iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 3 **Issue:** VII **Month of publication:** July 2015

DOI:

Volume 3 Issue VII, July 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Achieving High Data Rates with Diversity Techniques in LTE

Karthika S[1]
[1]Research Scholar, Department of Electronics Engineering, Madras Institute Of Technology, Chennai, India

Abstract— Orthogonal Frequency Division Multiple Access (OFDMA) is a technology for higher date rates in next generation of wireless communication standards. Efficient diversity in frequency selective channels improves data rates in LTE. LTE is a part of 3GPP and it evolved from the UMTS technology. User channelization is used to enhance the diversity techniques in time varying channels. Existing schemes provide efficient diversity based on subcarrier locations. They capture diversities technique based on resource structure. The existing methods are implemented for one type of diversity and not considering the time variations in the transmission frame. In proposed scheme, time variations of the frame are taken into considerations. The diversity depends upon the transmission scheme used in scenario. Diversity scheme varies among the mobile speeds. For moderate speed (30km/hr to 100km/hr) mixed type scheme are used for the higher data rates. BER and outage probability performance are compared for the 4 Tap channel. Simulations are done under the LTE parameters and the performances of the mixed type with other diversity schemes are compared.
Keywords— LTE, User Channelization, Interleaved type, Band Type

I. INTRODUCTION

OFDMA is a multiuser OFDM and It is considered as multiple access and modulation methods for fourth generation system. The technical challenge of the new generation communication systems is to support high data rates. In 4G, the mobile speed is up to 350km/hr. To address the above mentioned challenge efficient diversity schemes are used. Diversity scheme depends on transmission frame. The proposed method focused on efficient diversity in time varying channels. The types of diversity are frequency , time and multiuser diversity. The existing frequency diversity are bit interleaved coded modulation [1], subcarriers and bit allocation [8]-[9], Space time frequency diversity in underwater communication [7]. The multiuser diversity explains resource allocation [2]-[6] or scheduling [5]-[6] depends on the Channel State Information. Scheduling gives better user channels based on the channel quality and resource allocation schemes assigns resource to the scheduled users. In high speed communication, the channel information is outdated. If the CSI is outdated, performance degrades. For high speed frequency diversity gives better data rates. User Channelization is assigns the resource structure in time or frequency domain. The two types of resource structure are Interleaved type and Band type. In interleaved type, subcarriers are randomly located and it uses multiuser diversity. In band type, subcarriers are adjacently located and it uses frequency diversity. Interleaved type needs channel knowledge but band type does not need knowledge of the channel. Existing methods use only one type of diversity and do not consider the time variations of the transmission frame. Section II describes about the system model of the proposed system. Section III describes about the resource structure of the system. Section IV describes about the simulation parameters Section V gives out the references.

II. SYSTEM MODEL

Consider the OFDMA (multi user OFDM) in time varying channels. In multiuser diversity, the channel knowledge is outdated with some delay ρ. To offer efficient service for various range of mobile speeds, the channel gain may vary within the transmission frame. In frequency selective channel, symbol duration is greater than the coherence bandwidth. Let H [i,n] is the channel gain of i^{th} subcarrier in n^{th} OFDM symbols. If the channel knowledge is outdated by the delay then the channel gain is given by H [i,-ρ]. μ[n+ρ] is the correlation between the nth OFDM symbol and channel knowledge of the i^{th} subcarrier. The H [i,n] and H [i,-ρ] are related by

$$H[\iota,\nu] = \mu[\nu+\rho] * H[\iota,-\rho] + N[\iota,\nu] \qquad (1)$$

where N [i,n] is the noise process.

Resource structure is totally different from the resource allocation or scheduling. The resource structures are allocated based on the user channel in user channelization. The proposed System has R resource blocks and N OFDM symbols. The block diagram of OFDM is shown in the Fig. 1. The resource blocks or physical resource blocks are subdivided into several sub physical resource

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

block. The DFT size is D. the number of used carriers of the OFDM symbol N_{used}. In practical system, null guards are inserted for the easier FFT implementation and spectral control. The number of subcarriers per sub channel is given by $N_{sc} = N_{used} / R$. Several resource blocks in OFDM symbols is given by S_b. Several resource blocks per physical resource block is given by $U = S_b / R$. Several resource blocks consist of consecutive subcarriers to reduce the dimensionality of the user channels. The band type channelization is given by,

$$B\kappa(\nu,:) = [(\kappa-1)Y,(\kappa-1)Y + 1\square..] \quad (2)$$

The interleaved type channelization is given by

$$I\kappa(\nu,:) = [(\kappa-1)\square\kappa-1+Y\square.] \quad (3)$$

where n=0,1…..N-1.

At low speed, band type resource structure uses multiuser diversity. When the speed increases, the channel gains becomes uncorrelated to the Base station (Channel knowledge is not available in the latest part of the frame), then the subcarriers occur deep fading. The deep faded channel is may be good for some users and not useful for some users. When the CSI is outdated with ρ delays, frequency diversity provides robustness. Interleaved type does not require CSI knowledge. The total bandwidth is divided into N sub channels. The single user occupies 1/N whole bandwidth.

The optimal user channelization is given by

$$\vartheta_1(\nu,:) = \alpha\rho\gamma\ \mu\iota\nu\ E\ [M(\nu, \vartheta + I_o) \mid H[\iota,-\square]\ ] \quad (4)$$

where n =0,1,..N-1

The criterion of the outage probability is given by

$$M(\nu, \vartheta \mid H[\iota, -\square]) = \pi\{\textstyle\sum_i log2\,(1 + |H[i,n]S) < Rt(H[i,-\rho] \quad (5)$$

where i ε J

$$I= \begin{cases} \arg\min \sum log2(1 + H[i,0]2S \mid H[i,0] & \rho = 0 \\ \arg\min P[\sum log2(1 + H[i,0]2S) < Rt \mid H[i,-\rho] & \rho > 0 \end{cases} \quad (6)$$

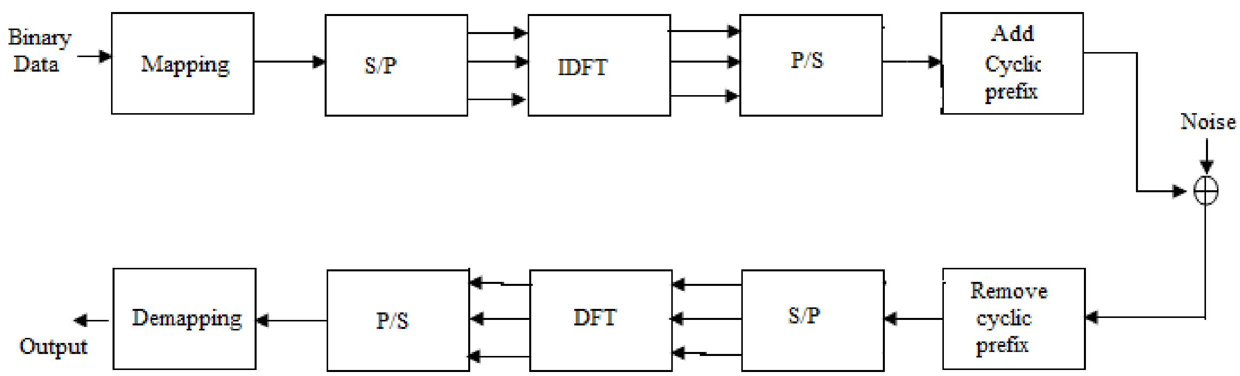


Fig.1 Block Diagram of the OFDM

III.RESOURCE STRUCTURE DESIGN

The structure consists of three phases. The three phases varies depend on mobile speed. The first phase uses multiuser diversity in low speed. For high speed, it uses frequency diversity. In moderate speed (30 km/hr to 250 km/hr), transition phase has been used. This resource structure is optimal for the small and large dimensionality structures. The channel gains and diversity order are required for this proposed scheme.

The three phases are: Multiuser diversity (N_M duration) Uses Band type via Channel State Information. Middle Phase (N_{mm} Duration) diversity changes into frequency diversity. In this, Channel knowledge becomes outdated, it uses Interleaved type for an efficient communication. These three phases depends on the mobile speed, channel gains, carrier frequency and symbol duration. In low speed, only one type of diversity has been used. In moderate speed two types of phases has been used. In high speed, the resource structure have all three phases. The time durations of the each phase depends upon the diversity order. T_{sym} be the duration of the

Volume 3 Issue VII, July 2015
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

OFDM symbols including cyclic prefix and guard interval.

IV. SIMULATION RESULTS AND DISCUSSION

A. Simulation Parameters

The standard parameters of the LTE system are used for the proposed scheme. The advantage of the proposed schemes is compared with the existing methods. Consider the OFDMA systems with N=128 subcarriers. Number of subcarriers is same as that of the DFT size. The simulation parameters of the LTE systems are Carrier frequency is 2 GHz, Subcarrier spacing is 15kHz, the symbol durations including Cyclic prefix is 71.36 µs and the frame length is 14. The channel model is frequency selective fading channel (the delay spread is larger than the one symbol duration). There are 4 taps have an exponential power delay profile is 3dB. The channel gains vary from symbol to symbol. The convolutional encoder with rate ½ has been used in QPSK modulation. The modulation schemes used in proposed schemes are Quadrature Phase Shift Keying (QPSK) and Quadrature Amplitude Modulation (QAM). Viterbi decoders are used in the receiver part. In this simulation, the resource structure are 8 Physical resource blocks, 16 Several Physical Resource Block and 8 SPRB per PRB.

B. Simulation Results

Fig. 2 describes about the BER Performance of the proposed scheme of QAM and QPSK modulation.

Fig. 3 explains about the outage probability of the Band type and Interleaved type are compared. Fig. 4 describes about the comparison of the Band type, Interleaved type and Proposed scheme. It describes the BER Performance versus mobile speed. The mobile speed varies from 0km/hr to 250km/hr.

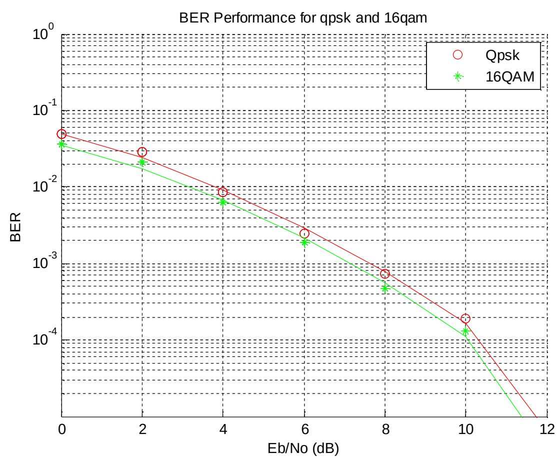


Fig. 2 BER performance of the Frequency diversity for QPSK and 16 QAM modulations

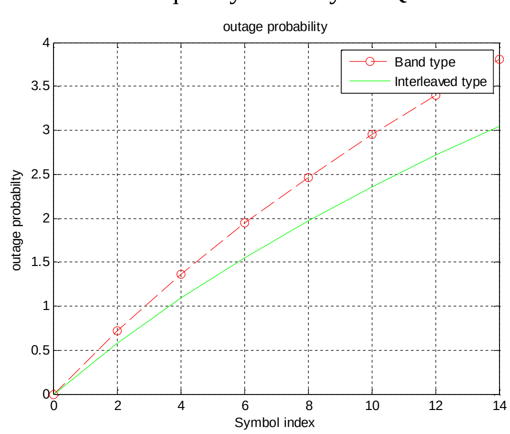


Fig. 3 Outage probability of Band type and interleaved type

Fig. 5 describes about the Comparison of BER performance under various Signal to Noise Ratio in dB for proposed method and the existing methods. In this performance the OFDM symbol is 14 and the QPSK modulation has been used. The performance of the proposed system in the figure are calculated under the speed of 150km/hr.

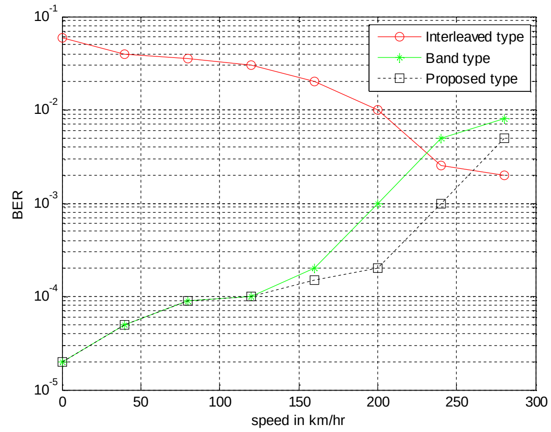


Fig. 4 BER performance under various mobile speeds between the proposed scheme, Band and Interleaved type

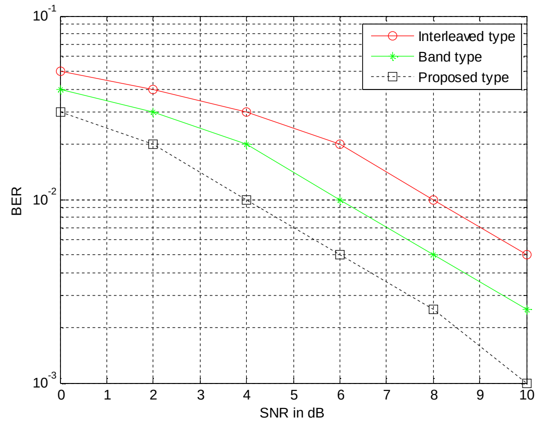


Fig. 5 BER Performance under various SNR in dB for proposed resource structure and the existing methods

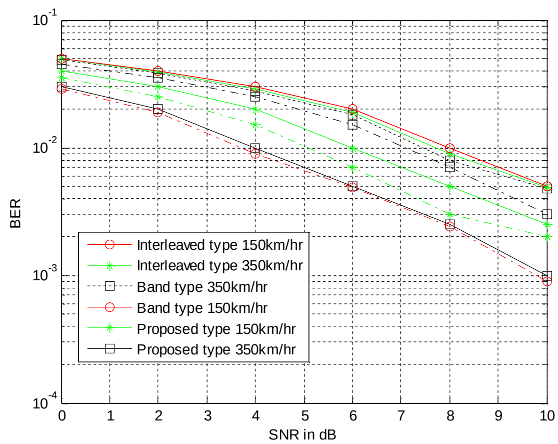


Fig. 6 BER performance under various SNR in dB for proposed resource structure and existing methods in various speeds

Fig. 6 shown that BER performance of the proposed and existing methods. When speed of the mobile increases, the error performance of the interleaved type decreases. When mobile speed increases, the BER performance of the band type increases. If the speed increases, the channel knowledge outdated. If the channel knowledge is outdated, then the error increases. If the knowledge of the channel outdated, frequency diversity gives better performance. The interleaved type uses frequency diversity. Fig.7 shown error performances of the proposed structure in different speeds. Under various speeds proposed schemes gives better results.

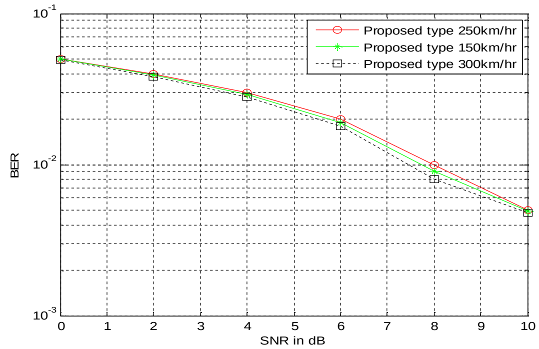


Fig. 7 BER Performance of the proposed structure under the different speed

V. CONCLUSION

This paper proposed a approach for the enhanced diversity techniques. In this approach, resource structures are used to enhance the diversity in time varying channels. Proposed scheme are compared with the existing methods and it gives better performance when compared to the existing methods. Interleaved type gives better results when the speed is high. When in low speed multiuser diversity gives good performance but proposed method gives better performance under various speeds. The theoretical formulation of BER and Outage probability of the resource structures has been calculated. This method is simpler complexity and flexibility. The proposed methods are not sensitive to the order of diversity and mobile speeds. This is consists of three phases (multiuser diversity, middle phase and frequency diversity) under various speeds. The resource structure enhanced diversity starts with multiuser diversity. If the channel knowledge are outdated in the later part of the transmission frame, it uses middle phase and at last it uses frequency diversity. The proposed approach provided better BER performance than the existing methods.

REFERENCES

[1] D. Huang, K. B. Letaief, and J. Lu, “Bit-interleaved time-frequency coded modulation for OFDM systems over time-varying channels,” IEEE Trans. Commun., vol. 53, no. 7, pp. 1191–1199, July 2005.

[2] Xin Wang and Georgios B. Giannakis, “Resource Allocation for Wireless Multiuser OFDM Networks”, IEEE Trans. On Information Theory, vol.57, no.9, pp.4354-4372, July 2011.

[3] Nassar Ksairi, Pascal Bianchi and Philippe Ciblat, “Nearly Optimal Resource Allocation for Downlink OFDMA in 2-D Cellular Networks”, IEEE Trans. On Wireless commun., vol.10, no.7, pp.2101-2115, July 2011.

[4] Derrick Wing Kwan Ng and Robert Schober, “Resource Allocation and Scheduling in Multi-Cell OFDMA Systems with Decode-and-Forward Relaying”, IEEE Trans. On Wireless Commun., vol.10, no.7, pp.2246-2258, July 2011.

[5] A.F. Al Rawi B.S. Sharif C.C. Tsimenidis, “User priority aware scheduling and dynamic resource allocation in orthogonal frequency division multiple access”, IET Commun., vol.5, Issue.7,pp.1006-1019, Feb 2011.

[6] M. Nicolaou, A. Doufexi, S. Armour,Y. Sun, “Reduced feedback selective cluster index scheduling
with user pre-selection for next-generation multi-input multi-output orthogonal frequency division multiple access systems”, IET Commun., vol.5, Issue.6, pp.853-863, Dec 2011.

[7] Konstantinos Pelekanakis and Arthur B. Baggeroer, “Exploiting Space–Time–Frequency Diversity With MIMO–OFDM for Underwater Acoustic Communications”, IEEE Journal on Oceanic Engineering, vol.36, no.4, pp.502-513, Oct 2011.

[8] B. Bai, W. Chen, Z. Cao, and K. B. Letaief, “Achieving high frequency diversity with subcarrier allocation in OFDMA systems,” in Proc. IEEE GLOBECOM, pp.1–5, Nov 2008.

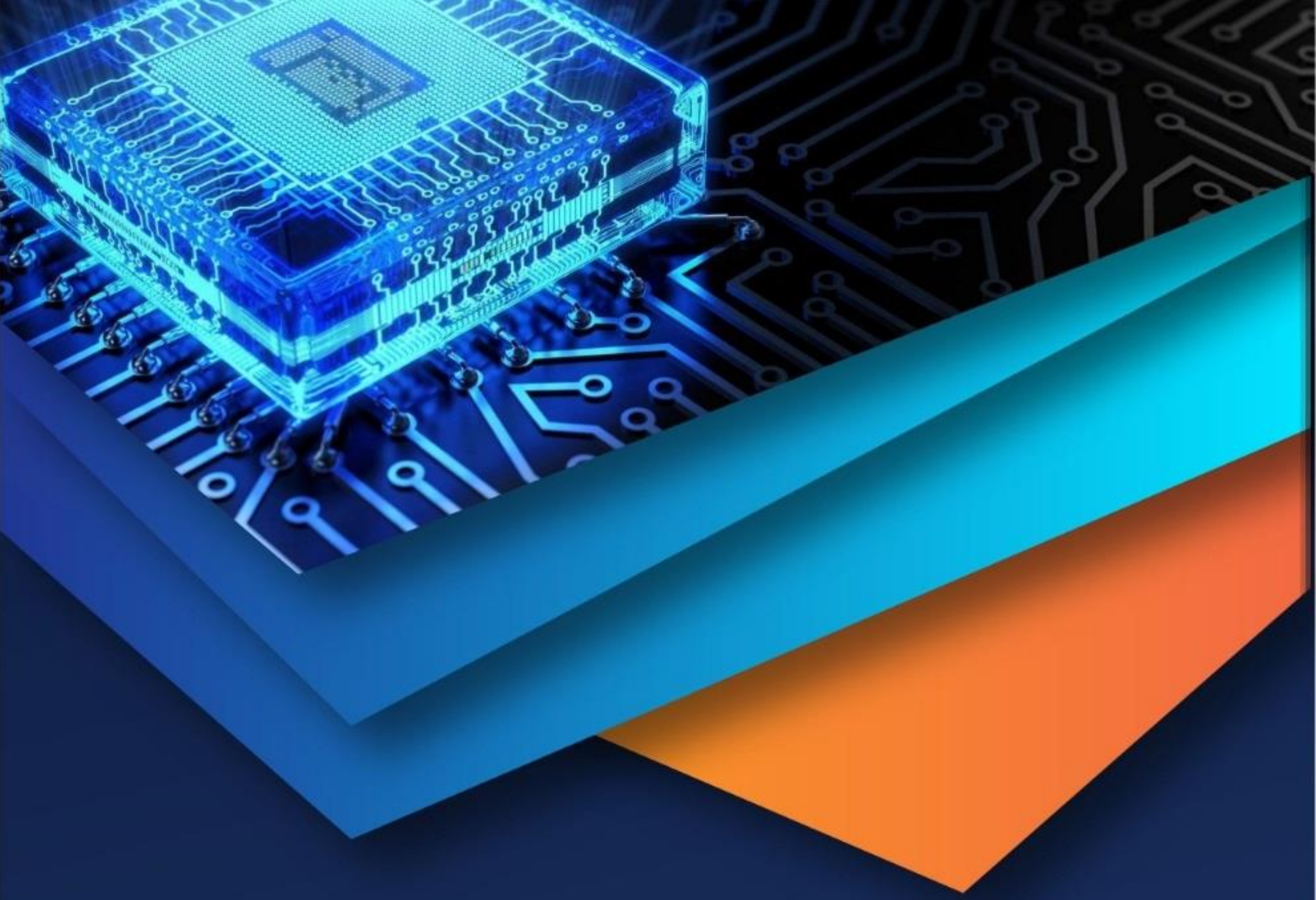
[9] C. Y. Wong and R. S. Cheng, “Multiuser OFDM with adaptive subcarrier, bit, and power allocation,” IEEE J. Sel. Areas Commun., vol. 17, no. 10, pp. 1747–1758, Oct. 1999.

[10] J. G. Proakis and M. Salehi, Digital Communication, 5th edition. McGraw-Hill, 2008.

[11] T. May, H. Rohling, and V. Engels, “Performance analysis of Viterbi decoding for 64-DAPSK and 64-QAM modulated OFDM signals,” IEEE Trans. Commun., vol. 46, no. 2, pp. 182–190, Feb. 1998.

[12] H.S. Shahraki K. Mohamed-Pour, “Power allocation in multiple-input multiple output orthogonal frequency division multiplexing-based cognitive radio networks”, IET Commun., vol.5, Issue.3, pp.362-370, April 2011.

[13] Cheolkyu Shin, Hyounkuk Kim, Kyeong Jin Kim, and Hyuncheol Park, “High-Throughput Low-Complexity Link Adaptation for MIMO BIC-OFDM Systems”, IEEE Trans. On Commun., vol.59, no.4, pp.1078-1088, Apr 2011.



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY