# Space Time Coded OFDM for High Data Rate Wireless Communication Over Wideband Channel

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***Abstract***—A **STC (space-time codes) OFDM (orthogonal frequency-division multiplexing) is the scheme in which the receiver antennas and multiple transmitters on compared time-chosen fading channels and frequency. The time-selectivity product array is the input parameter to describe the associated fading channel outage capacity. The space-time codes with huge efficiency is used even in environment of fading channels .Here the code used is space time block code. The comparison between RS code and space time code is performed. Different parameters are used for comparison like BER, SNR, FER, PAPR. Due to the assumed orthogonality structure of STBC, the decoding rule reduces to a single step.**

***Keywords*: Space- time codes, Alamouti code, Multiple Antennas, Wireless Communication**

## 1.INTRODUCTION

Nowadays there is more interest in services of high data-rate like internet access of multimedia, video conference, WAN and transfer of files on wireless channel of wide-band ,and hence this is presented in PCS band. Wireless communication in air causes the multipath fading. This is the competitive task, provided that the limited connection budget and wireless environment severity, and for forceful bandwidth efficient methods the calls that effort consistently at low SNRs. Finally, the most efficient technique, an OFDM (orthogonal frequency division multiplexing) of space time code was developed .This OFDM joins modulation and coding. Nowadays recommendation is to the space-time codes for wireless channels of narrowband is increasing. These codes contains high spectral effectiveness and very less SNR functioning and efficient bandwidth. Hence as an Alternative OFDM has established as a system of modulation for wideband channels, and hence this joins in a natural way and plan a scheme attaining 1.5-3 Mbps data rates. On a bandwidth channel of 1 MHz, This scheme needs 18-23 dB accept SNR at 10-2 probability of frame error with one receive antennas and two transmit antennas(MISO SYSTEM). Since space-time coding does not need any interleaving form ,like LDPC and hence the recommended system is smart for the applications of delay-sensitive. Wireless communications across the wideband channels are being used widely for various applications as transmitting high end applications like wide area network file transfers, video conferencing, multimedia applications. But, there are some limitations about implementations and they are mainly because of the limited channel capacity, the complexity of wireless communication environments. A physical layer is constructed across the Space-time coded OFDM system has two types and this can be used to achieve reliable communication over wireless channel even in case of low SNR and it helps in increasing the speed of file transfer. Any type of interleaving can be eliminated with the help of Space-Time coding and this coding is also a best choice for delay sensitive applications like video conferencing, multimedia applications and wide area network. A multiple transmitter antenna and single receiver antenna wireless communication system is very is considered to proceed with the development of the proposed system like OFDM. Wireless communication is the transfer of information or power between two or more points that are not connected by an electrical conductor like any conducting wire. The most common **wireless** technologies use radio waves and it is widely growing technology. The demand for connecting devices without use of cables is increasing everywhere. Orthogonal Frequency Division Multiplexing or OFDM is widely used a modulation format that is being used for many of the latest wireless and telecommunications standards. OFDM or orthogonal frequency division multiplexing has been adopted in the Wi-Fi area where the standards like 802.11a, 802.11n, 802.11ac and many more. It has also been chosen for the cellular telecommunications standard like long term evaluation( LTE / LTE-A), and it has been adopted by other standards like WiMAX and many more. OFDM or Orthogonal frequency division multiplexing has been used for a number of broadcast standards such as DAB Digital Radio to the Digital Video Broadcast standards, DVB.

## 2. Literature Review

Study of some papers is performed .One of them is " DESIGN OF MIMO SPACE TIME CODE FOR HIGH DATA RATE WIRELESS COMMUNICATION" .Advantage of that system is it is less complex .But ,efficiency is less. Second paper is "SPACE TIME BLOCK CODES FROM ORTHOGONAL DESIGNS". Advantage is its simple and maximum decoding .but ,there is no Diversity in transmitter and receiver. Third paper is "ON LIMITS OF WIRELESS COMMUNICATION IN A FADING ENVIRONMENT WHEN USING MULTIPLE ANTENNAS. Advantage is greater mutual coupling effect. but, its capacity increases drastically.

## 3. SPACE-TIME CODING FOR WIRELESS COMMUNICATION:

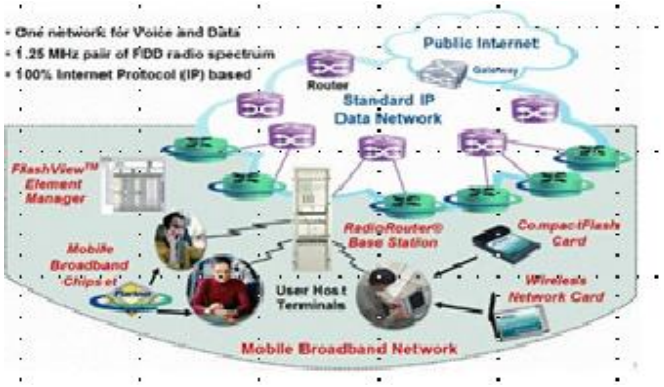



**Figure 1**.Applications of OFDM

Space-Time Codes were first introduced by Tarokh et al. from AT&T research labs to provide transmit diversity in carriers of wireless fading channels using multiple transmit antennas and one receiver antennas. Two most frequently used examples of space-time codes are space-time trellis codes and space-time block codes. We survey the basic designs and complexity ,some internal features, advantages diversity results of these two types of space-time codes, and summarize their relative performance and the result is that space time block codes does not have coding efficiency and space time trellis code has coding efficiency. Space-Time Codes (STC) were first introduced by Tarokh et al. from AT&T research labs in 1998 as an effective means of enhancing the available transmit diversity for the multiple-antenna fading channels. Previously, multipath fading in multiple antenna wireless systems was mostly dealt with by other diversity techniques, such as , frequency diversity, temporal diversity and receive antenna diversity, and receive antenna diversity is the most widely used technique. However, it is hard to efficiently use receive antenna diversity at the remote units in case of wireless channels because of the need for them to remain relatively simple, inexpensive and small and effective. Therefore, multiple antennas are preferred for commercial reasons, at the base stations.

## 4.SPACE-TIME-FREQUENCY CODED OFDM OVERFREQUENCY-SELECTIVE FADING CHANNELS:

Multiple antenna at the transmitter side, orthogonal frequency-division multiplexing (OFDM) transmissions over frequency-selective Rayleigh fading channels is applied in various applications. Incorporating sub channel grouping and choosing appropriate system parameters, we first convert our system into a set of group space time frequency (GSTF) systems and it leads to simplification of STF coding within each GSTF system. We have derived design criteria for Space Time Frequency coding and squeeze existing Space Time coding techniques to construct basics of both STF block codes and trellis codes. The result of these codes are shown to be capable of achieving maximum diversity and coding gains, while affording low-complexity decoding. The performance advantages of our standard design is confirmed by verifying simulations and compared with existing alternatives. Multipath diversity becomes available due to multiple transmit antennas when frequency selectivity is present, which is the typical situation for broadband wireless channels. Space-time trellis coding (STTC) was introduced in as an effective transmit diversity technique to combat fading. For a fixed number of multiple transmit antennas, its decoding complexity increases with the transmission rate exponentially as there are number of transmitters. Space-time block coding (STBC) was proposed as an attractive alternative to its trellis code as space time block code has much lower decoding complexity. Space-time codes or STBC are originally designed for flat-fading channels, it is very difficult to apply them over frequency-selective channels because it is necessary for them to satisfy orthogonality condition. An easy approach is to employ orthogonal frequency division multiplexing (OFDM) which converts a frequency-selective channels into parallel independent frequency-flat subchannels using the most effective and computationally-efficient Fast Fourier Transform (FFT).

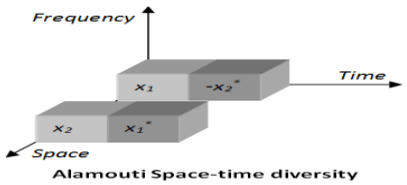



**Figure 2.**Alamouti Space-time diversity

## 5. SPACE-TIME CODED OFDM FOR HIGH DATA RATE WIRELESS COMMUNICATION :

Recently there has been an increasing interest in providing high data-rate services such as wide area network, video conferencing, multimedia internet access and WAN over wideband wireless channels. Wideband wireless channels available in PCS band (2 GHz) have been envisioned to be used by mobile (high Doppler) and stationary (low Doppler)units in a different variety of delay spread profiles. This is a challenging task, given the limited link budget and severity of wireless environment, and helps for the development of new robust bandwidth efficient techniques which work reliably at low SNRs and wireless severity.

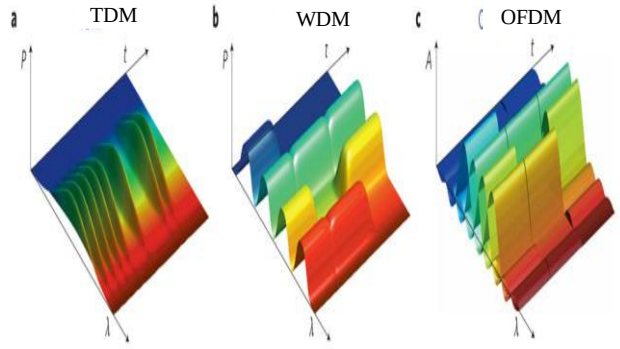
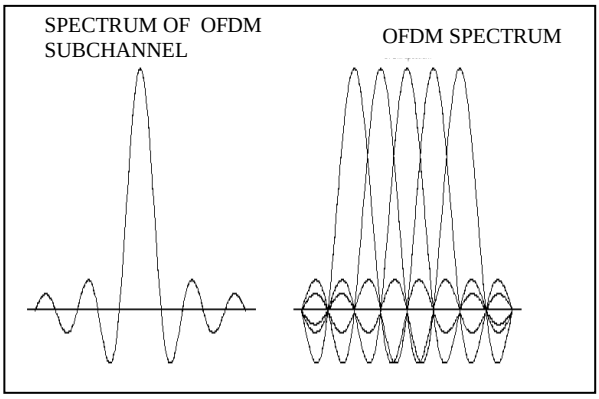



**Figure 3.**Difference in TDM,WDM and OFDM




5.1 **Maximum Ratio Combining**

X=(X1 X2)=[x1x2 ; -x2* x1*]

$$\tilde{c_0} = h_1^* r_1 + h_2^* r_2$$

$$= (\alpha_1^2 + \alpha_2^2) c_0 + h_1^* \eta_1 + h_2^* \eta_2$$

**6. SPACE TIME CODE:**

A **space–time code** (**STC**) is a method employed to improve the reliability of data transmission in wireless communication systems using multiple transmit antennas. The basic of STC is transmitting multiple, redundant copies of a data stream to the receiver in the hope that at least some of the data may survive the path between transmission and reception in a very best enough state to allow correct and reliable decoding in wireless communication over fading channels.

Space time codes may be split into two main types:

- Space–time trellis codes (STTC) provides a trellis code over multiple antennas and multiple time-slots and provide both coding gain and diversity gain.
- Space–time block codes(STBCs) act on a block of data which is input data (similarly to block codes) and provides diversity gain but it doesn't provide coding gain.

STC may be further subdivided according to whether the receiver knows the channel impairments(weakness). Some cases like coherent means STC, the receiver knows the channel impairments through some type of training or some other form of estimation. These codes have been studied more widely, and division algebras can also be used over number fields have now it becomes the standard tool for constructing such high efficient codes.

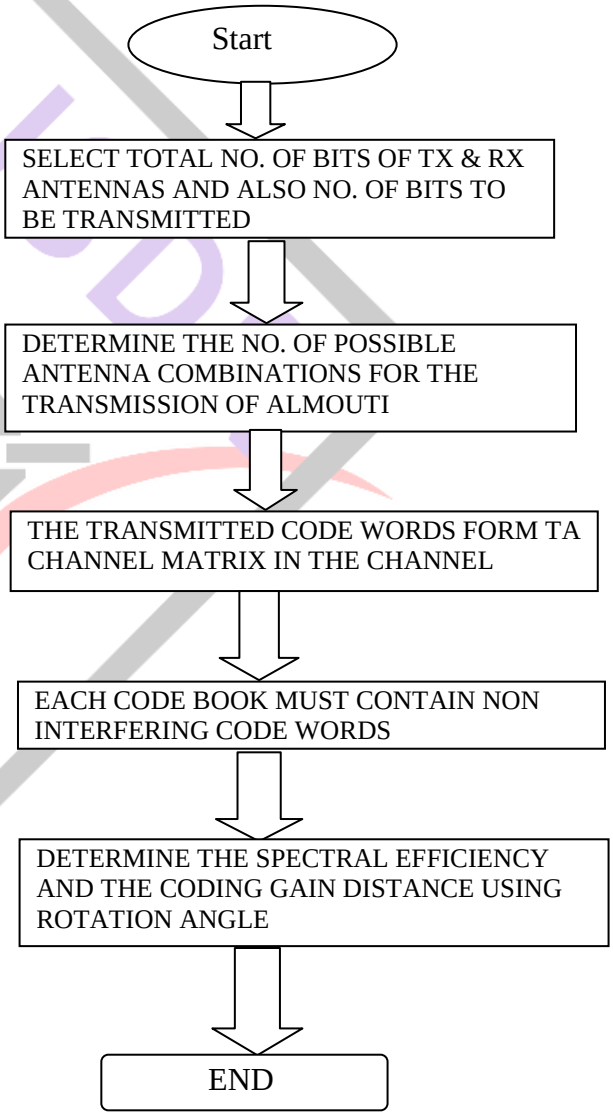
**7. RS CODE:**

Reed-Solomon codes are block-based error correcting codes used in many applications in storage and digital communications. Reed-Solomon codes are used to correct errors in many systems including:

- Mobile or Wireless communications (including microwave links, cellular telephones etc)
- Satellite communications
- High-speed modems such as ADSL, xDSL
- Storage devices (including, DVD, barcodes, tape, Compact Disk etc)
- Digital television / DVB

The Reed-Solomon encoder takes a block of digital data that is input data to be checked and adds extra redundant bits. various errors occur during transmission or storage for a number of reasons (for example scratches on a CD, different type of noise or interference, etc). The Reed-Solomon decoder processes each block and efforts to correct errors and recover the original data. The number and type of errors that can be corrected depends on the quality, features, characteristics of the Reed-Solomon code

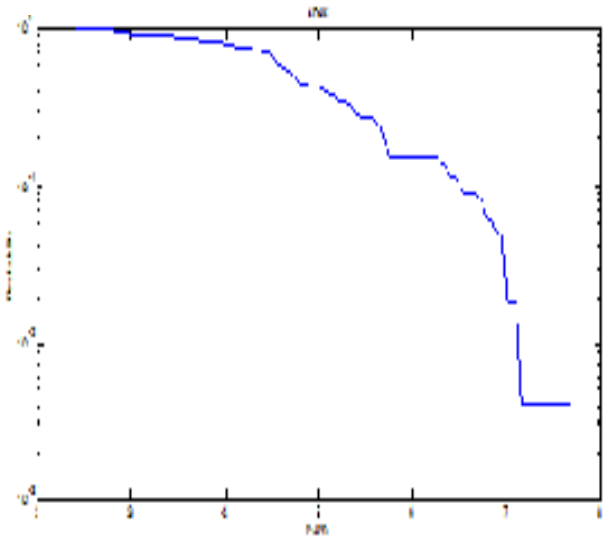
**8. Flowchart:**



**9. RESULTS**:

The result of PAPR ratio is as follows:

SPACE TIME PAPR



RS CODED PAPR

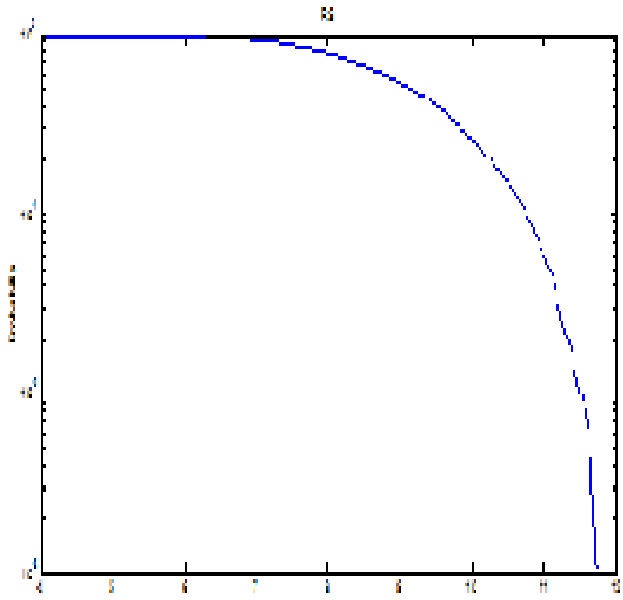
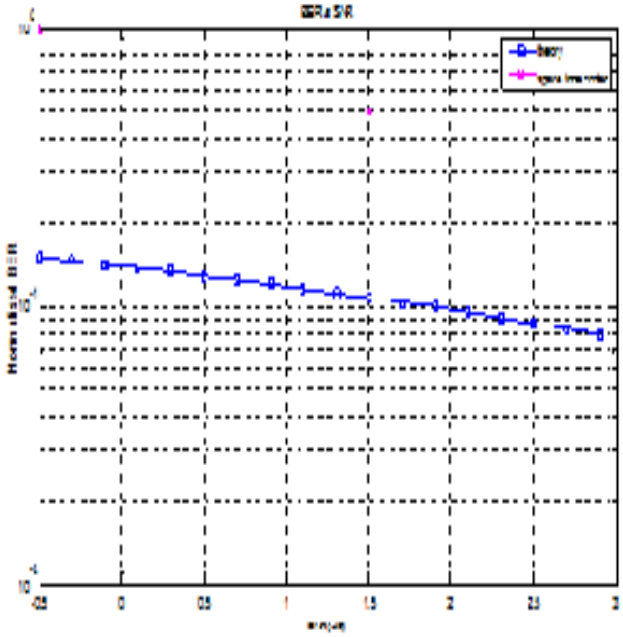


**Figure 5.**comparison of PAPR ratio of space time code and RS code.

SNR VS BER SPACE TIME CODED



SNR VS BER RS CODED

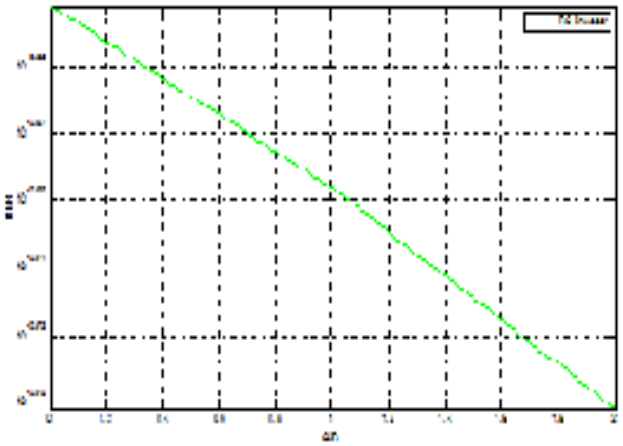
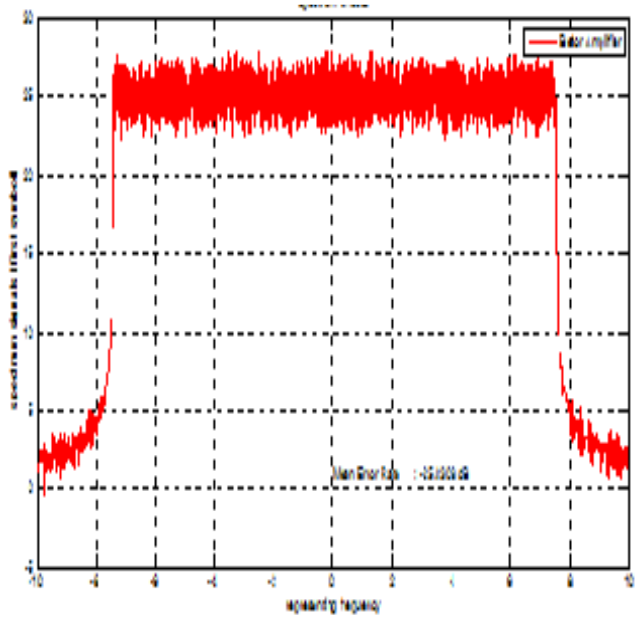


**Figure 6.**comparison of SNR vs BER of Space time code and RS code

SPECTRUM BEFORE AMPLIFIER SPACE TIME CODED



SPECTRUM AFTER AMPLIFIER SPACE TIME CODED

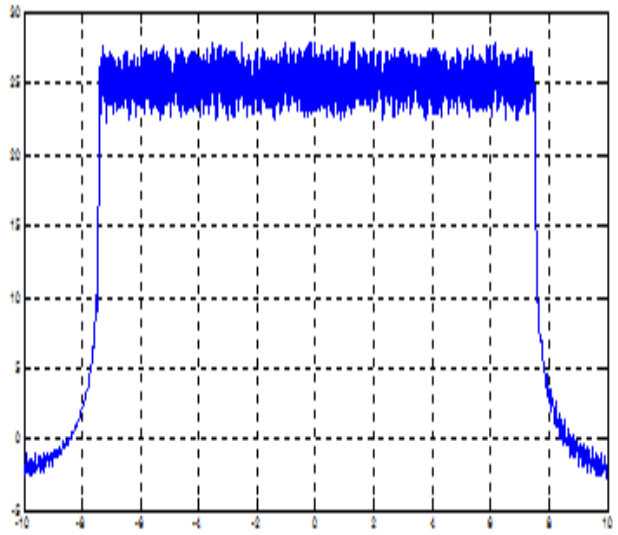
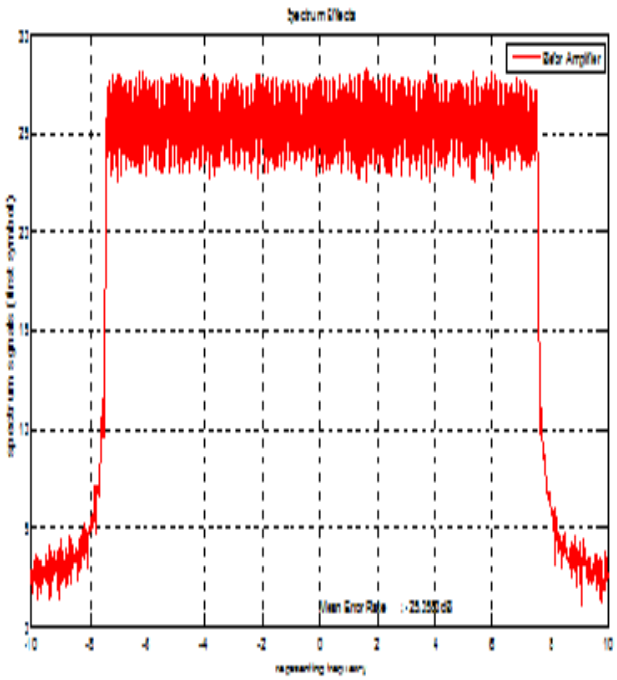


**Figure 7**.Spectrum of Space time coded before and after amplification

RS CODED SPECTRUM BEFORE AMPLIFIER



RS CODED SPECTRUM AFTER AMPLIFIER

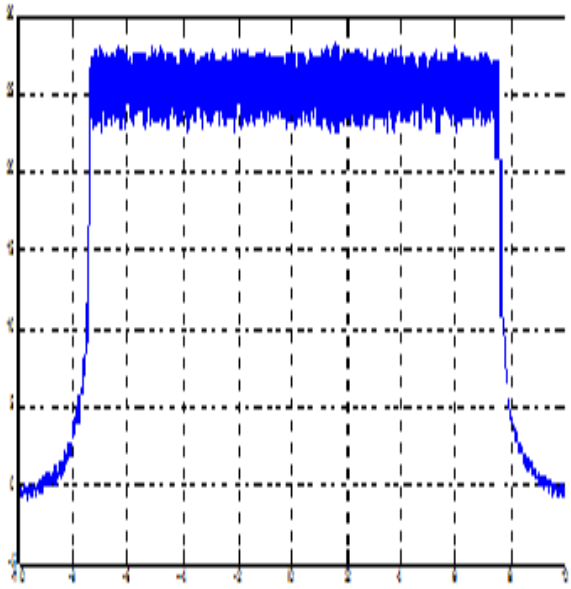


**Figure 8**.Spectrum of RS code before and after amplification

## 10. ADVANTAGES

1. Immunity to selective fading

2. Resilience to interference

3. Spectrum efficiency

4. Resilient to ISI

5. Simpler channel equalization

**11. APPLICATIONS**

1. OFDM is commonly used for high data rate wireless applications.

2. To achieve optimum performance with such systems, some form of diversity (time, frequency, channel coding) is often used.

3. The performance of OFDM systems using STBCs yielded significant gains.

4.Attractive for delay-sensitive applications.

**12. CONCLUSION**

In this paper we have described space time coded ofdm for high data rate wireless communication over wideband channels. We have compared RS code and Space time code. Out of these two Space time code is efficient.

**13. Acknowledgement**

It gives me immense pleasure to put forward this practical venture. surely, it would not have been possible without proper encouragement and guidance. So I would like to thank my . Guide **Prof. S. M. Wagh** and also those people without whose support this paper would not have been a success. I owe a special thanks to Head of Department, Electronics & Telecommunication, **Prof. Dr. S. K. Jagtap** and all the staff members who extended the preparatory steps of this paper work. I am also thankful to **Mr. A. S. Shirsat** for showing faith in us and providing essential facilities.

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[5] Space-Time Coded OFDM for High Data rate Wireless Communication over Wideband Channels by 1Sana, 2Ravinder Kumar Research Scholar, Lecturer 1, Department of Electronics and Communication Engineering, Al-Falah, University, Dhauj, Faridabad© 2016 IJEDR | Volume 4, Issue 3 | ISSN: 2321-9939.