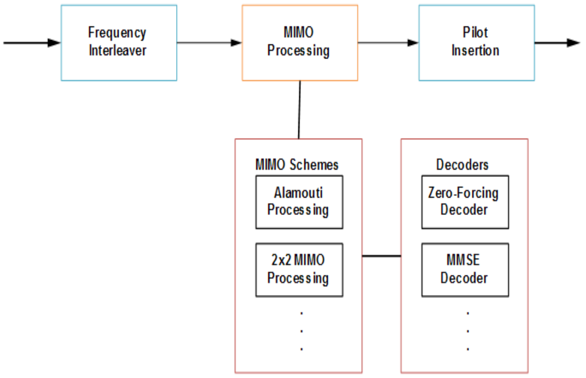

Fig 2: Block of MIMO Processing Unit

The main function of the Alamouti sub block here is to encode the signal along with the Alamouti space time block code. This will work on the OFDM cells. Since the block sends the output to two antennas, we can say that the output data will be twice the size of the input. In the first time slot, transmitter 0 (TX0) sends out s0 and transmitter 1 (TX1) sends out s1. In the second time slot, TX0 sends out -s1* and TX1 s0*. Here, * denotes the complex conjugate. The Alamouti scheme is a full rate transmission scheme as one unique symbol is transmitted in each time slot.

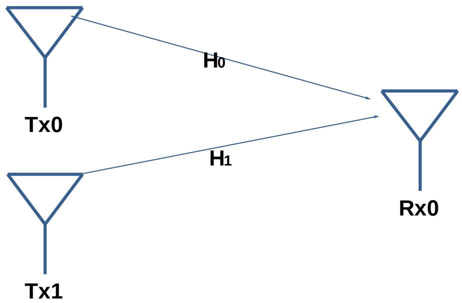

Fig 3: Illustration of Alamouti scheme.

The signals travel through two channels, h0 and h1, to the receiver. The two signals must have a correlation of less than 0.7 and roughly equal transmit powers in order for the scheme to provide diversity gain.

B. PEAK TO AVERAGE POWER RATIO (PAPR) REDUCTION

In order to decrease the PAPR, two modifications are allowed for the transmitted OFDM symbol. The two techniques which are used are the Active Constellation Extension Technique and the Tone Reservation Technique. Both can be used simultaneously. These techniques are used on the active portion of the OFDM symbol excluding P1, and after this the guard intervals are inserted. When both the techniques are being used simultaneously, the Active Constellation Extension Technique will be used in the first place to the signal. But this cannot be used on the Pilot carriers or the reserved tones or even when the rotated constellations are being used.

III. DVB-T2 RECEIVER

The main function of an MIMO receiver separates the signals received from the transmitter using signatures of the spatialsignal. The receiver antenna always receives the combined form the sent signals and the signal should be de-correlated in order to get the original signal. Here we are about to see the differenttypes of receiver architectures and their characteristics. They are the zero forcing receiver, V-BLAST receiver and the maximum likelihood receiver.

A..Zero Forcing Receiver

This is also known as the linear de-correlator. Here the architecture of the receiver is very simple and it gains knowledge from the channel matrix. With this it estimates the sent signal. The estimated signal is calculated from the equation given below.

$$\hat{s} = H^{\dagger} r$$

Where H value is given by

$$H^{\dagger} = (H^{*}H)^{-1}H^{*}$$

Where H* is the complex conjugate,it is transpose of the H and r is denoted by the receive signal. One of the main advantages of the zero forcing receivers is that it separates the signals perfectly from the transmitter. But it is only suitable in case where the SNR value is high because it will enhance the noise at low SNR[6].

B.Minimum Mean-Square Error Receiver

Another method called the minimum mean square error also helps in the separating of the co channel signals. It does this by minimising the impact created by co-channel interference and noise present in the received signal. The following equation helps in calculating the the signal estimation,[2]

$$\hat{s} = (H^{*}H + \propto^{2} I)^{-1}H^{*}r$$

This receiver is less sensitive to noise and on the other hand does not produce a high separation quality. For high SNR conditions $\propto^{2} \approx 0$[6].

C.V.Blast Receiver

V-BLAST is abbreviated as the Vertical Bell Labs Space Time Architecture. It works by increasing the computational capability of the receiver comparatively to the minimum mean squarereceiver andzeroforcing receivers. But at the same time it provides a thorough signal separation and the capability of tolerance towards noise. It operates by separating the signals iteratively by order of strength and finally when all the signals have been detected and separated it reconstructs the signals[2].

D. Maximum Likelihood Receiver

This receiver has a better error rate performance than the remaining receivers, but it is as equally complex in its architecture.

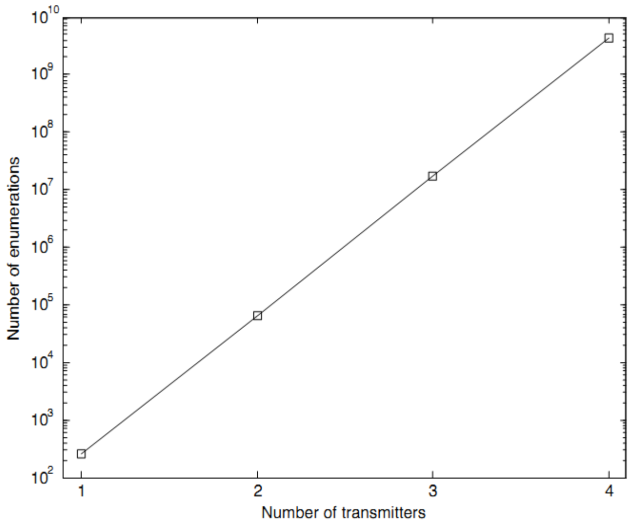

Fig. 4.Maximum Likelihood receiver using 256-QAM modulation showing computational complexity.

The above figure shows the increase in growing of computational complexity by using highest order modulation in the DVB-T2 system which uses 256QAM. The following equation helps in the calculation of the maximum likelihood estimation.

$$\hat{s} = argmin \, \|r - Hs\|^2$$

It calculates the minimum over all possible code word vector s, and this in turn leads to the computational complexity as with the increasing number of complex antennas.

D. RECEIVER BLOCK DIAGRAM

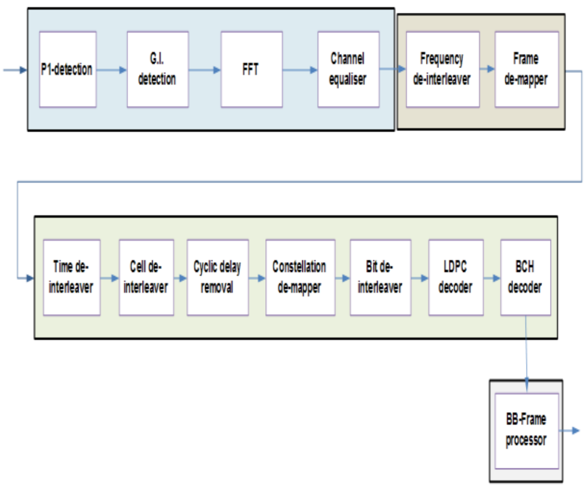

Fig. 5. DVB-T2 Demodulator

It is about the consumer receivers whose main function is to decode and produce an output which combines the Transport stream carried by one PLP and its common PLP interface. Certain parts belonging to the receiver corresponds directly to any of the blocks or features in the modulator and other part such as synchronization does not play any counterpart with the re ceiver [2].

IV. RESULTS AND ANALYSIS

MATLAB code has been written for each block and link all the blocks. Input Bit stream has generated given to the BCH encoder .Bit stream length is 43040 for LDPC cord identifier 2/3. The DVB-T2 transmission system transmitter and receiver has been implemented with Multiple Input Single Output technique which already with the system. Because more time consumed for developing the DVB-T2 standard system the MIMO technology could not implemented in the MATLAB. But most part of the DVB-T2 system has been implemented and simulated using MATLAB.

From the implemented blocks, the input to the BCH encoder and output from the BCH decoder has been compared and bit error rate calculated for the SNR value of 1:15. Output from the QAM and Rotated QAM has been plotted. Finally Bit error probability graph plotted between SNR vs. BER.

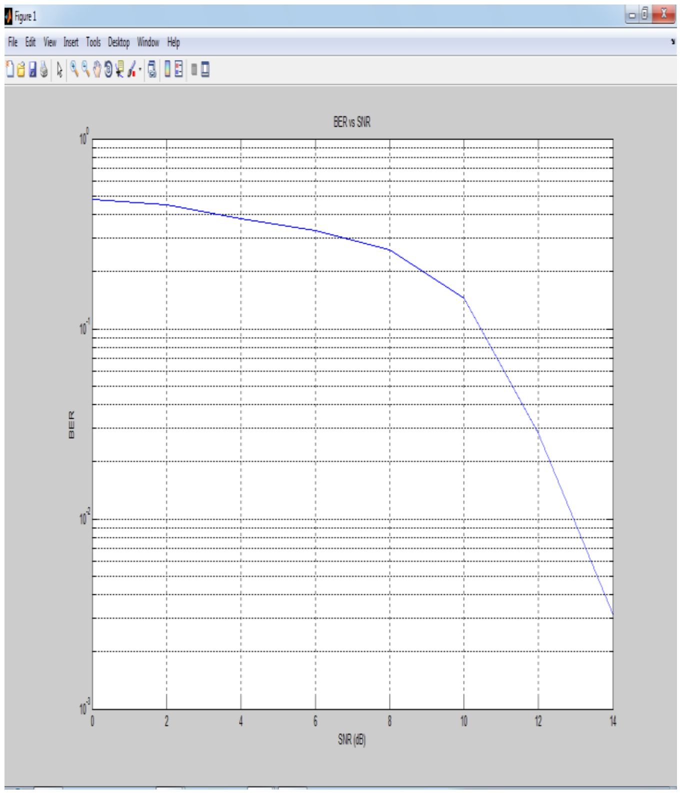

Figure 6. Plotted graph between SNR vs. BER

BER is the measure of error rate compare between transmitted and received bits. With the help of BER transmission accuracy can be measure easily. The above fig obtained is used to calculate how error free transmission has been achieved. The graph is exponentially decaying as the amount of noise level is decreased gradually. We can see that the E_b/N_o value at about 14 dbhas very less BER.

V. CONCLUSIONS

Before starting the development process, lot of primary as well as secondary research has been made. During this research period I have learned a much about the DVB-T2 system and MIMO-OFDM technology. After making the necessary background required to do the development, I have explored the MATLAB and learned different coding techniques, logics and working principle of MATLAB. During the development of the DVB2 simulator, I learned how the wireless communication simulation can be achieved using MATLAB before implementing in the real world. Since the OFMD is very flexible as it supports different modulation techniques. During this implementation the transmission of random binary stream using the 16-QAM the constellation received from the transmitter is accurate which proves that the transmission method is going on the right way.It is concluded that the MIMO technology will provides better solution for large number of users using HDTV. The obtained BER vs. SNR graph shows the accuracy of the system after the execution.

REFERENCES

[1] Jong-SooSeo(2011), 'Improved CIRBased Receiver Design for DVB-T2 System in Large Delay Spread Channels:Synchronization and Equalization'Vol. 57, No. 1

[2] Hala M. Mahmoud, AllamS. Mousa, Rashid Saleem(2010), 'ChannelEstimation Based in Comb-Type Pilots Arrangement for OFDM Systemover Time Varying Channel'Journal of Networks, Vol. 5, No. 7

[3] Jokela. T,Tupala. M, Paavola. J (2010), 'Analysis of Physical Layer Signaling in DVB T2 Systems' IEEE Transactions on Broadcasting,Vol .56, Issue.3

[4] Lukasz Kondrad, Vinod Kumar, Imed Bouazizi, MiikaTupala,And MoncefGabbouj (2010) 'Cross-Layer Optimization of DVBT2 System forMobile Services'International Journal of Digital Multimedia Broadcasting, Volume 2010, Article ID 435405

[5] Robert J. Barsanti, James Larue, Ph.D.(2011), Peak To Average Power Ratio Reduction For Digital Video Broadcast T2', IEEE Conference paper.

[6] A. J. Paulraj and H. Bolcskei, Multiple-Input Multiple-Output (MIMO) Wireless Systems,The CommunicationsHandbook, CRC Press, second edition, 2002.