EFFECTIVE ANALYSIS OF OFDM AND MC-CDMA SYSTEM USING DIFFERENT MODULATION SCHEMES

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Abstract
The principle work of the exploration is Multiple Input and Multiple Output (MIMO) Multi Carrier Code Division Multiple Access (MC-CDMA) structure by using balance methods and distinctive regulation frameworks that significantly diminishes the Bit Error Rate (BER). MC-CDMA is a Multi Carrier Code Division Multiple Access and different get to structure which is formed by the Orthogonal Frequency Division Multiplexing (OFDM) and Code Division Multiple Access (CDMA). The MC-CDMA structure with exchange gives higher data rates. In any case, Inter Symbol Interference (ISI) impacts the general execution of this structure. To upgrade the execution of the structure it is proposed to separate the system with different regulation methods, for instance, Binary Phase Shift Keying (BPSK), Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM) and with equalizers, for instance, Minimum Mean Square Error (MMSE) and Maximum Likelihood Sequence Estimation (MLSE). Finally the generation is finished using MATLAB and the execution of the framework is assessed.
Keywords: *MC-CDMA; MIMO; ISI; Relay; MMSE; MLSE.*

Introduction

Remote correspondence is a creating field with goliath advancement in the past couple of years. To fulfill the necessities of different systems that give high data rates are taken here. Multicarrier code division Multiple Access (MC-CDMA) is a promising systems for the 4G correspondence models that give high data rate.MC-CDMA which is a blend of OFDM and CDMA which is multi-carrier structures [1 - 4]. MC-CDMA (Multiple Carrier-Code Division for Multiple Access) is narrowband level obscuring channel. The MC-CDMA upgrades the execution of remote correspondence structure through low probability of screw up and high data rate. In MC-CDMA, each picture is transmitted on a couple of subcarriers and spread using code chips. There is no requirement for the amount of code length to be proportionate to the transporters, henceforth it offers a level of versatility. Numerous Input Multiple Output (MIMO) which uses different radio wires at both transmitter and recipient, so both transmit and get contrasting qualities are associated with confine obscuring that happens in view of the banner assortments through the different channel [5 - 10].

To upgrade scope restriction due to low level Signal to Noise Ratio (SNR) at the edge of the phone, week flag gathering due to scope crevices, high cost of extending the amount of base stations and high power need at versatile stations in view of passing on wherever isolates at high speeds remote exchanging techniques were displayed. These points of interest make MIMO giving off strategies a fundamental for edge remote systems [11 - 16]. Adjustment discards Inter Symbol Interference (ISI) conveyed by multi route inside time dispersive channels. If the change exchanges speed of the information transmission of the radio channel, ISI happens and beats are spread in time into neighboring pictures.

Equalizer must be flexible since the channel generally dark and time evolving. Only, the

word leveling can be used to speak to a carrier handling operation those reductions ISI [17 - 22].

With this strategy the locator misuses the repeat grouped qualities displayed by the blurring channel without enhancing the additional substance technique. Generally, hand-off instrument can be requested into two sorts submitted hand-off and non-committed transfer (co-specialist). In dedicated exchange, a game plan of centers, ordinarily known as submitted Relay Stations (RSs), are inserted into the frameworks with the sole limit of giving off. In co-operator exchange signals cooperate with each other in their transmissions [23 - 27]. An extensive variety of exchange transmission procedures have been delivered. Exchanges can be either full-duplex or half-duplex. Full-duplex exchanges can transmit and get meanwhile while half-duplex exchanges can't. Since full-duplex exchanges are difficult to complete, practical systems focus on half duplex exchanges [28 - 30]. Exchanges are furthermore described by how they handle the got hail. The most noticeable giving off techniques are Decode and Forward (DF) and Amplify and forward (AF). DF exchanges have higher computational diserse quality in light of the need of translating the pictures and are valuable just in case they can unravel adequately to the signs. Stood out from DF exchanges, AF exchanges have the upside of less troublesome flag taking care of and end-to-end straight imposition of data transmission, so it can be used versatile in heterogeneous frameworks including various center points of different diserse quality or models.

System Model

The Fig. 1 exhibits the three center point AF hand off MIMO-MC-CDMA system where the source center transmits information to the objective center direct and moreover through exchange center point. The source, exchange, and objective center are furnished with NS, NR and ND gathering contraptions, independently. The correspondence strategy between the source and objective center point is done in two availabilities. In the main opportunity, the banner plan is controlled by subcarriers, as number of pictures in the nth subcarrier and it is transmitted to hand-off centers and moreover objective. In second opening the exchange transmit the expanded adjustment of flag to the goal [31].

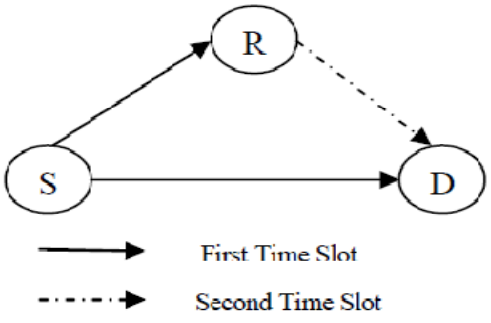

Fig. 1 Three nodes AF relay

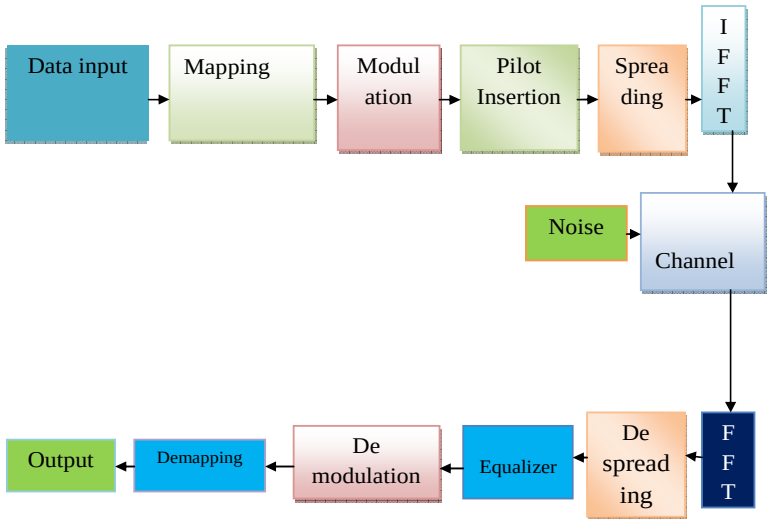

Fig. 2 System model of MIMO MC-CDMA Transmitter and receiver

The square chart of the fundamental model of MIMO-MC-CDMA transmitter and beneficiary framework. Consequent to tweaking, the data framework is copied by a spreading game plan. The pilot flag are added to the data streams for assessing occupy response in the beneficiary. After regulation the flag are transmitted to both the hand-off and objective through various gathering mechanical assemblies [32]. In get side the got beneficiary is demodulated using Fast Fourier Transform (FFT). After demodulation the flag data pictures and pilot pictures are recovered by de-spreading with relating spreading codes. The required trade work for channel estimation and levelling is recovered from the pilot progression. Finally the main data stream is recuperated by separating the gotten motion by channel reaction.

The received signal in the destination nodes of the relay can be expressed as [3]

$$y_r^{(n)}(t) = H_S^{(n)} x^n(t) + v_r^{(n)}(t), \quad n = 1, \ldots\ldots N_C \quad (1)$$

$$y_d^{(n)}(t) = H_d^{(n)} x^n(t) + v_d^{(n)}(t), \quad n = 1, \ldots\ldots N_C \quad (2)$$

Where and framework pre coding for the source signals at the subcarrier, is a MIMO lattice channel between the source and hand-off hubs. is and MIMO lattice channel between the goal and source hubs. Also, are the gotten flag and the clamor vectors at the transfer hub, separately, and are the flag got and the commotion vectors at the goal hub at time t, individually [33]. In the second opening, the increases transfer hub the got flag vector at the subcarrier with a x grid and transmits the flag intensified vector to the goal hub. $x_r^{(n)}(t+1) = F^{(n)} y_r^{(n)}(t)$, n=1,…….. N_C

$$y_d^{(n)}(t+1) = H_r^{(n)} x_r^{(n)}(t+1) + v_d^{(n)}(t+1) =$$

$$H_r^{(n)} \; F^{(n)} H_S^{(n)} x^n(t) + H_r^{(n)} \; F^{(n)} + v_r^{(n)}(t) + v_d^{(n)}(t+1) \quad (3)$$

The sum of the received signal at the source to destination node over the two time slot is expressed using expression (2) and (3) as

$$y^n(t) \cong \begin{bmatrix} y_d^{(n)}(t+1) \\ y_d^{(n)}(t) \end{bmatrix}$$

$$= \begin{bmatrix} H_r^{(n)} \ F^{(n)} H_S^{(n)} x^n(t) \\ H_d^{(n)} x^n(t) \end{bmatrix} + \begin{bmatrix} H_r^{(n)} \ F^{(n)} + \ v_r^{(n)}(t) + v_d^{(n)}(t+1) \\ v_d^{(n)}(t) \end{bmatrix}$$

where $H_r^{(n)}$ is an $N_d \ X \ N_r$ MIMO channel between the relay and destination nodes, $y_d^{(n)}(t+1)$ and $v_d^{(n)}(t+1)$ are the received signal and the noise vectors at the destination node at time t+1,respectively.

MMSE Equalization

The frameworks, because of the isolating effect of correspondence channel or effects, for instance, reflections coming to fruition multipath, ampleness or stage mutilation happens depending upon the repeat. Review of the distortion expedited by the direct in the beneficiary is the leveling system [34]. The fundamental leveling structure turns around the impact of ISI and modifies the perfect Channel Impulse Response (CIR) in the collector. Exactly when ISI happens, the banner regard got at the investigating time in the recipient is the entire of the flag that scaled by coefficients which change with desired banner and ISI estimation of close-by banners. So the banner in the beneficiary at the time k is this:

$y_k = a_k + \sum_{i=-\infty}^{\infty} c_i \, a_i, \ i \neq \mathrm{k}$

yk is the collector motion at the time k and Ak is the kth estimation of the bit progression. Neigh boring picture qualities are Ai and ISI effect of these pictures are Ci. In case inspiration response of the channel is known or can be found, Ci coefficients are known. Thusly, it is possible to discard the ISI affect in the beneficiary flag. MMSE equalizer restricts the mean square goof. It hopes to constrain the effects of ISI and besides commotion flag. MMSE equalizer, generally, does not get rid of the effect of ISI. On the other hand, MMSE equalizer constrains the total vitality of bustle and ISI fragments which affect on yield. For MMSE game plan, it needs to find a coefficient set for each testing time k. These c[k] systems must point of confinement the blunder between the carrier is varied.

$E(e[k])^2 = E(s[k] - c[k] * y[k])$

e[k] is the error at time k. For MMSE solution, it needs to find c coefficients minimize the $E(e[k])^2$ value.

MLSE Equalization

The recipient utilizes a biggest Maximum Likelihood Sequence Estimation (MLSE) realized by strategies for the Viterbi calculation to alter for the generous specific twisting achieved by multipath spread. The execution of the recipient is surveyed through a channel test framework suitable for adaptable correspondences. The results obtained exhibit the colossal lead characteristics for the flag in different techniques for operation. Straightforward execution of the contraption using VLSI development is typical for an enhanced discoverer for cutting edge

flag is the need not to imitate the transmitter information, but instead it should do a best estimation of the transmitted data with the scarcest possible number of blunders. The recipient duplicates the turned channel. All possible transmitted data streams are maintained into this deformed channel. The recipient differentiates the time response and the certified got flag and chooses the no uncertainty signal. In cases that are most computationally clear, root mean square finding can be used as the decision reason for the slightest slip-up probability. Expect that there is a shrouded flag {x(t)}, of which a watched flag {r(t)} is open. The watched flag r is related to x by methods for a change that may be nonlinear and may incorporate debilitating, and would when in doubt incorporate the breaker of Random variables. The Stoical parameters of this change are normal known. The issue to be understood is to use the observations {r(t)} to make an average gage of {x(t)}. Most outrageous likelihood progression estimation is formally the usage of most prominent likelihood to this issue. That is, the gage of {x(t)} is portrayed to be progression of characteristics which expand the utilitarian L(x) = p(r | x), Where p(r | x) implies the unexpected joint probability thickness limit of the watched game plan {r(t)} given that the shrouded game plan has the qualities {x(t)}.

Result and Discussion

Reproduction Results are plotted for the bit error rate execution of MIMO MC-CDMA System. The hand-off and the non attendance of hand-off and reproduction execution using BPSK, QPSK, 4 QAM direction strategy condition considering nonappearance and proximity of MMSE and MLSE Equalizer. It can be watched that bit blunder rate around 0.4 in BPSK, QPSK, 4QAM when no night out is performed. Bit mistake rate decreasing when MLSE equalizer is performed however later on it keeps up an unfaltering estimation of 0.0015 in BPSK and 0.02 in QPSK, 0.0003 of every 4QAM.

Table 1 Simulation parameters

Carrier modulation used	BPSK,QPSK,4QAM
Number of SCs	64
Antennas	2x2
Channel	Rayleigh fading
Equalization	MMSE and MLSE

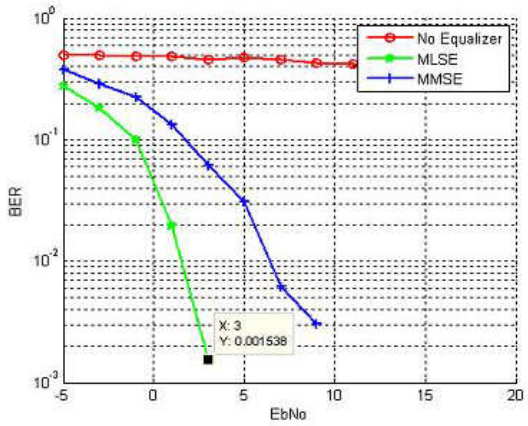

Fig. 3. BER Performance of MIMO MC-CDMA System with relay

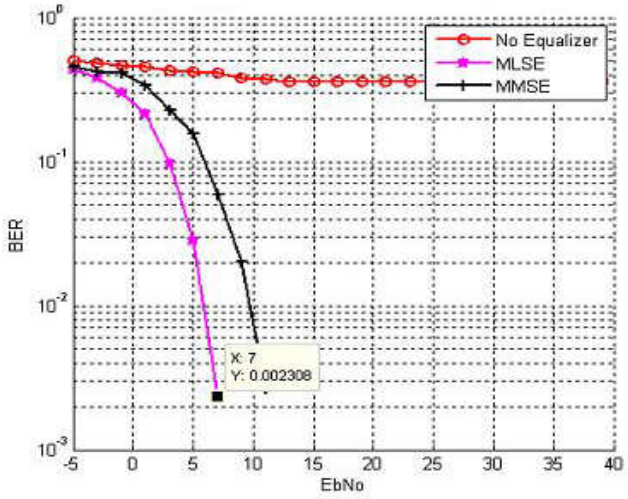

Figure 4: BER for QPSK using MIMO-MC-CDMA

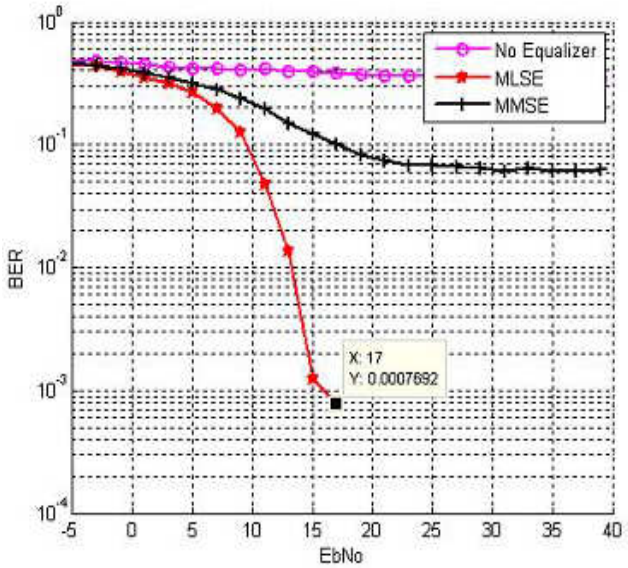

Figure 5 BER for QAM using MIMO-MC-CDMA

Conclusion

BER is limited utilizing Maximum Likelihood Sequence Estimation. The paper differentiates the execution of un evened out structures and the levelled system. The bit error rate is pushed ahead. The use of the demonstrated BPSK, QPSK, 4QAM, 16QAM, change procedure in MIMO MC-CDMA structure with a point of view of diminishing the cover picture impedance. In this way we have investigated the MIMO MC-CDMA framework transfers, distinctive adjustment and the levelling methods.

References

1. Alamouti S.M., "Simple Transmit Diversity Technique for Wireles Communication", "IEEE J. Select Areas Commun, pp.1451 -1458, oct.1998.
2. J. Kirubakaran, Dr.G.K.DPrasanna Venkatesan, "Performance analysis of MIMO based ASTM - OFDM System for indoor communication", Int J Adv Engg Tech/Vol. VII/Issue II/April-June,2016/662-666.
3. Prasanna Venkatesan.G.K.D., " Network onchip with CDMA technique" Journal of Scientific and Industrial Research (JSIR). Vol.73, pp.209-213, April 2014, ISSN:0022-4456.
4. Prasanna Venkatesan.G.K.D.," CDMA Technique with Inter process Communication" Research Journal of Applied Sciences, Engineering and Technology (RJSET). Vol.7(8), pp.1691-1696, February 2014. ISSN:2040-7459.
5. Shengbo Zhang, Xiang-Gen Xia, and Jiangzhou Wang, "Cooperative Performance and Diversity Gain of Wireless Relay Networks," *IEEE J. Sel. Areas Commun.,* vol. 30, no. 9, pp.1623-1632, Oct. 2012.
6. S.Berger, M. Kuhn, A. Wittneben, T. Unger, and A. Klein, "Recent advances in amplify-and-forward two-hop relaying," *IEEE Commun. Mag*., vol. 47, no. 7, pp. 50–56, July. 2009.
7. Prasanna Venkatesan.G.K.D.,"Applying Buffer Prioritization based Code Assignment Scheme in WCDMA NoC" Turkish Journal of Electrical Engineering & Computer Sciences, ISSN 1300-0632.
8. Shashidhar Kasthala, GKD Prasanna Venkatesan, A Amudha, "MIMO PLC Channel Modelling on Indian Residential Networks" International Journal of Applied Engineering Research, 0973-4562/July 2017/ Vol. 12, N0. 14
9. M. Pachiyaannan, Prasanna Venkatesan.G.K.D "Designing of Wireless Sensor Node using MSP", International Journal of Research in Electronics & Communication Technology Volume 1, Issue 2, October-December, 2013, pp. 146-153.
10. Tarokh V, Calder bank A.R. Seshadri N, " Space time codes for high Data rate wireless communications: Performance criterion and code construction", IEEE Trans. Inform. Theory, vol. 44,pp.744-76 Mar.1998.
11. Dr.G.K.D PrasannaVenkatesan and V.C Ravichandran, "Performance Analysis of MC-CDMA for wide band channels. Information Technology Journal 6(2): 267 -270,2007 ISSN 1812 -5638 @ 2007 Asian Networks for Scientific Information.
12. Dr. G.K.D Prasanna Venkateasan, and V.C Ravichandran, "Performance Analysis of MIMO –CDMA technique for wireless communication, Information technology journal 02/2007; DOI: 10.3923 / itj.2007.267.270
13. V.C Ravichandran, and Dr.G.K.D Prasanna Venkatesan," Networks on chip with CDMA technique" Journal of Scientfic & Industiral Research, 2014. ISSN:0975- 1084(0nline); 0022 -4456(Print).
14. V.C. Ravichnadran, and Dr.G.K.D Prasnna Venkatesan, R. Rani," CDMA coding techniques for inter connect between IP cores, Issue Date: Apr-2014.

15. Li-Chun Wang and Chiung-Jang Chen "performance analysis of scheduling in multiuser MIMO systems with zero forcing receivers" vol 25 No 7,September 2007.
16. Hamid Jafarkhani, Vahid Tarokh, , and A. Calderbank, "Space–Time Block Codes from Orthogonal Designs" vol 45 No 5 July 1999.
17. M. Pachiyaannan, G. K. D. Prasanna Venkatesan, " LTE 4600 MIMO Antenna: Design and Optimization", Asian Journal of Research in Social Sciences and Humanities Vol. 7, No. 3, March 2017, pp. 802-811.
18. Shashidhar Kasthala, GKD Prasanna Venktesan, "Experimental Verification of Distributed Parameters on Indian Residential Networks for Power Line Communication", International Journal of Engineering and Technology, 0975-4024/ Jan 2017/ Vol 8, No. 6, pp 2845 - 2852
19. Dr. G.K.D Prasanna Venkatesan, and V.C Ravichndran,"Performance Analysis of MC-CDMA for wide band channels", Information Technology Journal 6(2), 267 -270, 2007
20. P.J. Voltz Y.S. Choi, , and F.A. Cassara, "On channel estimation and detection for multicarrier signals in fast and selective Raleigh fading channels, " IEEE Trans. Commun., vol.49, pp.1375 – 1387, Aug. 2001.
21. M. G. L. Studer, Russell and, "Interchannel interference analysis of OFDM in a mobile environment," in proc.IEEE VTC 1995, Chicago, IL, July 1995,pp.820-824.
22. Zhaobiao cardinal Xing hang, , and Wenbo Wang, "Performance Analysis of Multiuser Diversity in MIMO Systems with Antenna Selection" Vol 7 No 1,2008.
23. A. H. Sayed N. Al Dhahir and, " The finite length multi input multi Output MMSE-DFE,"IEEE Trans. Signal Processing. Vol.48, pp.2921 – 2936, Oct.2000.
24. Peng Liu, Min Kim, Saeed Gazor and Dong In Kim, "Noncoherent Amplify-and-Forward Cooperative Networks: Robust Detection and Performance Analysis," *IEEE Trans. Commun.*, vol. 61, no. 9, pp 3644 3659, Sep. 2013.
25. Shengbo Zhang, Jiangzhou Wang, and Xiang-Gen Xia, "Cooperative Performance and Diversity Gain of Wireless Relay Networks," *IEEE J. Sel. Areas Commun.,* vol. 30, no. 9, pp.1623-1632, Oct. 2012.
26. Venkatesan, GKD Prasanna, and V. C. Ravichandran. "Performance analysis of dynamic sub-carrier allocation technique for adaptive modulation based MC-CDMA system." *IJCSNS* 7.2 (2007): 201.
27. Chitra, V., A. Nithya, and G. K. D. Prasannavenkatesan. "An Energy Efficient Data Collection for Mobile User With Cluster Points." IOSR Journal of VLSI and Signal Processing (IOSR –JVSP), vol.4, issue 3,pp 44-47, May-Jun.2014.
28. S.Berger, A. Wittneben, M. Kuhn, , T. Unger, and A. Klein, "Recen advances in amplify-and-forward two-hop relaying," *IEEE Commun. Mag.*, vol. 47, no. 7, pp. 50–56, July.2009.
29. Ravichandran, V., and GKD Prasanna Venkatesan. "A Novel mechanism for interconnection between peripherals in SOC'S using CDMA technique." *International Journal of Scientific and Research Publications* 2.8 (2012): 1-5.
30. Kirubakaran, J and PrasannaVenkatesan, GKD 2016, 'Performance Analysis of MIMO Based ASTM-OFDM System For Indoor Communication', has been published for

International Journal of Advanced Engineering Technology, vol.7, no.2, pp. 662-666. ISSN: 0976-3945.

31. Kirubakaran, J and PrasannaVenkatesan, GKD 2015, 'Performance Analysis of MIMO systems using CDMA for 4G wireless communication', has been published for the International Journal of Applied Engineering Research. vol. 10, no.41, pp. 30377-30382. ISSN: 0973-4562.
32. Kirubakaran, J and GKDParasannaVenkatesan,Viji 2014, S, "Parallel AES Encryption Engines Many-Core Processor Arrays',in International Journal of research in engineering and advanced technology, vol.2, issue 3, June – July 2014,ISSN: 2320 – 8791.
33. Kirubakaran, J., G. K. D. PrasannaVenkatesan, and D. Mohana 2014, 'A Novel Approach to PAPR reduction with Reduced Complexity Based On OICF Algorithm',in International Journal of Advanced Technology in engineering and Science, volume No.02, Issue .06, June 2014, pp.9-18,ISSN: 2348 – 7550.
34. Kirubakaran, J., G. K. D. PrasannaVenkatesan, and R.Muthusuganya 2014, 'An Efficient Location Based Anonymous Routing Protocol For ADHOC Networks',in International journal of research in engineering and Advanced technology, volume 2, issue 2, Apr-May 2014,ISSN: 2320 – 8791.